PROGRAMME SPECIFICATION

Awarding body/institution	Glyndŵr University
Teaching institution (if different from above)	
Details of accreditation by a professional, statutory or regulatory body (including link to relevant website)	The programme team will apply for Royal Society of Chemistry (RSC) accreditation after one year of delivery. .
What type of accreditation does this programme lead to?	*Subject to validation by the RSC*, students enrolling from September 2014 and achieving the MSc award will be eligible for Chartered Chemist (CChem) status. .
Is accreditation in some way dependent on choices made by students?	No
Final award/s available eg BSc/DipHe/CertHE	MSc/PGDip/PGCert
Award title	MSc / PGD Formulation Science MSc / PGD Polymer and Biopolymer Science PGC Applied Polymer Science
JACS 2 code	
UCAS code (available from Admissions)	N/A
Relevant QAA subject benchmark statement/s	The QAA Chemistry Benchmark Statement 2007
Other external and internal reference points used to inform the programme outcomes	FHEQ 2008, CQFW, Output Standards for RSC Accredited Programmes
Mode/s of study *(p/t, f/t, distance learning)*	Full Time, Part Time
Language of study	English
Date at which the programme specification was written or revised	August 2013

Criteria for admission to the programme

Normally, applicants will be required to attend an interview. Where this is not feasible, e.g. for overseas students, interviews may be undertaken via telephone or Skype. The interview will seek to confirm that applicants possess a breadth of understanding of both theoretical and practical chemistry through prior learning. Places on the programme will be offered on the basis of the applicants' background, qualifications and where appropriate, experiences.

Normal entry requirements will be one of the following:

1) A Bachelor of Science Honours degree in Chemistry or other suitable Bachelors Honours degree, with a 1st or 2nd class award deemed relevant by the programme team

2) A non-graduate can be admitted for candidature provided that:

   i. he/she has a non-graduate qualification which Glyndŵr University has deemed to be of a satisfactory standard for the purpose of post-graduate admission,

   or

   ii. he/she has held, for a minimum of two years, a reasonable position relevant to the scheme to be pursued deemed relevant by the programme team.

3) Equivalent qualifications of another overseas country which are deemed satisfactory by the programme team

In addition to the academic entry requirements, international students whose first language is not English require a TOEFL score of 575 (paper) or 232 (online), or an IELTS score of 6.5.

Irrespective of a candidate's entry qualifications, the student must provide evidence to the satisfaction of the interview panel of his/her ability to complete academic work of the required standard to successfully complete the scheme of study proposed.

AP(E)L:
Students who wish to claim AP(E)L will be considered on an individual basis in line with University and Department policies (supporting evidence). AP(E)L will only be granted for a maximum of 4 modules excluding the research project.

Aims of the programme

This programme is designed to impart knowledge at the forefront of the academic discipline and to develop a critical awareness and comprehensive understanding of the advanced techniques and technologies that are available to conduct research and development in the areas of Polymer and Biopolymer Science and Formulation Science. In providing high quality relevant training to students, it will enable them to better progress within their professional career or equally to proceed on to doctoral study. The latter may include students who undertake a taught MSc degree as a precursor to a PhD, in cases where they wish to change discipline or have not attained a high enough award at BSc level to warrant direct admission to doctoral study. It should also serve as a route to a Postgraduate Certificate (PGCert) or Postgraduate Diploma (PGDip) for those applicants who may lack the finance or time to commit

to an MSc. Whilst the target market is inclusive of both UK and overseas students attending on a FT basis, the emphasis of the course will be on delivering the skills needed by employers and as such the course should attract local PT students.

For the department the programme should generate increased PhD applications, boost the number of published papers and through training of local part time students, assist in strengthening the relationship between the centre and local industry.

Distinctive features of the programme

Rationale

Considerable thought has gone into how best to market a programme comprising a common core of polymer and colloid science to graduates with disparate professional aspirations. To many, 'polymer science' may conjure up a programme rooted in the study of plastics and rubber and certainly would not attract those seeking skills in formulating cosmetics or pharmaceuticals and for this reason a *Formulation Science* route is proposed. The only other *Formulation Science* MSc in the UK – offered by the University of Greenwich – has a strong bias towards pharmaceutical formulation. The Glyndŵr University course will appeal to students interested in learning formulation skills across a wide range of chemical sectors. Similarly to capture the new generation of chemists working in the rapidly growing biotechnology / biomass processing industry the *Polymer and Biopolymer Science* route was conceived.

Research Environment

The students on this programme will be part of the University Research Centre for Materials, Engineering and Manufacturing (CMEM) and the programme will be delivered by team members from the Centre for Water Soluble Polymers, (CWSP) and Glyn O. Phillips Hydrocolloids Research Centre (PHRC) with additional input from Centre for Solar Energy Research (CSER) staff. The programme curriculum genuinely reflects the ongoing research across the Research Centre and students will be integrated into the culture of research from enrolment through to graduation. Not only will they benefit from specific expertise within *Polymer and Biopolymer Science* and *Formulation Science*, but they will also interface with researchers from other disciplines. They will work alongside MPhil and PhD students and also Post-doctoral researchers.

The core research activity within the programme team is polymer and colloid chemistry, an area for which the Centre has an International reputation. Professor Peter Williams, module leader for two of the taught modules has organised more than 30 international conferences, published over 200 scientific papers and edited over 40 books and is co-founder and Editor-in-Chief of the international journal Food Hydrocolloids.

Flexibility.

The programme is designed to offer flexibility to meet the needs of the student. One way this is evidenced is the programme structure which allows the student to specialise in *Polymer and Biopolymer Science* or *Formulation Science* according to their intended career path. This is expanded on below. Attendance is also flexible, with both full-time and part-time options. The latter opens opportunities for those in full time employment to attend through a 'day release' scheme with their employer. All students will be strongly encouraged to undertake all or part of their Research Project with relevant local employers and for PT students already employed in the sector the project may be undertaken in their regular workplace. The modular nature of the programme facilitates three possible exit routes: PGCert, PGDip and MSc. Additionally this facilitates entry to the programme via Accreditation of Prior and Experiential Learning, AP(E)L routes.

Definitive features of *Formulation Science* and *Polymer and Biopolymer Science* programmes.

Whether working within formulation or within polymer / biopolymer science a robust and broad–reaching understanding of core polymer and colloid science is key to achieving success. In both *Formulation Science* and *Polymer and Biopolymer Science* programmes this core knowledge is delivered within three common modules: Chemistry and Technology of Water Soluble Polymers, Formulation Science and Structure and Function of Industrial Biopolymers. A distinguishing feature of both programmes however is their applied nature and this is where the student's specialisation in either *Formulation Science* or *Polymer and Biopolymer Science* is realised. The most visible differentiation is the selection of a specific case study module (Product Formulation or Polymer Characterisation / Application) in the taught element and by the choice of Research Project topic. However significant elements of Research Methods and Advanced Material Science modules – particularly those assessed – inherently allow the student to select material that reflects their chosen speciality. Both of these modules are exclusive to Masters students in the Chemistry department and are delivered by research chemists with first hand skills and expertise in these areas.

Industrial Relevance

Research within CMEM is strongly industrially focussed with current research partners including market leaders like Unilever, BP and Croda. These relationships ensure the currency of research endeavour within the Centre and also provide opportunities for students to benefit from visiting industrial speakers and undertake industry-relevant Research Projects. Additionally the Programme Leader has over 10 years' experience as a Formulation Chemist within industrial, pharmaceutical and personal care sectors. The Centre has laboratories at both Wrexham and St Asaph sites which enjoy a high level of specialised equipment and are recognised nationally in this respect. Industrial relevance will be formally confirmed by the establishment of an Industrial Liaison Committee.

RSC Accreditation

The programme team are in discussion with the Royal Society of Chemistry and are committed to gaining RSC accreditation for this programme from 2014, subject to PB validation. This will facilitate graduates of the programme to gain the RSC award of Chartered Chemist, (CChem) from 2014/15 entry onwards.

Employability

The Research Centre has an excellent track record in provision of postgraduate research degrees with many successful MPhil and PhD completions. Its postgraduates have been employed within R&D positions in leading international companies including Unilever, Danisco, and Akzo Nobel. Employability of graduates of this programme will be enhanced by the reputation of the contributing research centres and in due course by RSC accreditation. The industrial relevance of the programme should also ensure that its graduates are well placed to secure positions as specialist polymer / biopolymer scientists or formulation scientists in various sectors of the chemical industry, or indeed to equip them to undertake doctoral study. In the case of part-time students employed in the industry, the aim is to accelerate their career progression within their organisation. Graduates from this programme should be appropriately equipped to step into technical / R&D roles. The predecessor to this programme, *MRes Polymer Science & Technology* validated in 2008 recruited only small cohorts of students yet from these were recruited 4 PhD students, and a research assistant whilst two students went on to join the KTP scheme (one within a Glyndŵr University partnership) with others working in R&D positions in companies including Unilever and Akzo Nobel. The outcome was thus favourable for both student and department. This MSc proposal is an opportunity for the department to capitalise on these strengths and venture into the taught masters area.

