Polymer Materials and Engineering

Education Programme for Undergraduates

（QMUL Engineering School, NPU）

Northwestern Polytechnical University

June, 2018

Education Programme for Undergraduates (English Version)

NPU Education Programme for Undergraduates (QMUL Engineering School)

Name of Programme Polymer Materials and Engineering

Code of major 080407H

School name QMUL Engineering School, NPU

Education programme planner ____________ Y M D

Dean of school ____________ Y M D

Directorof EAC ____________ Y M D

Northwestern Polytechnical University

Polymer Materials and Engineering Education Programme for Undergraduates（QMUL Engineering School）

1. Programme Introduction

Polymer materials are at the cutting-edge inter-discipline of materials science and soft materials. It builds the development foundation of many scientific research and industries, such as aviation, new energy, sustainable development, bio-science, health and medicine, information technology, and intelligent manufacturing. As a popular programme for undergraduates, Polymer Materials and Engineering in Queen Mary University of London (hereinafter as QMUL) covers metals, ceramics, polymers, and composite with the involvement of chemistry, materials and engineering. It is one of the most influential and distinct programmes in QMUL. The programme provides elite education and professional training for students with a thorough grounding in the structure of materials, the properties of materials, the performance of materials, the manufacturing processes and design, shaping and applications. It has been rated as 5-star programme by the British government for many times. A survey conducted by the National Union of Students in 2011 showed that it ranked top 1 in the UK. The Material programmes in Northwestern Polytechnical University (hereinafter as NPU) enjoy a high reputation and a great popularity internationally. Material discipline of NPU is the National Key Discipline and ranked top 3 among all National Key Disciplines in the 2012 Discipline Evaluation in China. The programmes, Polymer Materials and Engineering is the “Famous Brand Programme” and “Distinctive Programme” of Shanxi Province.

Approved by the Ministry of Education of China, NPU and QMUL have launched a joint educational institution named Queen Mary University of London Engineering School, Northwestern Polytechnical University (hereinafter referred to as JEI), in order to provide Chinese students with typical British education that emphasizes on developing undergraduate students’ innovation ability. The JEI, which builds on the acknowledged expertise and experience of the two universities and their complementary research strengths in materials science, fully uses educational resource advantages and high-level international cooperation platforms of both universities to provide a high quality degree level education in the programme of Polymer Materials and Engineering (080407H). The programme draws on the academic expertise of both institutions and adopts an international teaching mode with curriculum system, teaching materials, and assessment methods from the UK. The mission of this programme is to develop qualified and innovative talents who can study and work transnationally with the knowledge of natural science, polymer materials science and engineering, and social science. Students graduate with comprehensive qualities, high professional competencies, a global horizon, a life-long study ability, and recognition of international rules.

2. Educational Objectives

Under the guidance of Marxism, this programme aims to enhance morality and foster talents, to develop qualified and innovative talents who can study and work transnationally with the knowledge of natural science, polymer materials science and engineering, and social science. Students graduate with comprehensive qualities, high professional competencies, a global horizon, a life-long study ability, and the recognition of international rules. Students who have completed their studies are able to pursue higher degrees and research within universities in China and internationally or careers in the expanding materials science and manufacturing industry in world famous enterprises.

(1) Be equipped with solid basic knowledge and professional skills

Students should master basic knowledge of shaping, characterisation, forming, product design and applications in polymer materials, and professional knowledge of the structure and properties of polymer materials, chemical and physical structure characterisation of polymer materials, and evaluation of materials properties. Being equipped with problem-solving abilities, Students are able to conduct research and engineering practice with their basic knowledge and professional skills in the field of polymer materials.

(2) Be equipped with international competitiveness

Students become highly proficient in English language: reading English materials and books in polymer materials, writing academic essays in English, and conducting technical presentations in English. The programme develops students' global horizon and the recognition of international rules via the British teaching mode and oversea internship programmes. Students can obtain, use and manage various information to conduct cross-cultural communication and cooperation with innovative abilities and international competitiveness. Students can recognize Chinese characteristics and international comparisons correctly, as well as comprehend modern China and the world objectively and comprehensively.

(3) Be equipped with the ability of life-long study

Students should stick to Marxist theory, promote and practice Socialist Core Values, recognize the responsibility of times and mission of history, and to understand ambition and dedication correctly. Students should have a strong sense of social responsibility, a healthy mental and moral state, the ability of leading and working in teams, and outstanding communicative and practical skills. Equipped with good presentation skills and writing abilities, students can communicate effectively with their peers and the public against complex engineering and scientific problems. The cultivation of consciousness of engineering ethics, and the concept of working for the wellbeing of the human beings and sustainable development can help students to adapt to dynamic changes, and master the cutting-edge knowledge and new trend in the field of polymer materials so as to constantly improve students' abilities.

3. Educational Requirements

(1) Master basic knowledge

Students should master: extensive knowledge in the field of materials science including materials science, the structure of materials, the properties of materials, the performance of materials, the manufacturing processes and design, and application and development; intensive professional knowledge, including polymer chemistry, functional polymer, high-property polymer, and resin matrix polymer; experimental and computational methods in the field of polymer materials science and engineering.

(2) Develop professional skills

Students should be equipped with creative problem-solving and transferable skills and recognize the important value of materials science to engineering and other technologies. On the premise of safety, students conduct various experiments practically and are able to design, conduct, analyse and evaluate experiments and the results. Students are familiar with chemistry, material experiments, and analysing equipment, and are capable of searching, collecting and selecting data and presenting scientific and technical report. At last, students should have related abilities to conduct scientific research and develop technology and products in the field of polymer materials.

(3) Develop comprehensive qualities

Students should have the abilities of international competitiveness, communication, life-long study, independent study and work, and leading and working in teams. Students can estimate the relevance, importance and reliability of various information and realize the influence of science and engineering on the future of the society worldwide. Students are capable of communicating and cooperating transnationally with innovative ability and international competitiveness. With the concept of sustainable development in mind, students are exposed to cutting-edge technology changes in the field of materials and can improve themselves constantly in practice.

4. Qualification and Degree Certificate

Official length of the programme: 4+0 years' study in accordance with the credit management system.

Qualification and certificate: Successful students of the programme will be awarded diploma by NPU, BEng degree by NPU, and BEng degree by QMUL.

5. Fundamental Credits/ Hours

Polymer Materials and Engineering (080407H), total modules 52, credits 167.0, teaching hours 2738, detailed as follows:

Module	Credit	Hour	Language
General Education	66.0	1122	Chinese/English
Discipline	86.0	1376	English

Comprehensive Literacy	6.0	96	Chinese
Comprehensive Practices	9.0	144	English

6. Discipline Module

Polymer Materials and Engineering (080407H) discipline module, total modules 24, credits 86.0, total hours 1376, detailed as follows:

A. Discipline elementary modules (2 modules, 7.0 credits)

Module Code	Module Name	Credit
NXC4012	Mechanical Modelling	3.5 credits
NXC4008	Engineering Design Methods	3.5 credits

B. Discipline core modules (22 modules, 79.0 credits)

NXC4122	Thermodynamics and Fluid Mechanics	3.5 credits
QXU4000	MS 1 Structure and Properties	3.5 credits
QXU4001	Molecules to Materials	3.5 credits
QXU4006	MS 2 Processing and Applications	3.5 credits
NXC4010	Introduction to Functional Materials	3.5 credits
QXU4011	Introduction to Engineering Materials	4.0 credits
QXU4007	Experiments in Materials 1	3.5 credits
QXU5017	Experiments in Materials 2	3.5 credits
QXU5010	Surfaces and Interfaces	3.5 credits
QXU5031	Polymer Chemistry	4.0 credits
QXU5032	Physical Properties of Polymers	4.0 credits
NXC5013	Polymer Characterisation	3.5 credits
NXC5014	Elastomer Materials	3.5 credits
NXC5028	Polymer Degradation	3.5 credits
QXU5030	Composite Materials	3.5 credits
QXU6002	Materials Selection in Design	4.0 credits
QXU6007	Environmental Properties of Materials	3.5 credits
NXC6018	Polymer Processing	4.0 credits
NXC6019	Failure of Polymers	3.0 credits
NXC6020	Polymer Product Design	3.0 credits

QXU6034	Functional Polymers	3.5 credits
QXU7033	Advanced Polymer Synthesis	4.0 credits