International market
Feedback from the International Office indicates that the course should have improved appeal overseas compared to the MRes as the MSc award is preferred and better known. However the programme team are keen to avoid over-reliance on this market and believe the part-time route in particular will boost local applications.

Curriculum
Curriculum design is such that students will achieve a demonstrable working knowledge of the discipline through significant exposure to laboratory problem solving tasks and substantial individual project work.

The programme promotes enhancement of technical understanding, with emphasis on problem solving and team / group working, awareness and – where possible – practice of latest developments in the discipline and increased capability for independent learning and work through case studies and projects. These will encourage master's students to accept responsibilities, formulating ideas proactively, dealing with open-ended and unfamiliar problems, planning and developing strategies, implementing and executing agreed plans, evaluating achievement against specification and plan and decision making. The elements within the curriculum of this programme aim to prepare students for their future.

Summary
The key benefits to students of studying the programme may be summarised thus:

- Receive training and build expertise in use of a wide range of high level instrumentation.
- Undertake a tailored research project in industry or Research Centre laboratories.
- Develop systematic knowledge of polymer and colloid chemistry as applied to the disciplines of Polymer and Biopolymer Science and Formulation Science.
- Gain proficiency at application of acquired knowledge to challenging industrial scenarios.
- Build transferable skills enabling career progression and potential for doctoral study.

Programme structures and requirements, levels, modules, credits and awards

The structure of the programme is shown in the table below.

DELIVERY	**PART 1** **(Trimester 1 & 2)**	**PART 2** **(Trimester 3)**
F/T (Yr1)	120 Credits	60 Credits
P/T (Yr1)	60 Credits	-
P/T (Yr2)	60 Credits	-
P/T (Yr3)	60 Credits	-

The levels and credit ratings and the awards that can be gained are detailed below. Personal Development Planning is an integral part of the learning process of each element of the programme.

The programme has been designed in accordance with the Regulations for Glyndŵr University: 'Taught Masters Degrees'.

- Full-time students starting the MSc programme in the Autumn trimester follow a one

year programme which consists of two trimesters of taught modules, and a research project which takes place over the summer trimester, requiring approximately 40 hours of study per week.

- Part-time students on the MSc programme undertake the equivalent overall workload over a longer period of study, normally three years, and will normally start in September.

The MSc award requires 180 credits at level 7: 120 credits for the taught elements and 60 credits for the Research Project. Taught modules are equivalent to 20 credits. Typically a full-time student studies modules equivalent to 60 credits per trimester with 15 weeks of teaching, revision and assessment activities for each module.

The full degree scheme, including submission of the dissertation in the prescribed form, shall normally be completed within the following periods from date of registration:

Full-time candidates 1 year
Part-time candidates 3 years

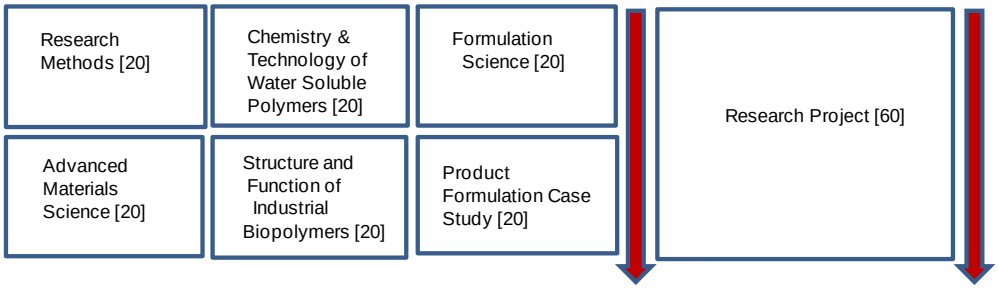
All taught modules and the research project module are marked on a percentage scale with a pass/fail threshold of 40%. Preferably students will be encouraged to achieve the full Masters qualification. Whilst the benefit to students unable to complete their full programme of study, of the Postgraduate Certificate (PGCert) and Postgraduate Diploma (PGDip) exit routes is acknowledged, these routes are also seen as viable final awards in their own right, particularly for part time students who may not be able to commit to the Masters. The full list of awards and their requirements is as follows:

Award	***Credits at level 7***
MSc	180
Postgraduate Diploma	120
Postgraduate Certificate	60*

*The Award Title at PGCert level is Applied Polymer Science. To qualify for this award the student must pass *any 3* taught modules.

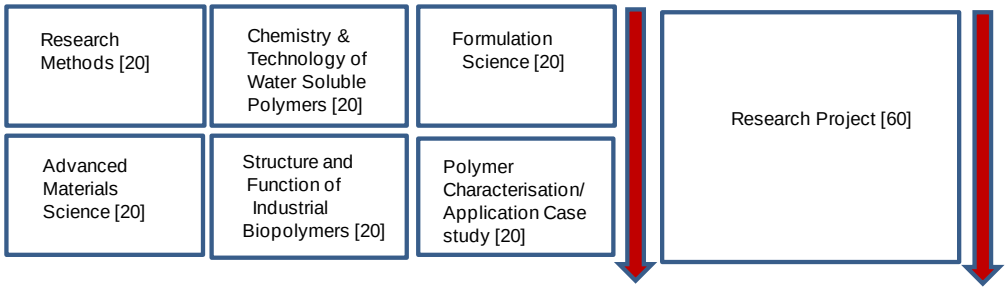
Differentiation in programme content between the two named awards *Formulation Science* and *Polymer and Biopolymer Science* at PGDip / MSc level is achieved in a number of ways. The most visible of these is by selection of either the Product Formulation Case Study module or else the Polymer Characterisation / Application Case Study module, as illustrated below. The choice of directed learning material, for example journal articles studied, and in particular the choice of Research Project topic facilitate further differentiation.

Formulation Science



PGDip (120 Credits) MSc (180 Credits)
PGCert (60 Credits)

Polymer & Biopolymer Science



PGDip (120 Credits) MSc (180 Credits)
PGCert (60 Credits)

All modules may also be offered as credit bearing CPD courses which on completion will award students Glyndŵr University Certificate of Continuing Education.

Progression:

- Detailed information relating to progression and awards are outlined in the Regulation for Glyndŵr University: 'Taught Masters Degrees'.
- Each student follows a course of study which will enable the successful candidate to attain either an exit award of Postgraduate Certificate or the exit award Postgraduate Diploma or to progress to the MSc.

Delivery Schedule (Full Time):
The table below illustrates the planned trimester in which each module will be delivered. Taught content of the programme is delivered over 2 days each week in trimesters 1 and 2 for Full Time students. For MSc/PGDip students the Case Study module studied in trimester 2 is appropriate to the chosen route: Product Formulation Case Study for MSc/PGDip Formulation Science, Polymer Characterisation/Application Case Study for MSc/PGDip Polymer and Biopolymer Science. All modules are core, Level 7.

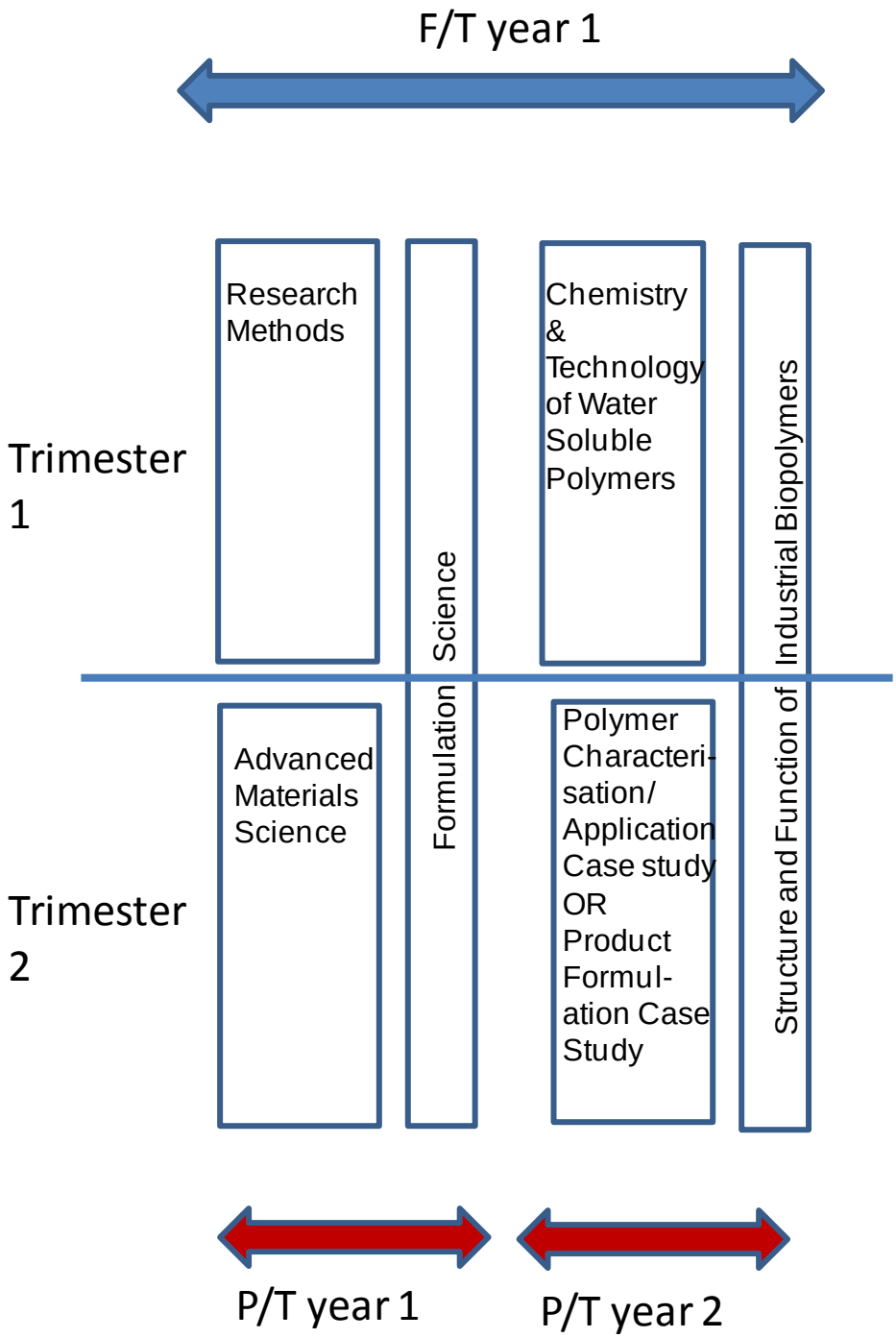
Code	Module Title	Credits	Module Leaders	Trimester
SCI707	Research Methods	20	I. Ratcliffe	1
SCI712	Chemistry and Technology of Water Soluble Polymers	20	P.A. Williams	1
SCI713	Formulation Science	20	I. Ratcliffe	1 & 2
SCI714	Structure and Function of Industrial Biopolymers	20	P.A.Williams	1 & 2
SCI709	Advanced Materials Science	20	J. Yang	2
SCI716	Product Formulation Case Study	20	I. Ratcliffe	2
SCI715	Polymer Characterisation/Application Case Study	20	I. Ratcliffe	2
SCI717	Research Project	60	I. Ratcliffe	3

Indicative Delivery Schedule (Part Time):
The table below illustrates the planned trimester in which each module will be delivered. Taught content of the programme is delivered over 1 full day (including evening) each week in trimesters 1 and 2 for Part Time students. For MSc/PGDip students the Case Study module studied in year 2, trimester 2 is appropriate to the chosen route: Product Formulation Case Study for MSc/PGDip Formulation Science, Polymer Characterisation/Application Case Study for MSc/PGDip Polymer and Biopolymer Science. All modules are core, Level 7.

Code	Module Title	Credits	Module Leaders	Year/ Trimester
SCI707	Research Methods	20	I. Ratcliffe	Yr 1 / 1
SCI713	Formulation Science	20	I. Ratcliffe	Yr 1 / 1 & 2
SCI709	Advanced Materials Science	20	J. Yang	Yr 1 / 2
SCI712	Chemistry and Technology of Water Soluble Polymers	20	P.A. Williams	Yr 2 /1
SCI714	Structure and Function of Industrial Biopolymers	20	P.A. Williams	Yr 2 / 1 &2
SCI716	Product Formulation Case Study	20	I. Ratcliffe	Yr 2 / 2
SCI715	Polymer Characterisation/Application Case Study	20	I. Ratcliffe	Yr 2 / 2
SCI717	Research Project	60	I. Ratcliffe	Yr3 / ! & 2

The Research Project (60 Credits) can be undertaken partly or wholly within a suitable company. Whilst this is not compulsory for achievement of the award, students will be encouraged to capitalise on this opportunity to gain valuable industrial experience.

A schematic of the delivery schedule is included overleaf to illustrate how full and part time delivery fit onto the same delivery matrix.



Schematic to illustrate co-delivery of taught modules on F/T and P/T programmes using a common delivery matrix.

Intended learning outcomes of the programme

The programme in this proposal will provide opportunities for students to develop and demonstrate knowledge and understanding, qualities, skills and other attributes. Students will be able to implement practical application of chemistry skills, combining theory and experience, and using other relevant knowledge in a wide range of situations, including problem solving, communication, and working with others, as well as the effective use of modern technologies to achieve polymer/biopolymer and/or formulation objectives within an economic, social and environmental context. The programme emphasises emerging and state-of-the-art techniques and technologies within the discipline and will deliver a range of course materials to cover technical, environmental and economic issues. It will provide an opportunity for students to gain comprehensive theoretical knowledge, improve their analytical and practical skills, and allow students to further develop skills and knowledge whilst giving the flexibility to investigate areas of interest in more depth.

The programme provides opportunities for the learners to achieve the outcomes described in the specific learning outcomes defined below for each specific award.

Postgraduate Certificate (PGCert) in Applied Polymer Science

(60 Credits)

A. Knowledge and Understanding – able to:

1. Critically interpret observed performance properties of complex fluids such as (bio)polymer solutions or formulated products in terms of the key underlying colloid and polymer science.

2. Identify the physicochemical properties of specific polymers and biopolymers and justify their utilisation in a range of commercial applications with reference to the structure-function relationship.

B. Intellectual Skills - able to:

1. Exploit theoretical concepts / knowledge to solve complex challenges involving formulation / (bio)polymers.

2. Critically interpret scientific literature e.g. journal articles, patents.

C. Practical Skills - able to:

1. Design / select experimental procedures for measurement of polymer / colloid solutions with due regard to the appropriateness of the method to meeting objectives.

2. Plan and perform experiments using advanced instrumentation with due regard to risk assessment, calibration / initialisation of the instrument and consideration of sources of error.

3. Report experimental data in a concise and professional way.

D. Transferable/key skills - able to:

1. Work independently.
2. Use instrument specific software for data acquisition.
3. Use internet search engines, patent searches and scientific databases effectively to locate and retrieve pertinent published research.
4. Evaluate experimental data with reference to existing published literature
5. Collate and format experimental data in a form suitable for presentation or publication.
6. Assess the statistical significance of research output.

PG Cert Applied Polymer Science CURRICULUM MATRIX demonstrating how the overall programme outcomes are achieved and where skills are developed and assessed within individual modules.

	A. Knowledge and Understanding C. Practical Skills B. Intellectual Skills D. Transferable / Key Skills															
	A			**B**			**C**				**D**					
Module Title	**1**	**2**		**1**	**2**		**1**	**2**	**3**		**1**	**2**	**3**	**4**	**5**	**6**
Research Methods					■				■				■			
Formulation Science	■	■		■	■		■	■	■		■	■	■	■	■	■
Chemistry and Technology of Water Soluble Polymers	■	■		■	■		■	■	■		■	■	■	■	■	■
Advanced Materials Science					■		■	■	■			■	■	■	■	■
Structure and Function of Industrial Biopolymers	■	■		■	■		■	■	■		■	■	■	■	■	■
Polymer Characterisation /Application OR Product Formulation Case Study	■			■	■		■	■					■			