7. Curriculum Modules and Credits, total 52 modules,167.0 credits

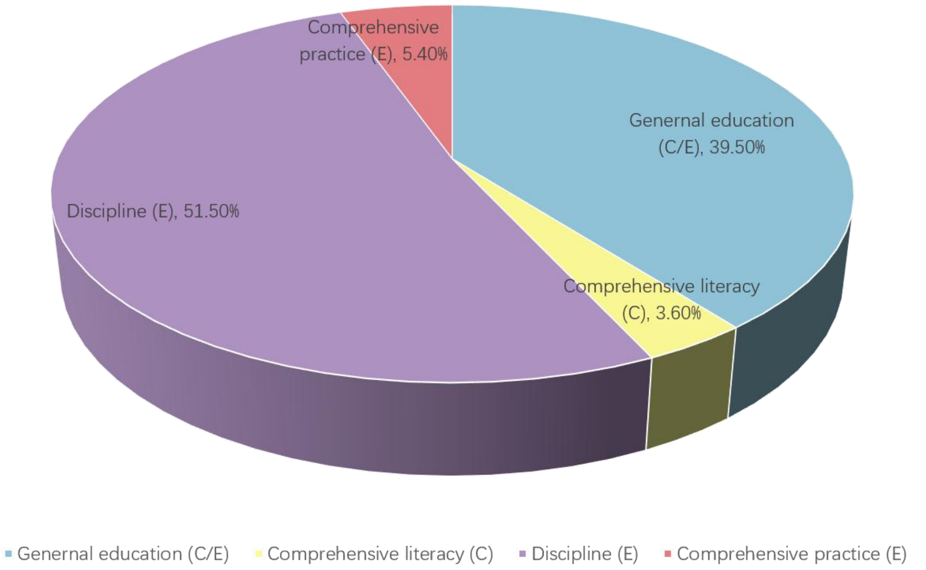
There are 4 modules in this major, as:

- General education module : 22 modules, 66.0 credits/ 1122 hours;
- Discipline module: 24 modules, 86.0 credits/ 1376 hours;
- Comprehensive literacy module: at least 4 modules, 6.0 credits/ 96 hours;
- Comprehensive practices module : 2 modules, 9.0 credits/ 144 hours;

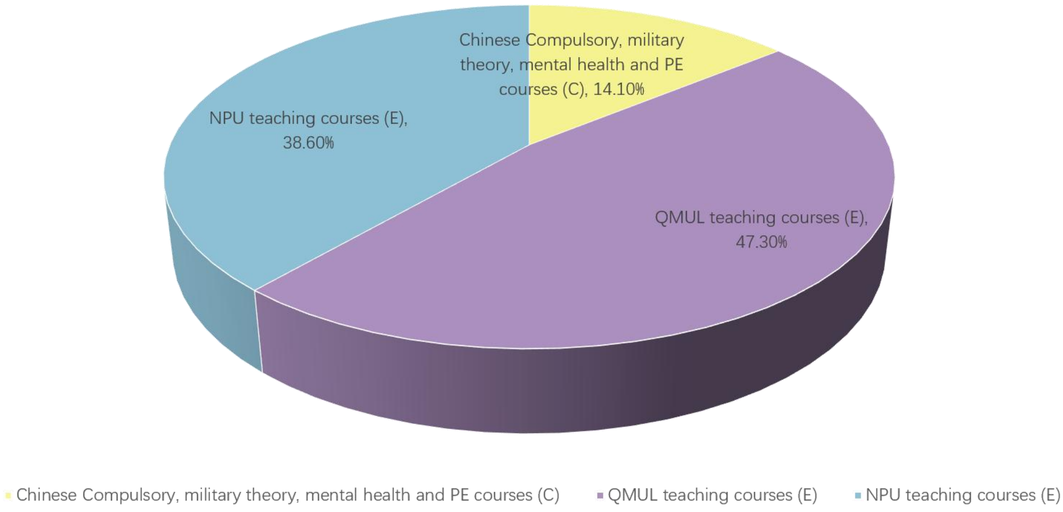
Except for Ideological and political theory modules, Military modules, Mental Health Education module and PE modules (23.5 credits), 79.0 credits are QMUL taught modules, 64.5 credits are NPU taught modules, and 20 introduced modules are English Language, PDP, 14 discipline core modules and major project, partially satisfying the requirement of *Regulations of the People's Republic of China on Chinese-Foreign Cooperation in Running Schools* and MoE relative rules, which are:

- numbers of introduced modules (20) take 39.2% of numbers of total modules (52)(over 1/3)；
- numbers of introduced major core modules (14) take 63.6% of numbers of total major modules (22) (over 1/3);
- numbers of QMUL teaching major core modules (14) take 27.5% of numbers of total modules (52);
- class hours of QMUL teaching major core modules (824) take 30.1% of class hours of total modules (2738).

Curriculum Modules and Credits



QMUL and NPU course hours proportion



(1) General education modules (22 modules, 66.0 credits)

A. Ideological and political theory modules (5 modules, 16.0 credits)

Module Code	Module Name	Credit
NXC2001	Chinese compulsory courses I-Essentials of Chinese Modern History	3.0 credits
NXC2002	Chinese compulsory courses II-Marxism General Principle	3.0 credits

NXC2003	Chinese compulsory courses III-Ethics and Fundamental of Law	3.0 credits
NXC2004	Chinese compulsory courses IV-Fundamental of Mao Ze Dong Thoughts	5.0 credits
NXC2005	Situation and Policy	2.0 credits

B. Military modules (2 modules, 3.0 credits)

Module Code	Module Name	Credit
U34G11002	Military Theory	2.0 credits
U34P41001	Military Training	1.0 credit

C. Mental growth and personal development modules (1 module, 0.5 credits)

Module Code	Module Name	Credit
U34G11001	Students Mental Health Education	0.5 credit

D. Career planning and development modules (3 module, 10.5 credits)

Module Code	Module Name	Credit
QXU3111	PDP I	3.5 credits
QXU4111	PDP II	3.5 credits
QXU5111	PDP III	3.5 credits

E. University general education modules (6modules, 13.0 credits)

Module Code	Module Name	Credit
QXU3101	English Language I	3.5 credits
QXU3102	English Language II	5.5 credits

Physical Education is compulsory module in the first to the fourth semester, taking 1 credit every semester. Students can freely choose different module according to their majors, physical conditions, interesting and physical basis.

Module Code	Module Name	Credit
U31G71001	Physical education I	1.0 credit
U31G71002	Physical education II	1.0 credit
U31G71003	Physical education III	1.0 credit

U31G71004	Physical education IV	1.0 credit

F. Level-based general education modules (5 modules, 23.0 credits)

Module Code	Module Name	Credit
NXC3000	Advanced Maths I	5.5 credits
NXC3004	Advanced Maths II	5.5 credits
NXC3002	Linear Algebra	3.0 credits
NXC3005	Mathematical Modelling and Computing	4.0 credits
NXC3001	General Physics	5.0 credits

(2) Discipline Modules (24 modules, 86.0 credits)

A. Discipline elementary modules (2 modules, 7.0 credits)

Module Code	Module Name	Credit
NXC4012	Mechanical Modelling	3.5 credits
NXC4008	Engineering Design Methods	3.5credits

B. Discipline core modules (22 modules, 79.0credits)

Module Code	Module Name	Credit
NXC4122	Thermodynamics and Fluid Mechanics	3.5 credits
QXU4000	MS 1 Structure and Properties	3.5 credits
QXU4001	Molecules to Materials	3.5 credits
QXU4006	MS 2 Processing and Applications	3.5 credits
NXC4010	Introduction to Functional Materials	3.5 credits
QXU4011	Introduction to Engineering Materials	4.0 credits
QXU4007	Experiments in Materials 1	3.5 credits
QXU5017	Experiments in Materials 2	3.5 credits
QXU5010	Surfaces and Interfaces	3.5 credits
QXU5031	Polymer Chemistry	4.0 credits
QXU5032	Physical Properties of Polymers	4.0 credits

NXC5013	Polymer Characterisation	3.5 credits
NXC5014	Elastomer Materials	3.5 credits
NXC5028	Polymer Degradation	3.5 credits
QXU5030	Composite Materials	3.5 credits
QXU6002	Materials Selection in Design	4.0 credits
QXU6007	Environmental Properties of Materials	3.5 credits
NXC6018	Polymer Processing	4.0 credits
NXC6019	Failure of Polymers	3.0 credits
NXC6020	Polymer Product Design	3.0 credits
QXU6034	Functional Polymers	3.5 credits
QXU7033	Advanced Polymer Synthesis	4.0 credits

(3) Comprehensive literacy modules (6.0 credits, at least 4 modules, students are suggested to choose English taught modules)

A. Scientific literacy modules: subjects on natural science such as introduction to aeronautics, astronautics and navigation, environment, biology, etc. Students must take one module among "An Introduction to Aviation", "An Introduction to Astronautics", and "An Introduction to Marine Navigation". Computer fundamentals are a compulsory module.