Postgraduate Diploma (PGDip) in Formulation Science (120 Credits)	**Masters (MSc) in Formulation Science** (180 Credits)
A. Knowledge and Understanding. Be able to 1 Demonstrate a comprehensive and systematic understanding of the origin, consequences, measurement and control of chemical and physical interactions between different molecular species in commercially significant formulations. 2 Exhibit an understanding of the wider applications of advanced materials beyond the student's own subject area and the interdisciplinary nature of advanced materials science. 3 Exhibit a comprehensive knowledge of the various types of commercially important natural and synthetic water soluble polymers. 4 Evidence current knowledge of the synthetic methods in the field of water soluble polymers. 5 Demonstrate a systematic understanding and critical awareness of the solution and interfacial behaviour of natural and synthetic water soluble polymers at the forefront of current knowledge. 6 Demonstrate current knowledge and a comprehensive understanding of the source, structure and physicochemical characteristics of hydrocolloids. 7 Resolve a complex formulation problem by identification of the key polymer and colloid chemistry underpinning the formulation. 8 Understand the role of the formulator in the development, scale up, manufacture and QC testing of formulated products.	A. Knowledge and Understanding. Be able to: 1 Demonstrate a comprehensive and systematic understanding of the origin, consequences, measurement and control of chemical and physical interactions between different molecular species in commercially significant formulations. 2 Exhibit an understanding of the wider applications of advanced materials beyond the student's own subject area and the interdisciplinary nature of advanced materials science. 3 Exhibit a comprehensive knowledge of the various types of commercially important natural and synthetic water soluble polymers. 4 Evidence current knowledge of the synthetic methods in the field of water soluble polymers. 5 Demonstrate a systematic understanding and critical awareness of the solution and interfacial behaviour of natural and synthetic water soluble polymers at the forefront of current knowledge. 6 Demonstrate current knowledge and a comprehensive understanding of the source, structure and physicochemical characteristics of hydrocolloids. 7 Resolve a complex formulation problem by identification of the key polymer and colloid chemistry underpinning the formulation. 8 Understand the role of the formulator in the development, scale up, manufacture and QC testing of formulated products.
B. Intellectual Skills - able to: 1. Source and critically review appropriate current and earlier scientific literature and patents to inform experimental design and confirm originality of study. 2. Systematically assess the impact of ethics, intellectual property and safety	B. Intellectual Skills - able to: 1. Source and critically review appropriate current and earlier scientific literature and patents to inform experimental design and confirm originality of study. 2. Systematically assess the impact of ethics, intellectual property and safety

/ environmental issues to a proposed research endeavour. 3. Critically assess and interpret experimental results with reference to statistical analysis and treatment of errors, and where necessary implement revision of experimental procedures. 4. Critically interpret and compare original experimental data to that in the scientific literature in respect of the key physical and chemical processes occurring. 5. Interpret and apply the procedure, regulations and standards for analytical techniques and sample preparation within academia and industry (QA, QC, ISO9001 etc.) 6. Identify typical challenges faced by formulation scientists on a daily basis and suggest plausible strategies to overcome them.	/ environmental issues to a proposed research endeavour. 3. Critically assess and interpret experimental results with reference to statistical analysis and treatment of errors, and where necessary implement revision of experimental procedures. 4. Critically interpret and compare original experimental data to that in the scientific literature in respect of the key physical and chemical processes occurring. 5. Interpret and apply the procedure, regulations and standards for analytical techniques and sample preparation within academia and industry (QA, QC, ISO9001 etc.). 6. Identify typical challenges faced by formulation scientists on a daily basis and suggest plausible strategies to overcome them. 7. Demonstrate ability to acquire and interpret originally raw data – obtained by a variety of techniques – and thus gain a practical understanding of how original research is used to create knowledge and to communicate this to a specialist or non-specialist group, both orally and in writing. 8. Reflect upon experimental data in the context of existing knowledge reported in the scientific literature.
<u>C. Practical Skills - able to:</u> 1 Independently design and execute appropriate testing procedures for the evaluation of a formulation. 2 Demonstrate an in-depth understanding of analytical techniques and testing of chemical materials utilised in advanced materials and critically evaluate the advantages and limitations of each technique. 3 Use instrument-specific software. 4 Report the results of practical investigations in a laboratory notebook and more formally as a written report. 5 Apply formulation knowledge gained in a discrete market sector e.g. foods	<u>C. Practical Skills - able to:</u> 1 Independently design and execute appropriate testing procedures for the evaluation of a formulation. 2 Demonstrate an in-depth understanding of analytical techniques and testing of chemical materials utilised in advanced materials and critically evaluate the advantages and limitations of each technique. 3 Use instrument-specific software. 4 Report the results of practical investigations in a laboratory notebook and more formally as a written report. 5 Apply formulation knowledge gained in a discrete market sector e.g. foods

to an apparently unrelated sector e.g. metal coatings.	to an apparently unrelated sector e.g. metal coatings. 6 Exercise the competent, accurate and appropriate use of advanced experimental techniques capable of yielding new data and knowledge in one of the subject areas of the Programme.
D. Transferable/key skills - able to: 1. Use appropriate software to undertake project planning / management and literature referencing. 2. Communicate research data effectively in written and oral / poster form in a style appropriate to both specialists and non-specialists. 3. Demonstrate independent learning ability required for continuing professional development 4. Demonstrate trouble shooting and problem solving skills, workplace communication, team working, patent and literature searching. 5. Develop strategies to deal with complex and unpredictable situations. 6. Evidence employment of generic spreadsheet / word processing programs to acquire and process experimental data and produce reports of a professional standard. 7. Define the role played by the formulator in a team in relation to individuals representing marketing, finance, process engineers, production managers etc. 8. Be self-critical in the evaluation of risks, experimental procedures and outcomes..	D. Transferable/key skills - able to: 1. Use appropriate software to undertake project planning / management and literature referencing. 2. Communicate research data effectively in written and oral / poster form in a style appropriate to both specialists and non-specialists. 3. Demonstrate independent learning ability required for continuing professional development 4. Demonstrate trouble shooting and problem solving skills, workplace communication, team working, patent and literature searching. 5. Implement strategies to deal with complex and unpredictable situations. 6. Evidence employment of generic spreadsheet / word processing programs to acquire and process experimental data and produce reports of a professional standard. 7. Define the role played by the formulator in a team in relation to individuals representing marketing, finance, process engineers, production managers etc. 8. Demonstrate project management skills. 9. Demonstrate ability to work independently. 10. Be self-critical in the evaluation of risks, experimental procedures and outcomes.

Formulation Science MSc CURRICULUM MATRIX demonstrating how the overall programme outcomes are achieved and where skills are developed and assessed within individual modules.

	A. Knowledge and Understanding C. Practical Skills B. Intellectual Skills D. Transferable / Key Skills																													
	A								**B**								**C**						**D**									
Module Title	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Research Methods									■	■	■												■	■	■		■					
Formulation Science	■											■					■			■											
Chemistry and Technology of Water Soluble Polymers			■	■	■	■														■										
Advanced Materials Science		■											■					■	■								■				
Structure and Function of Industrial Biopolymers			■		■															■										
Product Formulation Case Study							■	■						■							■					■		■			
	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Research Project															■	■						■								■	■	■

Postgraduate Diploma (PGDip) in Polymer and Biopolymer Science (120 Credits)	**Masters (MSc) in Polymer and Biopolymer Science** (180 Credits)
A. Knowledge and Understanding. Be able to 1 Demonstrate a comprehensive and systematic understanding of the origin, consequences, measurement and control of chemical and physical interactions between different molecular species in commercially significant formulations. 2 Exhibit an understanding of the wider applications of advanced materials beyond the student's own subject area and the interdisciplinary nature of advanced materials science. 3 Exhibit a comprehensive knowledge of the various types of commercially important natural and synthetic water soluble polymers. 4 Evidence current knowledge of the synthetic methods in the field of water soluble polymers. 5 Demonstrate a systematic understanding and critical awareness of the solution and interfacial behaviour of natural and synthetic water soluble polymers at the forefront of current knowledge. 6 Demonstrate current knowledge and a comprehensive understanding of the source, structure and physicochemical characteristics of hydrocolloids. 7 Resolve a complex polymer/biopolymer characterisation problem by identification of the key polymer and colloid chemistry at work 8 Understand the role of the polymer/biopolymer analyst in the development, scale up, manufacture and QC testing of polymer/biopolymer products.	A. Knowledge and Understanding. Be able to: 1 Demonstrate a comprehensive and systematic understanding of the origin, consequences, measurement and control of chemical and physical interactions between different molecular species in commercially significant formulations. 2 Exhibit an understanding of the wider applications of advanced materials beyond the student's own subject area and the interdisciplinary nature of advanced materials science. 3 Exhibit a comprehensive knowledge of the various types of commercially important natural and synthetic water soluble polymers. 4 Evidence current knowledge of the synthetic methods in the field of water soluble polymers. 5 Demonstrate a systematic understanding and critical awareness of the solution and interfacial behaviour of natural and synthetic water soluble polymers at the forefront of current knowledge. 6 Demonstrate current knowledge and a comprehensive understanding of the source, structure and physicochemical characteristics of hydrocolloids. 7 Resolve a complex polymer/biopolymer characterisation problem by identification of the key polymer and colloid chemistry at work 8 Understand the role of the polymer/biopolymer analyst in the development, scale up, manufacture and QC testing of polymer/biopolymer products.
B. Intellectual Skills - able to: 1. Source and critically review appropriate current and earlier scientific literature and patents to	B. Intellectual Skills - able to: 1. Source and critically review appropriate current and earlier scientific literature and patents to

inform experimental design and confirm originality of study. 2. Systematically assess the impact of ethics, intellectual property and safety / environmental issues to a proposed research endeavour. 3. Critically assess and interpret experimental results with reference to statistical analysis and treatment of errors, and where necessary implement revision of experimental procedures. 4. Critically interpret and compare original experimental data to that in the scientific literature in respect of the key physical and chemical processes occurring. 5. Interpret and apply the procedure, regulations and standards for analytical techniques and sample preparation within academia and industry (QA, QC, ISO9001 etc.). 6. Identify typical challenges faced by polymer/biopolymer scientists on a daily basis and suggest plausible strategies to overcome them.	inform experimental design and confirm originality of study. 2. Systematically assess the impact of ethics, intellectual property and safety / environmental issues to a proposed research endeavour. 3. Critically assess and interpret experimental results with reference to statistical analysis and treatment of errors, and where necessary implement revision of experimental procedures. 4. Critically interpret and compare original experimental data to that in the scientific literature in respect of the key physical and chemical processes occurring . 5. Interpret and apply the procedure, regulations and standards for analytical techniques and sample preparation within academia and industry (QA, QC, ISO9001 etc.). 6. Identify typical challenges faced by polymer/biopolymer scientists on a daily basis and suggest plausible strategies to overcome them. 7. Demonstrate ability to acquire and interpret originally raw data – obtained by a variety of techniques – and thus gain a practical understanding of how original research is used to create knowledge and to communicate this to a specialist or non-specialist group, both orally and in writing. 8. Reflect upon experimental data in the context of existing knowledge reported in the scientific literature.
<u>C. Practical Skills - able to:</u> 1 Independently design and execute appropriate testing procedures for the evaluation of a formulation. 2 Demonstrate an in-depth understanding of analytical techniques and testing of chemical materials utilised in advanced materials and critically evaluate the advantages and limitations of each technique. 3 Use instrument-specific software. 4 Report the results of practical investigations in a laboratory	<u>C. Practical Skills - able to:</u> 1 Independently design and execute appropriate testing procedures for the evaluation of a formulation. 2 Demonstrate an in-depth understanding of analytical techniques and testing of chemical materials utilised in advanced materials and critically evaluate the advantages and limitations of each technique. 3 Use instrument-specific software. 4 Report the results of practical investigations in a laboratory

notebook and more formally as a written report. 5 Amend polymer/biopolymer characterisation strategies developed in a discrete market sector e.g. foods to an apparently unrelated sector e.g. metal coatings.	notebook and more formally as a written report. 5 Amend polymer/biopolymer characterisation strategies developed in a discrete market sector e.g. foods to an apparently unrelated sector e.g. metal coatings. 6 Exercise the competent, accurate and appropriate use of advanced experimental techniques capable of yielding new data and knowledge in one of the subject areas of the Programme.
D. Transferable/key skills - able to: 1. Use appropriate software to undertake project planning / management and literature referencing. 2. Communicate research data effectively in written and oral / poster form in a style appropriate to both specialists and non-specialists. 3. Demonstrate independent learning ability required for continuing professional development 4. Exhibit trouble shooting and problem solving skills, team working and workplace communication, patent and literature searching. 5. Develop strategies to deal with complex and unpredictable situations. 6. Evidence employment of generic spreadsheet / word processing programs to acquire and process experimental data and produce reports of a professional standard. 7. Be self-critical in the evaluation of risks, experimental procedures and outcomes.	D. Transferable/key skills - able to: 1. Use appropriate software to undertake project planning / management and literature referencing. 2. Communicate research data effectively in written and oral / poster form in a style appropriate to both specialists and non-specialists. 3. Demonstrate independent learning ability required for continuing professional development 4. Exhibit trouble shooting and problem solving skills, team working and workplace communication, patent and literature searching. 5. Implement strategies to deal with complex and unpredictable situations. 6. Evidence employment of generic spreadsheet / word processing programs to acquire and process experimental data and produce reports of a professional standard. 7. Demonstrate project management skills. 8. Demonstrate ability to work independently. 9. Be self-critical in the evaluation of risks, experimental procedures and outcomes.

Polymer and Biopolymer Science MSc CURRICULUM MATRIX demonstrating how the overall programme outcomes are achieved and where skills are developed and assessed within individual modules.

	A. Knowledge and Understanding C. Practical Skills B. Intellectual Skills D. Transferable / Key Skills																												
	A								**B**								**C**						**D**								
Module Title	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Research Methods									■	■	■												■	■	■		■				
Formulation Science	■											■					■			■										
Chemistry and Technology of Water Soluble Polymers			■	■	■	■														■									
Advanced Materials Science		■											■					■	■								■			
Structure and Function of Industrial Biopolymers			■		■															■									
Product Formulation Case Study							■	■						■							■					■				
	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Research Project															■	■						■							■	■	■

Learning and teaching strategy used to enable outcomes to be achieved and demonstrated

The curriculum is designed to encourage an appreciation for learning. Learning is enriched by appropriate underpinning, current research, industrial applications and the development of transferable skills.

The overall strategy for teaching in respect of this programme is to impart upon the student a broad overarching knowledge of polymer and colloid science, advanced materials and subject specific research skills. This knowledge is expanded in areas appropriate to the award title: *Polymer and Biopolymer Science* or *Formulation Science* by application to specific examples and case studies.

Chemistry as a subject is amenable to the full range of teaching methodologies. In both the common and specialist elements in this programme a variety of teaching techniques are employed to ensure that students remain engaged, motivated and challenged to learn. The learning and teaching strategy is constructed to enable learners to freely meet the stated learning objectives. The practical elements of the course reinforce the ability of learners to conduct practical work in a safe and competent manner as demanded by the chemical science profession.

Lectures are utilised as the main delivery mechanism, typically supplemented by supervised problem and practical lab sessions and group discussion. Three of the taught modules feature a programme of 'self taught' laboratory investigations presenting students with the opportunity to develop 'hands on' experience with key instrumental techniques. Some modules include group and small-scale project work, with student-led seminars and presentations. Moodle is used to support teaching. The contributing Research Centres also operate a number of specialist labs, providing practical and analytical facilities. Owing to its multi-disciplinary nature, up to 50% of the practical aspect of the Advanced Materials Science module may be delivered at the University's St Asaph campus.

Lectures: This is usually a formal discourse for the purpose of dissemination of information, the demonstration of techniques and the discussion of supporting ideas and consequences. The lecture is supported by a full range of equipment including whiteboard, video and computer projection facilities where appropriate. Although this type of presentation is suitable for a one-sided discourse ample opportunity exists for questions, interaction and discussion.

Seminar and Tutorials: These activities encompass a wide range of activities, each suited to the particular module. Some tutorials will consist of the staff supporting students engaged in problem solving. Alternatively a tutorial may involve group exercises where each group is encouraged to allocate responsibilities, tasks etc. Generally this type of teaching is used to support the lecture, clarify the material and experiment with the techniques and skills required.

Laboratory: The nature of the chemistry and physics elements of the programme requires students to gain practical skills in the use and safe handling of chemical substances and analytical techniques/equipment. There are specialist laboratories at both Wrexham and St Asaph. Activities including demonstrations, practical sessions and problem solving activities take place in the laboratories and are supported by a staff member, practising skills in the use of sophisticated analytical techniques and essential safe laboratory practice.

Group Work: For some modules, students are encouraged to work in groups to achieve set

objectives. Assessment of these activities includes both group and individual elements. In this way, students learn to work as a team to achieve a common goal whilst at the same time individual contribution is recognised.

Research Project: The research project serves the primary purpose of integrating technological and research strands, and does so in a context of a piece of substantial research. Assessment of the dissertation will be crucial in determining whether master's level learning outcomes have been achieved.

The research project typically involves the student applying their knowledge of chemistry to the solution of an unfamiliar problem. The problem is original to the student and its solution therefore requires the innovative application of knowledge and techniques either studied in the previous taught stage or acquired through independent research of recent and relevant literature.

The research project provides a means for integrating specialist chemical knowledge with analytical, problem solving, and communication skills. All of these are exercised and evidenced through the execution and outcomes of the research project, which includes: a project proposal (assessed by oral presentation in the Research Methods module) dissertation, and final oral presentation.