B. Modules on economics, management and law: including economy, management, legal education, etc.

C. Humanities modules: including philosophy, ethics, history, culture, language, literature, society, aesthetics, life and development, etc.

D. Art literacy modules: students can choose modules form "An Introduction to Art", "Music Appreciation", "Art Appreciation", "Film Appreciation", "Drama Appreciation", "Dance Appreciation", "Calligraphy Appreciation", and "Chinese Opera Appreciation", among which "The Presentation of the Art of Peking Opera" is compulsory.

It is suggested that students should choose English taught modules, from all four categories above. Each module offered in each semester will be included in the course selection manual.

(4) Comprehensive practices (2 modules, 9.0 credits)

A. Design for graduation (1 module, 8.0 credits)

Module Code	Module Name	Credit
QXU6035	Polymer Project	8.0 credits

B. Scientific research project modules（1.0 credit）

Students can participate in a variety forms of scientific research training including innovative research programmes, academic competition, innovative and business training plan for college students, academic competitions, “Peak Experience Plan”, social research, and scientific research project. Students are encouraged to participate in a variety forms of central practice such as overseas practice, international internship, winter and summer camp.

Curriculum Modules and Credits Table

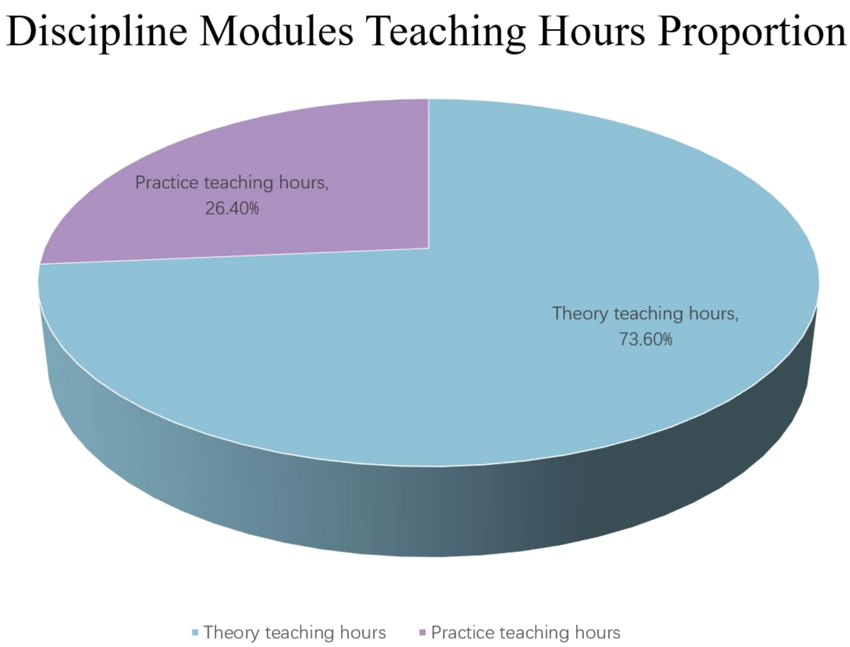
Module	Code of Course	Name of Course	Credit/ Hour	Test Approach		Hour Distribution		Hour Distribution for Semesters							
				Exam √	Test√	Teach	Practice (Computer)	1st	2nd	3rd	4th	5th	6th	7th	8th
General education	**General education**														
	NXC2001	Chinese Compulsory Modules I Essentials of Chinese Modern History	48/3.0	√		48			48/3.0						
	NXC2002	Chinese Compulsory Modules II Marxism General Principle	48/3.0	√		24	24		48/3.0	32/2.0					
	NXC2003	Chinese Compulsory Modules III Ethics and Fundamental of Law	48/3.0	√		24	24			48/3.0					
	NXC2004	Chinese Compulsory Modules IV Fundamental of Mao Ze Dong Thoughts	80/5.0	√		40	40				80/5.0				
	NXC2005	Situation and Policy	32/2.0		√	32				32/2.0					
	U34G11002	Military Theory	32/2.0	√		32		32/2.0							
	U34P41001	Military Training	16/1.0		√			3w/1.0							
	U34G11001	Students Mental Health Education	8/0.5	√			8	Select under the guidance of tutor							
	QXU3111	PDP I	56/3.5		√	56		24/1.5	32/2.0						
	QXU4111	PDP II	56/3.5		√	56				24/1.5	32/2.0				
	QXU5111	PDP III	56/3.5		√	56						24/1.5	32/2.0		
	QXU3101	English Language I	56/3.5		√	56		56/3.5							
	QXU3102	English Language II	88/5.5		√	88			88/5.5						
	U34G11002	Physical Education I	32/1.0	√			32	32/1.0							
	U34P41001	Physical Education II	32/1.0	√			32		32/1.0						
	U31G71001	Physical Education III	32/1.0	√			32			32/1.0					
	U31G71002	Physical Education IV	32/1.0	√			32				32/1.0				
	NXC3000	Advanced Maths I	88/5.5	√		78	10	88/5.5							
	NXC3004	Advanced Maths II	88/5.5	√		88			88/5.5						
	NXC3001	General Physics	82/5.0	√		50	32	50/3.0	32/2.0						
	NXC3002	Linear Algebra	48/3.0	√		48		48/3.0							
	NXC3005	Mathematical Modelling and Computing	64/4.0	√		40	24		64/4.0						
		Total	1122/66.0												
Discipline	Discipline														
	NXC4012	Mechanical Modelling	56/3.5	√		46	10			56/3.5					
	NXC4008	Engineering Design Methods	56/3.5	√		40	16			56/3.5					
	NXC4122	Thermodynamics and Fluid Mechanics	56/3.5	√		56					56/3.5				
	QXU4000	MS 1 Structure and Properties	56/3.5	√		56				56/3.5					
	QXU4001	MS 2 Processing and Applications	56/3.5	√		56					56/3.5				
	QXU4006	Molecules to Materials	56/3.5	√		56					56/3.5				

	NXC4010	Introduction to Functional Materials	56/3.5	√		40	16			56/3.5					
	QXU4011	Introduction to Engineering Materials	64/4.0	√		48	16	24/1.5	40/2.5						
	QXU5010	Surfaces and Interfaces	56/3.5	√		48	8					56/3.5			
	QXU5031	Polymer Chemistry	64/4.0	√		56	8					64/4.0			
	QXU5032	Physical Properties of Polymers	64/4.0	√		56	8					64/4.0			
	NXC5013	Polymer Characterisation	56/3.5	√		40	16						56/3.5		
	NXC5014	Elastomer Materials	56/3.5	√		40	16						56/3.5		
	NXC5028	Polymer Degradation	56/3.5	√		40	16					56/3.5			
	QXU5030	Composite Materials	56/3.5	√		56							56/3.5		
	QXU6002	Materials Selection in Design	64/4.0	√		48	16							64/4.0	
	QXU6007	Environmental Properties of Materials	56/3.5	√		56									56/3.5
	NXC6018	Polymer Processing	64/4.0	√		54	10							64/4.0	
	NXC6019	Failure of Polymers	48/3.0	√		40	8							48/3.0	
	NXC6020	Polymer Product Design	48/3.0	√		40	8								48/3.0
	QXU6034	Environmental Properties of Materials	56/3.5	√		56									56/3.5
	QXU7033	Advanced Polymer Synthesis	64/4.0	√		48	16							64/4.0	
	QXU4007	Experiments in Materials 1	56/3.5	√			56			56/3.5					
	QXU5017	Experiments in Materials 2	56/3.5	√			56						56/3.5		
		Total	1376/86.0												
Comprehensive literacy (Elective courses)	Comprehensive literacy														
	U01L11001	An Introduction to Aviation	NPU and QMES elective courses are available for students, including comprehensive development courses. Each semester courses can be checked on course-election handbook.												
	U02L11001	An Introduction to Astronautics													
	U03L11001	An Introduction to Marine Navigation													
	U30L11001	An Introduction to Art													
	U30L11002	Music Appreciation													
	U30L11007	Drama Appreciation													
	U30L11003	Art Appreciation													
	NXC1004	Fundamentals of Computer													
	NXC1005	Inorganic Chemistry													
	NXC1006	Fundamentals of Organic Chemistry													
	NXC1007	Physical Chemistry													
	NXC1008	3D Print													
	…	…													
		Total	96/6.0												
Comprehensive practice	Comprehensive practice														
	QXU6035	Polymer Engineering Project	128/8.0		√		128								128/8.0
		Scientific Research	16/1.0	Participate under the guidance of tutor											
		小计	144/9.0												
Total hours / total credits	**2738/167.0**														

Reference: Code QX courses are taught by QMUL. Code NX courses are taught by NPU. Code U courses are Chinese Compulsory Courses, Mental Health Military Theory courses from MoE, as well as some elective courses.

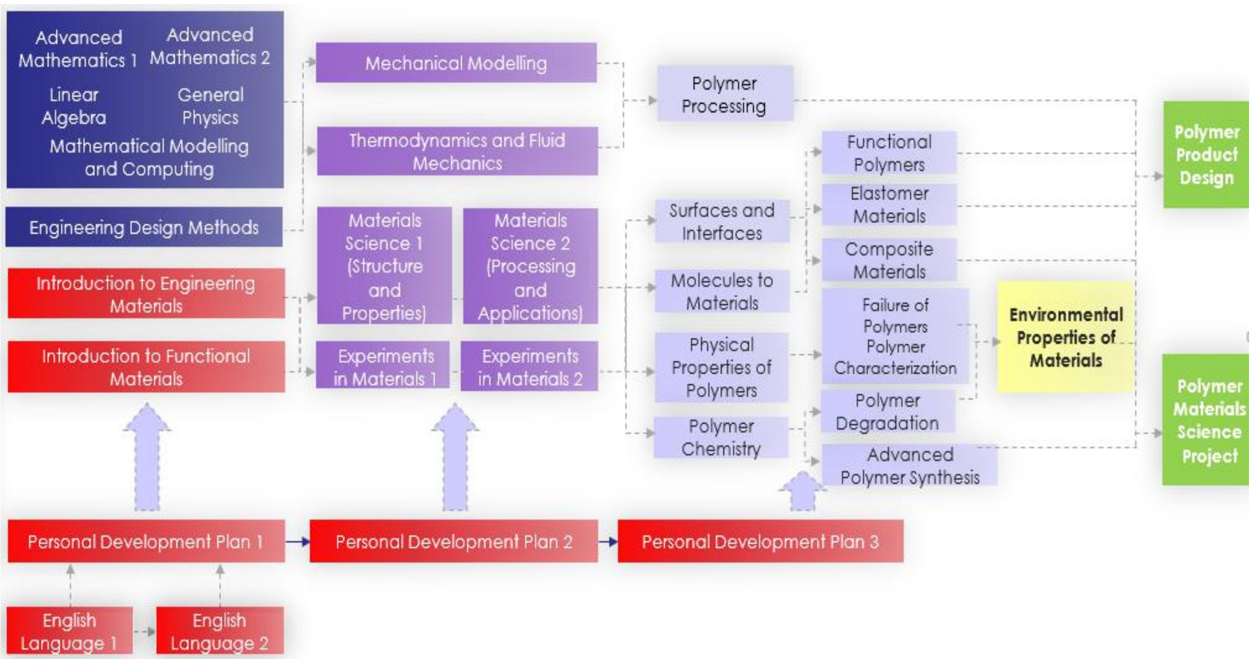
8. Mode of Teaching

Taking the use of Britain's high education concept to cultivate innovative bachelor talents for reference, multiple education modes are practiced, such as theory teaching, experiment teaching, case study, comprehensive application and open-experimental instruction, in all modules except for Chinese Compulsory and PE courses. Rather than relying on the traditional reception teaching, we adopt the student-centred teaching mode, which highlights on fostering students' ability of self-study, problem-solving and hands-on practice. JEI programmes intend to motivate students' inner impetus, discover their interests for knowledge and cultivate their lifelong learning as well as working ability.



9. Curriculum Logical Diagram

In accordance with the aim "to develop qualified and innovative talents who can study and work transnationally with the knowledge of natural science, materials science and engineering, and social science. Students graduate with comprehensive qualities, high professional competencies, a global horizon, a life-long study ability, and the recognition to international rules", major courses are divided into several modules, support and linked with each other, emphasizing on principle specialty, meeting the education standard of professional, composite and entrepreneurial talents.



Polymer Materials and Engineering (QMUL Engineering School, NPU) Curriculum Syllabus

(Arranged by previous modules in order)

Module title	Personal Development Plan 1
Summary Information	
Module Code	QXU3111
Class Hours/Credit(CN/UK)	56 hours/3.5 credits/15 credits
Responsible Institution	QMUL
Opening Semester	Fall & Spring
Teaching Profile	56 hours of seminars - 25 x 2 hrs seminars + 6 hours lectures = 56 hrs
Course Type	Technical
Textbook and References	Cottrell, S. (2010) Skills for success: personal development planning and employability. New York; Palgrave Macmillan Cottrell, S. (2008) The study skills handbook. New York; Palgrave Macmillan Hepworth, A. (2013) How to study at university and college: using personal development planning and how to prepare for employment. Lancashire; Universe of Learning Smale, B and Fowlie, J. (2009) How to succeed at university: an essential guide to academic skills and personal development. London; Sage.
Textbook	
References/Articles	
Course Description	The Personal Development Plan (PDP) modules provide a structured and supported process undertaken by individual students to reflect upon their own learning, performance and/or achievement and to plan for their personal, educational and career development. The emphasis of the PDP programme, which is designed specifically for the Joint Programme (JP) is compulsory for all JP students, is to enable them to improve their

	general skills for study and career management, and to relate their learning to a wider context. In addition to the academic subject content, the JP in Materials Science and Engineering at NPU will develop students as independent learners and lay a solid foundation for their subsequent professional development. Academic and professional development includes knowledge, understanding and skills, each of which underpins a set of activities. These are tailored to the JP and developed in conjunction with lecturers delivering the programme's academic content. The underlying knowledge, understanding and skills include: Academic skills and techniques; Communication and interpersonal skills; Responsibility, leadership and management skills; Academic and professional conduct.
Course Arrangement (Chapters/hours)	
Semester 1	
Week 1	
Course Overview (2 hrs)	Course introduction – welcome and essential course information, learning outcomes and objectives
Week 2	
Effective Time Management	Essential Study Skills - SMART targets, time management
Week 3	
Academic Register	Introduction to formal English register, nominalisation and passive voice
Week 4	
Developing Vocabulary	Methods for developing academic vocabulary, including parts of speech, dependent prepositions, collocations
Week 5	
Effective Presentations (1)	Structure and organisation / delivery and visual aids. Assessment task: Prepare group presentations on evaluation of existing materials (week 7)
Week 6	
Effective Presentations (2) Producing visual aids / dealing with questions (2 hrs)	Producing visual aids / dealing with questions / dealing with nerves
Presentation Practice	Practicing structuring and organising effective

	presentations
Week 7	
Short Writing Task PORTFOLIO	Assess the potential solutions for the reduction of carbon emission. Practice with referencing / bibliographies; and synthesis
Week 8	
Effective Lecture Comprehension (2)	Study listening. Structure and organisation. Signposting language. Staging and signal language. Taking effective notes, asking questions. Post lecture work -study groups to consolidation comprehension.
Week 9	
Effective Lecture Comprehension (1)	Study listening. Pre lecture preparation. Synopsis'. Making predictions.
Week 10	
Overview of Referencing and citation	Why do we do it? Why is it important? Key features.
Week 11	
Assessment	Group presentations
Week 12	
Assessment	Group presentations
Final Overview (3 hrs)	Review of semester 1 – projection to semester 2
Semester 2	
Week 1	
Welcome back	Overview and introduction to semester 2
Week 2	
Seminar Participation 1	Identify the features of successful university seminars; focus on the functional language typically used in academic seminars
Week 3	
What is an academic argument?	Claim, premises, outcome. Structuring effective academic arguments.
Week 4	
Seminar Participation 2	Practise putting forward and justifying a point of view; practise taking part in an academic discussion in a panel format / practise leading a seminar discussion, producing handouts / stimulating discussion
Week 5	
Study skills – approach to	Searching for information. Assessing reliability,