Feedback is provided continuously to students through informal contact with subject lecturers and tutors in the seminar/tutorial and laboratory sessions and with formal weekly contact with their project supervisor. In accordance with University Guidance, feedback is provided on assessed practical work normally within three weeks of submission of the work.

Accreditation of the programme by the RSC is a major aspect of the programme and will be applied for to enable this in time for the 2014/15 academic year. In anticipation of submitting for accreditation, the programme has been designed to meet the requirements for accreditation and this has involved the integration of the skills required into modules across the programme. The learning and teaching strategy adopts various methods as detailed above, and utilises problem-based learning and group project work which also supports this. Professionals from industry will provide guest lectures at various points throughout the programme to meet the requirements of chemistry professional institutions/bodies as defined in the QAA Chemistry Benchmark statement and also to ensure the relevance of the course content to the polymer / biopolymer and formulation communities, thereby enhancing the student's future employability within these sectors.

Students will be encouraged wherever possible to undertake their research project in an industrial setting, but this is not a formal requirement of the programme, but an opportunity to enhance the student experience.

Welsh Medium Provision

The University is also committed to expanding Welsh medium provision and while the chemistry team is currently unable to deliver any of the programme in Welsh, they are making small steps in the right direction. These include the development of some online material and lecture notes in the Welsh language as part of the Welsh Energy Sector Training (WEST) project at CSER (St Asaph).

Assessment strategy used to enable outcomes to be achieved and demonstrated

The Assessment strategy for this programme provides a framework for the assessment of students' competence, knowledge and understanding, and a grading of students for progression and the conferring of awards. It allows staff to give feedback to students and to evaluate the effectiveness of their own teaching. This strategy will be closely adhered to in the delivery of the programme and is guided by the QAA Chemistry benchmark statement (2007) section 6 Teaching, learning and assessment, Credit and Qualification Framework Wales (CQFW) and Glyndŵr University Assessment Guidelines.

Students will receive formative assessment, particularly during the practical and self-study elements of the programme to ensure they can keep track of their progress and development. This will also be a key factor in ensuring student engagement and retention on the programme of study. In the case of practical assessment, this may be a final summative assessment, so more frequent formative assessment provides academic rigour and increases student awareness and confidence in the subject.

There will be emphasis placed on students to undertake independent study and research activities, in particular when completing the Research Project element of the programme. The dissertation will be facilitated by a traditional summative assessment approach at the culmination of the work, however, there will be extensive use of formative feedback, milestones, and guidance from staff during this and other independent study and research-based assessment undertaken by students. This is common practice for such modes of study and is in line with the approach taken by postgraduate programmes in other HE institutions.

All assessments will be approved by the programme lead, academic head and the external examiners in line with University regulations, to ensure that each assessment is explicit in its intent, and that it is valid and reliable.

Grade related criteria will be used to assess the students' work, with feedback provided to facilitate individual and group development. All assessment will be internally and externally moderated in line with University regulations, to ensure that assessment is fair and consistent.

Module leaders will collate work and are responsible for presenting this at assessment boards, to enable ratification of results in line with the University's assessment regulations. External examiners with *due regard* will attend assessment boards and contribute to the process, to ensure external validity of assessment. Students will be informed of provisional results prior to an assessment board, and in writing following ratification of the results, with re-submission dates if needed.

Assessment will be made clear, and module leaders will provide assignment briefs in written (paper and electronic format) and/or audio format (which has proved extremely popular for other programmes in the University), with clear links to module learning outcomes. Assessment criteria/briefs will be discussed face to face and/or in electronic format through Moodle™ (virtual learning environment), to enable the student to clarify the nature of the assessment and raise any concerns/areas for clarification.

External Examiners: The appointment and responsibilities of the External Examiner for this programme conform with the current Glyndŵr University Academic Regulations.

Assessment / Awards Boards: The Module Assessment Boards and Award / Progression

Assessment Boards for this programme will be carried out in accordance with the current Glyndŵr University Academic Regulations.

Module Assessment Schedule – Chemistry: MSc Formulation Science / Polymer and Biopolymer Science

Full Time Delivery

	Modules:	**Research Methods**	**Formulation Science**	**Chemistry and Technology of Water Soluble Polymers**	**Structure and Function of Industrial Biopolymers**	**Advanced Materials Science**	**Product Formulation OR Polymer Characterisation/ Application Case Study**	**Research Project**
	code:							
week:	**credits:**	20	20	20	20	20	20	60
1			**i, i**	**i, i**	**i, i**			
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45								**a**
46								
47								
48								**a**
49								

i - assignment brief issued **a** - assignment submitted/assessment point **e** - formal examination

Part Time Delivery

	Modules:	**Research Methods**	**Formulation Science**	**Advanced Materials Science**		**Chemistry and Technology of Water Soluble Polymers**	**Structure and Function of Industrial Biopolymers**	**Product Formulation OR Polymer Characterisation/ Application Case Study**		**Research Project**
	code:									
YEAR 1 /week:	**credits:**	20	20	20	**YEAR 2 /week:**	20	20	20	**YEAR 3 /week:**	60
1			**i, i**		1	**i, i**	**i, i**		1	**i**
2		**i**			2				2	
3					3				3	
4					4				4	
5					5				5	
6		**a**			6				6	
7		**i**			7				7	
8					8				8	
9					9				9	
10					10				10	
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13		**a**			13	**a**			13	
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29			**a**	**a**	29		**a**	**a**	29	**a**
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49					49				49	

i - assignment brief issued **a** - assignment submitted/assessment point **e** - formal examination

Assessment regulations that apply to the programme

The Taught Masters Degrees, Postgraduate Diplomas and Certificates regulations apply to this programme.

Programme Management

Programme Team

Academic Staff:

Prof. Saphwan Al-Assaf	Professor of Hydrocolloids and Analytical Chemistry
Dr. Amiya Chaudhry	Senior Lecturer in Science
Prof. Stuart Irvine	Research Professor In Opto-electronics Materials for Solar Energy
Dr. Ian Ratcliffe	Lecturer in Science / **Programme Leader / Module Leader**
Prof. Peter Williams	Professor of Polymer & Colloid Chemistry, Academic Head Of Chemistry / **Module Leader**
Dr. Andy Wright	Senior Research Scientist
Dr. Jixin Yang	Senior Lecturer in Chemistry/Analytical Chemistry/ /**Module Leader**

Support Staff:

Dr. Chandra Senan	Senior Research Officer
Dr. Rachael Rowlands-Jones	Research Assistant

The Programme will be managed under the auspices of the Department of Chemistry and the programme will develop and operate within the terms of the overall management of curriculum within the Graduate School.

However there will be a designated **Programme Leader** for the MSc programme contained in this proposal, who will be responsible for the day-to-day running of the programme. Responsibilities and duties include the following:

- The management and development of curriculum and the course portfolio;
- Student tracking and student records;
- Collation of results and presentation of data at assessment boards;
- Management/co-ordination of overall assessment activities across the programme;
- Liaison with external bodies and agencies;
- Quality assurance and annual monitoring, including compilation of the Annual Monitoring Report;
- Co-ordination of admissions activities and other recruitment activities, including relevant publicity activities.

At module level responsibility is devolved to **Module Leaders** for the following:

- The maintenance and development of teaching and learning materials for all students enrolled on the module,
- The publishing and updating of module timetables, which shall include a weekly schedule of module sessions and required reading, to be distributed to students at the start of all modules,

- The setting, marking and collation of marks for all module assessments and examination papers, including resit assessments, and submission of student results to the Programme Leader
- Tutorial support for students taking the module which they are responsible for
- Quality monitoring, including processing of annual student feedback questionnaires and, where appropriate, student feedback for individual modules,
- Liaison with part-time members of staff involved in module teaching.

In addition the programme team will support the programme and module leaders in the following regard:

Lectures – Advanced Materials Science – all
Practical Supervisors - Advanced Materials Science – all
Lectures – Research Methods – Dr. Rachael Rowlands-Jones
Supervisors – Research Project - Prof. Saphwan Al-Assaf, Dr. Amiya Chaudhry, Dr. Andy Wright, Dr. Jixin Yang
Technical Support / Instrument Tuition– Dr Chandra Senan

Research and Scholarship underpinning the curriculum:

The programme's curriculum is underpinned by Research and Scholarship activities within Chemistry – in particular the Centre for Water Soluble Polymers (CWSP) and Phillips Hydrocolloid Research Centre (PHRC). The Advanced Materials Science module has significant input from team members of the Centre for Solar Energy Research (CSER) and Advanced Materials Research Laboratory (A.M.R.L.)

The **Programme Leader, Dr Ian Ratcliffe** has over 10 years industrial experience in product formulation across sectors including coatings, lubricants, cleaning products, personal care and pharmaceuticals. Subsequently he has gained over 13 years experience within the CWSP, mostly in research oriented positions, working on projects concerning controlled release, rheology, polymer synthesis, and latterly biopolymer modification and analysis. He is a member of the RSC Formulation Special Interest Group and committee member of the RSC North Wales Section. His research interests are within the 'green chemistry' field, particularly in the areas of biopolymers and their modification and characterisation. Ian was appointed as a lecturer in science in 2011 and also programme leader for postgraduate courses in Chemistry.

Professor Peter Williams is Academic Head of the Department of Chemistry and Director of the CWSP at Glyndŵr University. He has more than 30 years research experience in the area of polymer and colloid chemistry and in particular in the synthesis, characterisation, properties and applications of a broad range of polysaccharides and synthetic water soluble polymers. He is a Past Honorary Treasurer of the RSC "Colloid and Interface Science Group" (1993-1998) and a Past Chairman of the Society of Chemical Industry "Colloid and Surface Chemistry Group". He was presented with the Distinguished Service Award by the Society of Chemical Industry in 2007. He is a co-Founder and Secretary of the Food Hydrocolloids Trust (www.foodhydrocolloidstrust.org.uk) and Cellucon Trust (www.cellucontrust.org) established to promote polysaccharide research through the organization of conferences and has organised more than 30 international conferences. He has published over 200 scientific papers and edited over 40 books and is co-founder and Editor-in-Chief of the international journal Food Hydrocolloids (www.ees.elsevier.com/foodhyd).

Professor Stuart Irvine is Director of CSER at the St Asaph OpTIC campus of Glyndŵr University, and research professor of Opto-electronic Materials for Solar Energy at Glyndŵr

University. Research interests include pioneering work on deposition of thin film materials by Metal-organic Chemical Vapour Deposition (MOCVD), thin film solar cells and application of advanced thin film materials to the solar energy and opto-electronics industry. This research has led to the development of new optical in situ monitoring devices to measure growth rate, layers thickness and roughening of the growing films and was commercialised through the spin out of a company ORS Ltd which has now been bought by Laytech GMBH. The value of awarded grants to Professor Irvine's CSER team over the past five years has been in excess of £5M. The previous appointment was to the Chair of Opto-electronic Materials Chemistry in the Chemistry Department at the University of Wales Bangor, 2000- 2008. Prior to that Professor Irvine was Chair of Materials Chemistry at North East Wales Institute (NEWI) from October 1993 to 2000. From 1990 to 1993 he was an Assistant Manager, Array Producibility Research at Rockwell International Science Center in Thousand Oaks, California. He pioneered new methods in metal organic vapour phase epitaxy (MOVPE) for infrared detector applications carrying out novel research using new substrates. Previously, during 12 years at the Royal Signals and Radar Establishment he was the first to demonstrate the growth of the infrared detector material, mercury cadmium telluride (MCT), using MOVPE and also pioneered photo-assisted epitaxy for growth at low temperatures. He invented the interdiffused multilayer process (IMP) for the growth of compositionally uniform alloy layers, which is now a recognised technique worldwide and is in production in the UK. Appointments have included past chairman of the British Association for Crystal Growth (BACG) (1998-2001). Professor Irvine was chairman of the Welsh Opto-Electronics Forum (WOF), 1998-2000 and now chairs the PV special interest group. In his role as Chairman he initiated the Opto-electronics Technology and Incubation Centre (OpTIC) in St Asaph and started the company, Optropreneurs Ltd which managed the project from 2003 to 2008. From 2004 to 2012 he was Executive Director for the EPSRC funded collaborative research project "PV SUPERGEN".Current responsibilities also include coordinator of the PVNET, Chairman of the WOF PV Group, A member of the Management Board for the Low Carbon Research Institute (LCRI), Associate editor for the Journal of Materials Science: Electronic Materials, Co-editor of the Energy Materials Journal and chair of the Institute of Materials Mineral and Mining (IOM3) Energy Materials Group. He has published over 160 refereed papers, 8 book chapters and has seven awarded patents in the area of semiconductor materials growth.

Professor Saphwan Al-Assaf graduated in 1988 with a first class degree in Chemistry (Mosul University). He gained his MSc (1994) and PhD (1997) from Salford University in the field of radiation and solution properties of hyaluronan and cross linked form (Hylan).Subsequently he took up a postdoctoral research fellowship at NEWI working on the characterisation and modification of hydrocolloids. Since 2003 he became Director of the PHRC at NEWI. In 2007 he became a Reader in Chemistry and was awarded a personal chair in 2012. Professor Al-Assaf has published over ninety papers and holds ten patents. Current research interests mainly focus on the structure-function relationship of hydrocolloids, molecular assemblies and radiation chemistry of hydrocolloids.

Dr Rachael Rowlands-Jones has an industrial background in the scale up of dye-sensitised solar cells to industrial manufacturing and outdoor and accelerated testing of PV devices and scholarly activity related to this course reflects investigations into current developments and trends in reducing PV materials costs and challenges to large scale manufacture and Integration of PV technologies.

Dr. Andy Wright has worked in various field of R&D covering Aerospace (Hawker Siddeley Aviation, Rolls-Royce Aero Engines, National Gas Turbine Establishment), Optoelectronics, Electron Microscopy of thin films, Thin Film Nanotechnology and medical sterilisation. Originally training as an Engineer at a local college after leaving school at 16 he moved into Materials Science as an undergraduate at Bradford and learned high resolution

transmission electron microscopy (HRTEM) as a technique under RJD Tilley for his doctorate. An informal collaboration with D. Smith at the Cavendish labs in Cambridge facilitated his introduction to the computer image simulation method for HRTEM. He spent 8 years at UMIST (1983-1991) as Research Assistant, Research Associate and finally Institute Research Fellow working with Prof. J O Williams (Chemistry) on developing optoelectronic thin film materials using HRTEM/TEM. He spent much of his time developing a computer package for HRTEM image simulation making use of the local vector processer machines. Since 1991 he has been leading the AMRL as set up by Prof. J O Williams at the then NEWI, now Glyndŵr University. While still a practising microscopist, he has branched out into developing novel printing technologies and plasma-discharge sterilisation systems. In some sense, he has returned to his engineering roots, preferring to make things rather than just study them. Research interests include: formation of electrical microstructures of nanowires using magnetic fields to perform positioning and alignment, growth of carbon nanotubes by chemical vapour deposition, metal plating of carbon nanotubes to make metal nanowires, novel printing technologies and wearable electronics.

Dr Amiya Chaudhry received her BSc (Hons) (1998) in Environmental Science and a PhD (2004) in Polymer Chemistry from the University of Sussex. Her PhD, funded by the Atomic Weapons Establishment UK was based on the characterisation and degradation of a typical room temperature vulcanized (RTV) filled foamed poly(dimethyl)siloxane rubber. Her research interests lie in the broad area of polymer degradation and biopolymers which supports the Environmental Science discipline of the curriculum. In 2004 she was appointed as an associate lecturer at the Open University on a number of technology and science courses. In 2005 she joined the Materials Science Research Centre at Glyndŵr University as a knowledge transfer associate on a two-year research project funded by the Department of Trade and Industry and Almetron Ltd. In 2007 she took a permanent academic position teaching on the BSc Environmental Science and Forensic Science degree programmes.

Dr Chandra Senan completed a bachelor's degree in Chemistry and subsequently a Master's degree, including a dissertation concerning synthesis of various copolymers (hydrogels) – suitable for use as contact lens materials - by means of solution polymerisation. He then worked as research polymer chemist in Luxembourg for the International Synthetic Rubber Company for 4 years, carrying out numerous projects on both natural and synthetic rubbers. On returning to England, he did a Master's degree in Business Systems Analysis, his dissertation being the design of a materials database and its user interface. He then joined the Chemistry department of NEWI and undertook his PhD on a part-time basis, obtaining his PhD in Physical Chemistry in 1999. His thesis involved the synthesis of a number of hydrophobically modified sodium polyacrylates and the characterisation of their solution and adsorption properties largely by rheology and electron spin resonance spectroscopy.