research	authority, credibility. Accessing databases. Focus of databases available to Materials Science students.
Week 6	
Experimental design	Designing and occupying a research space. Considering variables and sample selection.
Week 7	
Overview of gathering quantitative data	Focus on designing experimental questionnaires
Week 8	
Discussion language	Turn taking, offering opinions, groups discussions and debates
Week 9	
Research pro-seminars	Structure and content organisation. Task overview.
Week 10	
Assessment	Group presentations
Week 11	
Assessment	Group presentations
Week 12	
Review of semester. Looking forward to next year	Feedback, course summary, overview of year 2
Final Overview (3 hrs)	Review of semester 1 – projection to semester 2
Experimental & Practical Section	N/A
Hours	Contents
Learning Outcomes	
	Public speaking and presentation skills, including use of presentation tools, such as Microsoft Powerpoint or others, to research and present on a range of current topics. Production of video on a range of topics, providing students with the opportunity to be creative and precise in the key messages they wish to convey.
	Critical thinking, especially in reading and writing, and production of evidenced judgements.
	Interpretation and evaluation of data from various sources for use in specific academic tasks.
	Use of oral, written and electronic methods for the communication for subject specific information
	Effective team-working with fellow students
Other Information	

Assessment Profile	
Grading Policy	
Coursework	60% coursework - project
Practical experiments	40% oral presentation
Examination (written)	

Module title	Personal Development Plan 2
Summary Information	
Module Code	QXU4111
Class Hours/Credit(CN/UK)	56 hours/3.5 credits/15 credits
Responsible Institution	QMUL
Opening Semester	Fall & Spring
Teaching Profile	56 hours of seminars - 25 x 2 hrs seminars + 6 hours lectures = 56 hrs
Course Type	Technical
Textbook and References Textbook	Cottrell, S. (2010) Skills for success: personal development planning and employability. New York; Palgrave Macmillan Cottrell, S. (2008) The study skills handbook. New York; Palgrave Macmillan Hepworth, A. (2013) How to study at university and college: using personal development planning and how to prepare for employment. Lancashire; Universe of Learning Smale, B and Fowlie, J. (2009) How to succeed at university: an essential guide to academic skills and personal development. London; Sage.
References/Articles	
Course Description	The Personal Development Plan (PDP) modules provide a structured and supported process undertaken by individual students to reflect upon their own learning, performance and/or achievement and to plan for their personal, educational and career development. The emphasis of the PDP programme, which is designed specifically for the Joint Programme (JP) is compulsory for all JP students, is to enable them to improve their general skills for study and career management, and to relate their learning to a wider context. In addition to the academic subject content, the JP in Materials Science and Engineering at NPU will develop students as independent learners and lay a solid foundation for their subsequent professional development. Academic and professional development includes knowledge, understanding and skills, each of which underpins a set of activities. These are tailored to the JP and developed in conjunction with lecturers delivering the programme's academic content. The underlying knowledge, understanding and skills

	include: Academic skills and techniques; Communication and interpersonal skills; Responsibility, leadership and management skills; Academic and professional conduct.
Course Arrangement (Chapters/hours)	
Semester 1	
Week 1	
Course Overview (2 hrs)	Course introduction – welcome and essential course information, learning outcomes and objectives
Week 2	
Effective Study Management	Essential Study Skills - NEW SMART targets, maintaining discipline
Week 3	
Advanced Academic Register	Advanced formal English register
Week 4	
Expanding advanced Vocabulary	Further methods for developing academic vocabulary
Week 5	
Presenting research findings (1)	Structure and organisation / delivery and visual aids. Describing results and procedures
Week 6	
Presenting research findings (2)	Discussing results and conclusions
Presentation Practice	Practicing structuring and organising effective presentations
Week 7	
Short Writing Task PORTFOLIO	Assess the validity of research findings
Week 8	
Effective Lecture Comprehension (3)	Developing advanced lecture comprehension
Week 9	
Effective Lecture Comprehension (4)	Developing advanced lecture comprehension
Week 10	

Advanced Referencing and citation	Footnoting system and cross referencing
Week 11	
Assessment	Group presentations
Week 12	
Assessment	Group presentations
Final Overview (3 hrs)	Review of semester 1 – projection to semester 2
Semester 2	
Week 1	
Welcome back	Overview and introduction to semester 2
Week 2	
Seminar Participation	Peer reviewing research proposals
Week 3	
Advanced academic argument?	Generating supported positions and stances
Week 4	
Seminar Participation 2	Reviewing the efficacy and legitimacy of broad and narrow research spaces
Week 5	
Accessing databases	Accessing databases. Focus of databases available to Materials Science students.
Week 6	
Advanced experimental design	Designing quantative research tools
Week 7	
Experimental procedures	Focus on designing experimental procedures
Week 8	
Developing Discussion language	Turn taking, offering opinions, groups discussions and debates
Week 9	
Research pro-seminars	Structure and content organisation. Task overview.
Week 10	
Assessment	Group presentations
Week 11	
Assessment	Group presentations
Week 12	
Review of semester. Looking forward to year 3	Feedback, course summary, overview of year 2
Final Overview (3 hrs)	Review of semester 1 – projection to semester 2
Experimental & Practical	N/A

Section	
Hours	Contents
Learning Outcomes	
	Public speaking and presentation skills, including use of presentation tools, such as Microsoft Powerpoint or others, to research and present on a range of current topics. Production of video on a range of topics, providing students with the opportunity to be creative and precise in the key messages they wish to convey.
	Critical thinking, especially in reading and writing, and production of evidenced judgements.
	Interpretation and evaluation of data from various sources for use in specific academic tasks.
	Use of oral, written and electronic methods for the communication for subject specific information
	Effective team-working with fellow students
Other Information	
Assessment Profile	
Grading Policy	
Coursework	60% coursework - project
Practical experiments	40% oral presentation
Examination (written)	

Module title	Personal Development Plan 3
Summary Information	
Module Code	QXU5111
Class Hours/Credit(CN/UK)	56 hours/3.5 credits/15 credits
Responsible Institution	QMUL
Opening Semester	Fall & Spring
Teaching Profile	28 hours of lectures, 28 hours of seminars
Course Type	Technical
Textbook and References	
Textbook	
References/Articles	
Course Description	The Personal Development Plan (PDP) modules provide a structured and supported process undertaken by individual students to reflect upon their own learning, performance and/or achievement and to plan for their personal, educational and career development. The emphasis of the PDP programme, which is designed specifically for the Joint Programme (JP) is compulsory for all JP students, is to enable them to improve their general skills for study and career management, and to relate their learning to a wider context. In addition to the academic subject content, the JP in Materials Science and Engineering at NPU will develop students as independent learners and lay a solid foundation for their subsequent professional development. Academic and professional development includes knowledge, understanding and skills, each of which underpins a set of activities. These are tailored to the JP and developed in conjunction with lecturers delivering the programme's academic content. The underlying knowledge, understanding and skills include: Academic skills and techniques; Communication and interpersonal skills; Responsibility, leadership and management skills; Academic and professional conduct.
Course Arrangement (Chapters/hours)	
1.	
2.	
3.	
4.	
5.	