Dr Jixin Yang received his BSc in Nanjing University (China) in 1996 and MSc in Chinese Academy of Sciences (Beijing) in 1999. Since then he studied his PhD at University of Nottingham on transient species in conventional and supercritical fluid solutions by time-resolved infrared spectroscopy. After graduating in 2003, he worked as a postdoctoral research fellow at Nottingham, focusing on the area of materials chemistry.Dr Yang took the academic position at Glyndŵr University in 2009. Now he is actively involved in undergraduate/postgraduate teaching and research in material chemistry, semiconductor materials, polymer nanocomposites, vibrational spectroscopy, supercritical fluids and green chemistry. He has published 25 research papers so far in peer-reviewed journals. Dr Yang is Charted Chemist (CChem), member of Royal Society of Chemistry (MRSC) and fellow of Higher Education Academy (FHEA). He is acting as a peer reviewer for a number of RSC

journals.

Publications for individual programme team members are detailed in CVs included with this submission and are not reproduced here.

All programme team members are committed to maintaining and developing links with industry, which help keep courses 'fresh' and up to date. The programme team feels that links between research and scholarship and teaching are essential in existing and new curriculum areas.

Particular support for learning

Students on the programme will receive the following forms of student support and guidance:

Admissions: All students on the programme will have the opportunity to discuss their application with staff, and receive appropriate advice and guidance prior to admission. This will include review of expectations of the programme and clarification of workload and requirements

Personal Tutorial Support: Each student is allocated a personal tutor at the beginning of the programme, has timetabled review sessions to engage in this process, and is supported in an academic context. Personal tutors will also assist in facilitating pastoral care by way of directing students to appropriate trained personnel within the University.

Induction**:** Prior to the commencement of teaching, the programme team run an induction programme for new students. This includes information on the requirements for academic and practical work, for example, module timetables, teaching methods and assessment strategies/types and documents that need to be completed, e.g. risk assessments and COSHH. The students are also introduced to their personal tutors and module leaders. Students are prepared for theoretical and practical experiences, and action is taken as far as reasonably possible to support and meet the individual needs of students, including introductions to teaching and learning resources that they will be expected to engage with, so that the learning experience can be maximised.

Learning Needs Analysis: A formal assessment of learning needs is conducted by the programme leader as part of the induction process to raise the programme team's awareness of each student's particular needs. The student and their personal tutor together review the learning needs analysis and advice is given appropriately as to how best to address the needs.

Student Handbook: All students receive a Student Handbook at induction which contains details and guidance on all aspects of the programme and forms of student support and guidance, programme-based, School-based and institutional.

Progress Review and Attendance Monitoring: Student attendance is subject to regular monitoring through electronic registers, and this assists the programme team to identify and support students with poor engagement. The attendance monitoring is such that it facilitates compliance with the UKBA requirements with respect to International students.

Complaints Procedure: Students are advised to initially raise academic problems with the lecturer concerned. If the problem is not resolved or it does not relate to a specific module, then they are advised to contact the Programme Leader. Details about the formal

complaints procedure are included in the Programme Handbook.

Monitoring and Feedback: The University has procedures in place for the regular review of its educational provision, including the annual review of both modules and programmes which draw on feedback from such sources as external examiners' reports, student evaluation, student achievement and progression data. In addition, programmes are reviewed every five years through a programme scrutiny quality review scheme that includes external input.

Feedback from students plays a critical part in informing the Department's strategic thinking. It also allows the Department to evaluate how its service provision is viewed by its most important group of stakeholders, its students. Students can provide formal feedback on their individual programme of study in a number of ways:

- Staff-Student Consultative Committee: SSCCs, chaired by a member of academic staff from outside the programme, will be held mid-trimester twice yearly and include elected representatives from the student body. Student feedback is minuted for action/response by the Programme Leader; the minutes plus the response from the Programme Leader are posted on the Moodle programme pages. SSCCs allow students to communicate their shared concerns in an informal manner, and permit staff to deal promptly with any issues.

- SEMs (Student Evaluation of Module survey): Module Leaders will distribute SEMs at the end of each module. A summary of the analysis of the SEMs, along with any other feedback, will be passed to the Programme Leader for action/response.

University learning resources: Students have full access to the library and IT resources at the Glyndŵr University Wrexham campus, and are introduced to the resources available during induction. Through access to UNICAT, a shared library catalogue, students are also able to request books from University of Bangor libraries, which are delivered to the Wrexham campus on a weekly basis. Students on this programme may also borrow books from a small library of specialised books housed in the CWSP. At enrolment students are given a library / IT account allowing access to use the University's networked computers and facilitating access to electronic textbooks and full text electronic journals. It also provides internet access and electronic mail. The library also provides laptops via a 24 hour loan scheme.

The University provides a wide range of software including word processing, spreadsheet, database and presentation packages. Students are also able to attend workshops and seminars enabling them to make effective use of the resources available.

Virtual Learning Environment (VLE): e-learning: the Programme Team will periodically provide some course content through the use of the Moodle™ software platform. Whilst there is utility in some modules for e-learning to replace formal lectures for certain specific module content, more commonly Moodle will be utilised to provide supplementary material to support material delivered in formal lectures and to provide a resource to assist students in directed learning activities. Indicative uses of Moodle include:

- Providing on-line teaching resources (e.g. lecture notes).
- Structuring on-line class activities (e.g. using discussion groups).
- Conducting on-line assessments (e.g. creating multiple choice tests).

Students enrolled on the programme will be from a wide geographical area and therefore need an effective communication system. Whilst emails are utilised within the programme,

the ‘Moodle’ site will provide an additional efficient communication method and a valuable learning resource for the programme students in all cohorts. Providing a variety of learning resources facilitates maximum student potential by catering for individual learning styles. Moodle provides the following:

- Announcement facilities to ensure information such as revised calendars or adaptation to sessions are communicated throughout the programme or to specific cohorts.
- All module handout materials are available prior to/ following each session. This enables students who learn more effectively by prior reading to access relevant materials wherever possible.
- Student’s group work is placed onto the site to enable shared learning.
- Discussion sites are used to explore particular topics, contributing towards collaborative learning.

Additional support for International Students: A number of formal strategies are put in place to support international students. Key examples are:

- Language provision designed to ensure that the international students have achieved a minimum level of language skills before they embark on their chosen degree programme. This is a six-week pre-sessional intensive English Language for Academic Study course that aims to bring students to an IELTS (International English Language Testing System) level of 6.5 – the standard demanded for entry into the masters degree programmes.
- Glyndŵr University offers English language classes alongside studies that improve not only spoken and written English but also academic English. Classes take place weekly and are delivered by the University’s English language tutors to also help students to integrate into the life of the local community as well as helping them develop transferable skills such as practical, research and report-writing skills.
- An induction / orientation course that precedes the start of formal teaching and that allows the international students to become familiar with the University and studying at the University whilst at the same time outlining some of the cultural differences that exist between their country of origin and the UK.

Support within the programme team:

- The programme team is itself of a multi-cultural nature and all programme team members work closely with international post-graduate students and post-doctoral research assistants on a day to day basis. Several programme team members are experienced in supervision of international MPhil / PhD and MRes students and are thus familiar with the particular learning difficulties an international student may have. The students on the programme will be an integral part of the research centre during their time at the University and will benefit from informal support from the postgraduate research student community.
- The incorporation of a dedicated learning needs analysis for this programme is of particular relevance to international students, who may arrive at the University with a very different experience of teaching than UK students and also different expectations of the learning and teaching strategy.
- The programme team will take particular care to ensure that all students fully understand the assessment process e.g. assignment briefs and submission procedures and are also fully aware of how to avoid plagiarism, an area open to misinterpretation

by international students.

Equality and Diversity

Education should be a part of a process to bring self-fulfilment to the individual, and teaching staff strive to uphold this by treating their students with respect, valuing their life experience and contributions in the classroom. This is further reinforced by the programme team making efforts to create a learning environment where students feel safe to ask questions and take part without fear of being embarrassed and where relationships with staff are collegial and friendly. Tutors believe that their role is that of facilitator of learning rather than just a transmitter of knowledge which the student receives passively.

Equality and Diversity are considered to be extremely important by the programme team and a number of measures have been put in place in many aspects of the programme to reflect this. The Admissions Policy at Department level clearly indicates how equality and diversity are integrated into the recruitment, selection and admission of students to the programme.

Programme information will be readily available through recruitment events and on the Glyndŵr University website and prospective students are given the opportunity to discuss individual needs during the interview phase of selection, as well as with the personal tutor once commenced on the programme. Reasonable adjustments will be made as far as possible, and advice will be provided in line with individual requests and needs, whilst also acknowledging professional body requirements. Modules have also been designed to create a variety of learning materials to enable all students to engage with the programme requirements, with the aim of enhancing inclusion and accessibility.

Individual needs will also be catered for in relation to completing the programme, with the support of the non-academic Student Support Services (Wrexham campus) sought as necessary. Resources and supportive mechanisms will be put in place as far as reasonably possible to allow the individual to engage with and complete the programme requirements on an equal footing with their peers.