6.	
7.	
8.	
9.	
10.	
11.	
Experimental & Practical Section	N/A
Hours	Contents
Learning Outcomes	
	Public speaking and presentation skills, including use of presentation tools, such as Microsoft Powerpoint or others, to research and present on a range of current topics. Production of video on a range of topics, providing students with the opportunity to be creative and precise in the key messages they wish to convey.
	Critical thinking, especially in reading and writing, and production of evidenced judgements.
	Interpretation and evaluation of data from various sources for use in specific academic tasks.
	Use of oral, written and electronic methods for the communication for subject specific information
	Effective team-working with fellow students
Other Information	
Assessment Profile	
Grading Policy	
Coursework	60% coursework - project
Practical experiments	40% oral presentation
Examination (written)	

Module title	Introduction to Engineering Materials
Summary Information	
Module Code	QXU4011
Class Hours/Credit(CN/UK)	64 hours/4 credits/15 credits
Responsible Institution	QMUL
Opening Semester	Fall & Spring
Teaching Profile	40 hours lectures, 16 hours tutorials, 8 hours seminars
Course Type	Technical
Textbook and References Textbook	Michael F Ashby & D. R, H. Jones (2012). Engineering materials. 1, An introduction to their properties, applications and design. 4th. Butterworth-Heinemann. Michael F Ashby & D. R, H. Jones (2012). Engineering materials. 2, An introduction to microstructures and processing. 4th. Butterworth-Heinemann. James Newell (2009). Essentials of modern materials science and engineering, John Wiley & Sons
References/Articles	N/A
Course Description	This module provides an introduction to the materials used in engineering design, classes of materials, understanding material properties and how this relates to the structure and how properties depend upon the processing route employed. The course will provide a framework for a suitable selection of materials developing problem solving skills and team working skills in applications that are relevant to aerospace, mechanical and general engineering. The context of engineering materials in terms of global issues and future challenges is introduced.
Course Arrangement (Chapters/hours)	
Chapter 1 / 2 hours	Global issues in Materials Science
	Impact of materials in society Global challenges and materials solutions
Chapter 2 / 6 hours + 8 hours seminars	Introduction to Materials Science
	Material behaviour: i) Classes of materials and how they come about (i.e. bonding) ii) Types of properties – mechanical, thermal,

	electrical, optical iii) Methods of processing – melting/casting, deformation/forming, fabrication, assembly
Chapter 3 / 10 hours	Structure-property relations:
	Relationship between structure properties and processing: i) Why the differences between materials? Atomic bonding – leads to mechanical, electrical, thermal props, processing / processability ii) Properties depend on microstructure as well as composition – related to processing iii) Difference between strength, stiffness and toughness. Shape factors in design – link to mechanics and modelling iv) Outline of failure mechanisms, fracture, creep, fatigue, wear (lifetime – from Engineering perspective i.e. design constraints of lifetime and inspection – not mechanisms of failure)
Chapter 4 / 6 hours	Product design issues
	Product design (introductory ideas only) i) Functionality ii) Ergonomics and marketability of products iii) Innovation and business strategy iv) The value chain – design, manufacture, marketing
Chapter 5 / 2 hours	Case study examples
	Everyday products that use a combination of materials and manufacturing methods
Chapter 6 / 10 hours	Engineering design limited by material properties
	Examples of application limited by material properties i) Stiffness ii) Stress iii) Thermal properties iv) Temperature v) Weight
Chapter 7 / 4 hours	Societal issues in materials engineering
	Sustainable engineering i) Impact on society – changes in lifestyle, impact on quality of life

	ii) Financial impact – cost effectiveness of solution iii) Environmental impact – total energy budget, life cycle analysis
Experimental & Practical Section	
Hours / 16 hours	Deconstruction of everyday product
	Group exercise on selected product i) Materials selection ii) Manufacturing methods iii) Product evaluation
Learning Outcomes	
	To enable students to understand why different materials exhibit specific key structural properties. To educate students about the most significant routes of manufacturing components using a wide range of different (metallic, polymer, composite and ceramic) materials. To educate students in strategies to be creative, to process ideas and to work successfully in a team environment. To develop analytical skills that allow students to examine and evaluate engineering problems. To develop strategies that will enable students to solve demanding design led problems in the field of Engineering.
Other Information	
Assessment Profile	
Grading Policy	
Coursework	20%
Practical experiments	
Examination (written)	80%

Module title	Introduction to Functional Materials
Summary Information	
Module Code	NXC4010
Class Hours/Credit(CN/UK)	56 Hours/3.5 credits/15 credits
Responsible Institution	NPU
Opening Semester	Fall
Teaching Profile	40 hours Lectures / 16 hours tutorial example classes
Course Type	Technical
Textbook and References	Deborah D L Chung (2010), Functional Materials: Electrical, Dielectric, Electromagnetic, Optical and Magnetic Applications World Scientific Publishing, ISBN-13: 978-9814287166
Textbook	
References/Articles	
Course Description	Introducing functional materials, including insulators, piezoelectrics, pyroelectrics, microwave dielectrics and electro-optical ceramics; ionic conductors for fuel cells; semiconductors and the basics of LED, solar cell and laser devices; organic electronics; superconductors; shape memory alloys and magnetic materials.
Course Arrangement (Chapters/hours)	
Chapter 1: / 5 hours	Elementary quantum mechanics: electronic structure of the atom, confined states, density of states, photon, phonon and plasmon interactions
Chapter 2: / 5 hours	Elementary Solid State Science: The arrangement of ions in ceramics, spontaneous polarisation, transitions, defects in crystals, electrical conduction, quantum conduction and tunnelling, polarisation mechanisms, thermal conduction
Chapter 3: / 4 hours	Basis of diodes and transistors, current / voltage characteristics, fermi-level, Boltzmann temperature effects, concept to dielectric, semi-conduction and conduction
Chapter 4: / 4 hours	Ceramic Conductors: High-temperature heating elements, Ohmic resistors, varistors, fast-ion conductors, gas sensors, superconductors

Chapter 5: / 4 hours	Dielectrics and Insulators: Background, dielectric strength, capacitors, low-er ceramics, medium-er ceramics, high-permittivity ceramics
Chapter 6: / 4 hours	Piezoelectrics: Background, piezoelectric parameters, PZT and other important commercial piezoelectrics, applications
Chapter 7: / 4 hours	Pyroelectrics: Background, IR detection, thermos-electrics including polymers?
Chapter 8: / 4 hours	Magnetic materials: Background, ferrites, magnetic properties, processing ferrites, applications
Chapter 9: / 4 hours	Electro-Optic materials: Background, PLZT, applications including polymers
Chapter 10: / hours	New materials: smart materials, multiferroics
Experimental & Practical Section	
Hours: 16 hours	Coursework – exercises in practice calculation (computer software) and recognising behaviour (I-V characteristics. Read and report some classic articles.
Learning Outcomes	
Other Information	
Assessment Profile	
Grading Policy	100 grades
Coursework	20%
Practical experiments	
Examination (written)	80%

Module title	English Language 1
Summary Information	
Module Code	QXU3101
Class Hours/Credit(CN/UK)	56 hours/3.5 credits
Responsible Institution	QMUL
Opening Semester	Fall
Teaching Profile	Lectures + Seminars = 56 hours 1 introductory session x 2hrs + 36 sessions x 1.5 hrs = 56 hours
Course Type	Technical
Textbook and References Textbook	Bailey, S. (2006) Academic Writing: A Handbook for International Students (2nd Edition). Abingdon: Routledge. Cottrell, S. (2008) The Study Skills Handbook (3rd Edition). London: Palgrave Study Guides Dunn, M., Howey, D. &Ilic, A. (2014) English for Mechanical Engineering in Higher Education. Reading: Garnet. Gillett, A., Hammond, A. &Martala, M. (2009) Inside Track to Successful Academic Writing. London: Pearson Education. Lynch, T. (2004) Study Listening: Understanding Lectures and Talks in English (2nd Edition). Cambridge: CUP McCarter, S. & Jakes, P. (2009) Uncovering EAP. Oxford: Macmillan. Oshima, A. & Hogue, A. (2006) Writing Academic English (4th Edition). London: Longman. Smith, R. H. C. (2014) English for Electrical Engineering in Higher Education. Reading: Garnet Wallace, M.J. (2004) Study Skills in English. Cambridge: CUP
References /Articles	
Course Description	The JP in Materials Science and Engineering at NPU will be taught in English. This module will develop the English language skills of students on the JP, extending them and ensuring that students are capable of meeting the demands of studying and being examined in English. The module will develop students' receptive skills of reading and listening, as well as the productive skills of spoken and written

	English, and will offer practice in formal and informal communication, using presentations, essays and English clubs. There will be an emphasis on scientific English.
Course Arrangement (Chapters/hours)	
Week 1	
1.Welcome and introduction to course (2hrs)	Course overview. Introduction to Portfolios Demonstration of QM Plus / QMHub. Demonstration of making a portfolio page / uploading materials
2. Adjusting to UK style studying	Note taking and class discussion on lecture topic: Looking ahead. SMART analysis for students.
3. Typical Problems for Chinese Learners	Challenges for Chinese Students taking a subject degree in English
Week 2	
4. Assessment Preparation	Focus on short answer questions for assessment – approaches and techniques
5. Tackling Assessment tasks	In class practice on exam taking techniques / answering SAQ's
6. Taking a Critical Thinking Approach	Blooms Taxonomy. Approaches to critical thinking and evaluation
Week 3	
7. Lecture Comprehension Academic Listening & Note-taking	Materials Science can Save the World A lecture on the significance and history of Materials Science. Develop academic lectures listening; note taking skills: Cornell Method
8. Precision in English	Accuracy in Writing: The mechanics of English. Precision in writing – overview of written accuracy, mechanics of sentence/lesson on parts of speech and sentence structure
9. What does it mean to Know a Word?	Knowing a word: (including affixes, connotation, etc. exercises); Noun phrases/prep phrases + punctuation; Vocab – consolidation of noun phrases and cohesive devices
Week 4	
10. Hunting the Elements	Periodic Success- The Hidden Beauty of the Periodic Table
11. What makes good academic	What makes good Academic Writing? A two-part

writing?	lesson. Part 1: Analysing different text types/styles and features of academic writing
12. Knowing Parts of Speech	What Makes Effective Academic Writing (2): The Mechanics of English GOOD GRAMMAR – An ability to construct effective, accurate sentences.
Week 5	
13. The Language of Computing	Concepts and vocabulary explored through the computing language. Application and function to materials science students and researchers.
14. The Language of Computing	Task based activation of concepts and vocabulary explored through the medium of computing language. Application and function to materials science students and researchers.
15. The language of Mathematics	Task based activation of concepts and vocabulary explored through the medium of mathematics. Application and function to materials science students and researchers through past papers and practical exercises
Week 6	
16. The language of Electrical Techniques	Concepts and vocabulary explored through the electrical techniques. Application and function to materials science students and researchers.
17. The language of Electrical Techniques	Task based activation of concepts and vocabulary with a focus on electrical techniques. Application and function to materials science students and researchers through past papers and practical exercises
18. Computers, Electronics and Mathematics	Review and consolidation of week's materials and concepts. Mini project work.
Week 7	
19. Focus on Lifecycle Assessment Introduction of Portfolio Task	What is lifecycle assessment? Lecture covering the basic concepts regarding lifecycle assessment
20. Writing definitions and describing	Case Study of LCA Preparation for PORTFOLIO TASK – conduct an LCA that describes and assesses the lifecycle of a product
21: Describing objects and materials	Describe objects and materials, classify materials and describe processes. The latter will be further unpacked in semester 2 basic language and activities to ensure clarity and accuracy in students'

	descriptions
Week 8	
22. Describing a process	Focus on description language, logical order, accuracy in and brevity in definition writing
23. Describing a process	Make notes – produce a set of instructions describing the test procedure/treatment process
24. Descriptive writing	Technical language for describing a process
Week 9	
25. Understanding the carbon Footprint	What is your Carbon Footprint? Overview of synthesis and approaches to research. Bringing ideas together.
26. Using Sources	Reading as a conversation to develop critical reading skills/ consider the sources students are reading at the moment and how they interact/differentiate between text types, authority and credibility/practice in synthesising students' current module readings
27. Interacting with sources (synthesis)	Developing the skills of text interaction – paraphrasing and summarising. Formal academic register.
Week 10	
28. Reducing our Carbon Footprint	Assessing the various approaches to climate change prevention and carbon footprint reduction
29. Introduction to paraphrasing and summarising	Reporting verbs, facts vs opinion, commentary and synthesis
30. Intro to referencing & Citation	Introduction to referencing and citation – Vancouver reporting verbs/boosting voice/hedging. Introduction to referencing & citation. Vancouver reporting verbs / boosting voice / hedging
Week 11	
31: Portfolio task	Short writing task – PORTFOLIO – Assess the potential solutions for the reduction of carbon emissions. Review extracts from various sources which discuss approaches to climate change and the reduction of the carbon footprint.
32: Assessment – Group Presentations	Group Presentations. Group presentations on prepared academic topic
33. Assessment – Group Presentations	Group Presentations. Group presentations on prepared academic topic
Week 12	
34: Short Writing Task –PORTFOLIO Video: Profiles	Scientists vs Engineers Debate; Group discussion in response to short extracts from a variety of sources

of scientists and engineers	
35. Review and consolidation	Review of semester, feedback and tutorials
36: Review and consolidation	Review of semester, feedback and tutorials
37: Review and consolidation	Review of semester, feedback and tutorials
Experimental & Practical Section	N/A
Hours	Contents
Learning Outcomes	
	English language ability at a level to lead to competence in meeting the requirements of the joint degree programme: QMUL BEng in Materials Science and Engineering and NPU BEng degree.
	Specific focus on scientific lexis in order to enhance academic performance in the joint degree programme.
	Read critically and show ability to evaluate sources and to formulate ideas in writing
	Understand and explain technical characteristics and complex ideas.
	Participate in, and to an intermediate level, lead academic discussions based on readings.
Other Information	
Assessment Profile	
Grading Policy	
Coursework	Written assignment (1200 words) 60% Portfolio - 4 pieces of work including reading, speaking, writing and listening (1000 words) 40%
Practical experiments	
Examination (written)	

Module title	English Language 2
Summary Information	
Module Code	QXU3102
Class Hours/Credit(CN/UK)	88 hours/3.5 credits
Responsible Institution	QMUL
Opening Semester	Spring
Teaching Profile	Lectures + Seminars = 88 hours *44 lectures + 44 hours seminars 1 introductory lecture session x 2.5 hrs + Final lecture 2 hrs + 14 TA Sessions x 2hrs + 37 sessions x 1.5 hrs = 88 hours
Course Type	Technical
Textbook and References	
Textbook	Bailey, S. (2006) Academic Writing: A Handbook for International Students (2nd Edition). Abingdon: Routledge. Cottrell, S. (2008) The Study Skills Handbook (3rd Edition). London: Palgrave Study Guides Dunn, M., Howey, D. &Ilic, A. (2014) English for Mechanical Engineering in Higher Education. Reading: Garnet. Gillett, A., Hammond, A. &Martala, M. (2009) Inside Track to Successful Academic Writing. London: Pearson Education. Lynch, T. (2004) Study Listening: Understanding Lectures and Talks in English (2nd Edition). Cambridge: CUP McCarter, S. & Jakes, P. (2009) Uncovering EAP. Oxford: Macmillan. Oshima, A. & Hogue, A. (2006) Writing Academic English (4th Edition). London: Longman. Smith, R. H. C. (2014) English for Electrical Engineering in Higher Education. Reading: Garnet Wallace, M.J. (2004) Study Skills in English. Cambridge: CUP
References/Articles	
Course Description	The JP in Materials Science and Engineering at NPU will be taught in English. This module will develop the English language skills of students on the JP, extending them and ensuring that students are capable of meeting the demands of studying and being examined in English. The module will develop students' receptive skills of reading and listening, as well as the productive skills of spoken and written English, and will offer practice in formal and

	informal communication, using presentations, essays and English clubs. There will be an emphasis on scientific English.
Course Arrangement (Chapters/hours)	
Week 1	
1. Welcome Back (2.5 hrs)	Course overview and objectives. Overview of Portfolios / QM Plus / QMHub
2. Writing for Science Subjects; characteristics of scientific writing	Review: Writing in science subjects is characteristically conventional. This means that scientific writing follows strict rules with regard to a number of issues [Northedge, A: The Science Good Writing Guide]
3. What Makes Good Scientific Academic Writing?	Analysing different text types / styles and features of academic writing
4. TA Seminar	Weekly consolidation and practice
Week 2	
5. Different Genres of Academic writing	Cause and effect writing / descriptive writing / report writing – common features / differences & similarities
6. Introduction to Report Writing	Report Writing as a Genre. Key differences between a report and an essay. Reports vs essays [Gillett, Hammond, Martala: Inside Track Successful Academic Writing pp 226/227]
7. Precision in materials science writing	Choosing the right words/level of detail/ambiguity [Alley, M: Scientific Writing]
8. TA Seminar	Weekly consolidation and practice
Week 3	
9. Scientific Argument and Evidence	Breakthrough in renewable energy. (Part focused on the proactive Chinese response) Class discussion: what is the best response to climate change? What more can be done?
10. Evaluating evidence	Using Evidence in Academic Writing: Avoiding Plagiarism. Recognising and forming an argument/purpose of an argument/distinguish between arguments, description, explanation, etc.
11. Supporting your points – facts and opinions	Separating fact from opinion. Evaluating arguments. Useful argumentative signposting language. Teamwork: Prep for group discussion in T/A
12. TA Seminar	Weekly consolidation and practice
Week 4	
13. Writing the report	Structure of reports/organisation of reports/IMRAD system [Gillett, Hammond, Martala: Inside Track

	Successful Academic Writing pp 226/227]
14. Referencing Literature	Literature presentation in Sciences and Engineering/ key words/the process of the narrative/example texts/CARS model
15. Literature searching	Library search / devising a research strategy / critical examination of evidence / top ten guide to searching the internet / databases, books, journal articles Reporting verbs/revisiting synthesis
16. TA Seminar	Weekly consolidation and practice
Week 5	
17. Structuring the Literature Section	Overview of the structure and organisation of the literature review section
18. Methodology	Set functions of the methodology section/ investigating edit sentences/using instructions
19. Applied experimental methodologies	Describing processes with clarity. Focus on step by step methodological analysis.
20. TA Seminar	Weekly consolidation and practice
Week 6	
21. Gathering data and Describing data	Methods of data collection, constraints/reliability and validity/language for describing statistical data/ analysis of data [J. Bell: Doing your research project] Describing processes/classifying and categorising [Gillett, Hammond, Martala: Inside Track Successful Academic Writing pp 226/227]
22. Language for describing data and statistics	Focus on specifically applied descriptive language for data and statistics [Northedge, A: The Science Good Writing Guide]
23. Designing and administering questionnaires	Question type / question wording / appearance and layout / drawing a sample / piloting the questionnaire
24. TA Seminar	Weekly consolidation and practice
Week 7	
25: Planning and conducting	Ethical considerations / question wording / countering bias / checklist for planning and conducting interviews J. Bell - Doing your research project
26: Describing Results	Discourse analysis of students' examples – Focus on descriptive writing [McCarthy' O'Dell: Academic Vocab in Use]
27. The Discussion Section	Aspects of the Discussion/Explanation of data/Writing a Discussion section/Analysing a Discussion section/ Interpreting in a Discussion section [J. Bell: Doing your

	research project]
28. TA Seminar	Weekly consolidation and practice
Week 8	
29. Discussion (2)	Discourse analysis of students' examples
30.Interpreting evidence and reporting findings	List questions / verbal questions / scales / checklist J. Bell - Doing your research project
31. Introduction and Conclusion	Introduction order/Introduction overview/Scan an Introduction/Studying a Conclusion/Scanning a Conclusion section/Experiment hypothesis
32. TA Seminar	Weekly consolidation and practice
Week 9	
33. Introduction and Conclusion	Discourse analysis of students' examples
34. Pro seminar (presentations)	Presentation of groups proposed study including info on research objective, sample, thesis and methodology
35. Report Referencing	Academic language and accuracy in referencing [McCarthy' O'Dell: Academic Vocab in Use]
36. TA Seminar	Weekly consolidation and practice
Week 10	
37. Packaging and Editing	Abstracts – Swales & Feak 1994/Title page/What is a supervisor/Supervisor's and Student's roles/Scanning for editing purposes
38.Proofreading for accuracy	Checking for common errors, economy of expression
39. Presentations of findings	Presentations of findings
40. TA Seminar	Consolidation and practice
41. Presentations of findings	Presentations of findings
42. TA Seminar	Weekly consolidation and practice
Week 11	
43. Assessment	Written assessment
44. Assessment	Written assessment
45. TA Seminar	Consolidation and practice
46. Review	Review of key elements from the course
47. TA Seminar	Weekly consolidation and practice
Week 12	
48. Review & Feedback	Review of key elements from the course & Feedback
49: Review and consolidation	Review of semester, feedback and tutorials
50: Review and consolidation	Review of semester, feedback and tutorials
51. TA Seminar	Weekly consolidation and practice
52. Final Lecture (2 hrs)	Overview of Year 1 (Eng 2) projection to next year
Experimental & Practical Section	N/A
Hours	Contents

Learning Outcomes	
	English language ability at a level to lead to competence in meeting the requirements of the joint degree programme: QMUL BEng in Materials Science and Engineering and NPU BEng degree.
	Specific focus on scientific lexis in order to enhance academic performance in the joint degree programme.
	Read critically and show ability to evaluate sources and to formulate ideas in writing
	Understand and explain technical characteristics and complex ideas.
	Participate in, and to an intermediate level, lead academic discussions based on readings.
Other Information	
Assessment Profile	
Grading Policy	
Coursework	Written assignment (1500 words) 60% Portfolio (750 words) 25% Seminar skills and presentation (1 hour) 25%
Practical experiments	N/A
Examination (written)	

Module title	Advanced Mathematics 1
Summary Information	
Module Code	NXC3000
Class Hours/Credit(CN/UK)	88 Hours/5.5 credits/15 credits
Responsible Institution	NPU
Opening Semester	Fall
Teaching Profile	Lecture + Practical Class/Discussion + Quiz
Course Type	Technical
Textbook and References Textbook	1) Thomas's Calculus (10th edition), Ross L. Finney, Maurice D. Weir and Frank R. Giordano, Higher Education Press, 2004.07. 2) Single Variable Calculus (7th Edition), J. Stewart, Brooks Cole Cengage Learning, 2012. 3) Multivariable Calculus (7th Edition), J. Stewart, Brooks Cole Cengage Learning, 2012.
References/Articles	
Course Description	Calculus gives the students of science and engineering all the basics knowledge they need for calculation. At the end, they have a strong training with the analytic calculus methods, what is essential to all other science courses and further education they are expected. In the exercises class, they can develop their ability to work in a team; it is also a way for them to go from the passive way of the lecture to an active way and at the same to assimilate the methods exposed; teacher is here to help them bypass the difficult points of executing by themselves.
Course Arrangement (Chapters/hours)	
Preliminaries: 2 hours	P1 Lines P2 Functions and Graphs P3 Exponential Functions P4 Inverse Functions and Logarithms P5 Trigonometric Functions and their Inverses
Chapter 1: Limits and Continuity 10 hours	1.1 Rates of Change and Limits 1.2 Finding Limits and One-Sided Limits 1.3 Limits Involving Infinity 1.4 Continuity 1.5 Tangent Lines
Chapter 2: Derivatives 12 hours	2.1 The Derivative as a Function 2.2 The Derivative as a Rate of Change

	2.3 Derivatives of Products, Quotients, and Negative Powers 2.4 Derivatives of Trigonometric Functions 2.5 The Chain Rule and Parametric Equations 2.6 Implicit Differentiation 2.7 Related Rates
Chapter 3: Applications of the Derivatives 10 hours	3.1 Extreme Values of Functions 3.2 The Mean Value Theorem and Differential Equations 3.3 The Shape of a Graph 3.4 Graphical Solutions of Autonomous Differential Equations 3.5 Modelling and Optimization 3.6 Linearization and Differentials 3.7 Newton's Method
Chapter 4: Integration 14 hours	4.1 Indefinite Integrals, Differential Equations, and Modelling 4.2 Integral Rules; Integration by Substitution 4.3 Estimating with Finite Sums 4.4 Riemann Sums and Definite Integrals 4.5 The Mean Value and Definite Integrals 4.6 Substitution in Definite Integrals 4.7 Numerical Integration
Chapter 5: Applications of Integrals 10 hours	5.1 Volumes by Slicing and Rotation About an Axis 5.2 Modelling Volume Using Cylindrical Shells 5.3 Lengths of Plane Curves 5.4 Springs, Pumping, and Lifting 5.5 Fluid Forces 5.6 Moments and Centres of Mass
Experimental & Practical Section	N/A
Hours	
Learning Outcomes	
	Students should master the concepts and graphs of functions mentioned in Chapter P, be familiar with the definition and calculation methods of limit, master the techniques to calculate derivative for different kinds of functions and know the applications of derivatives. Secondly, students

	should not only know how to evaluate integrals of the single variable functions, but also know how to calculate the volumes of solids, the lengths of curves and other things which can be calculated with integrals.
Other Information	This module leads on to Advanced Mathematics 2.
Assessment Profile	
Grading Policy	100 grades, every semester
Coursework	Daily quizzes, worksheets, homework, etc. 30%
Practical experiments	None
Examination (written)	Middle Exam 30%, Comprehensive Final Exam 40%

Module title	Advanced Mathematics 2
Summary Information	
Module Code	NXC3004
Class Hours/Credit(CN/UK)	88 Hours/5.5 credits/15 credits
Responsible Institution	NPU
Opening Semester	Spring
Teaching Profile	Lecture + Practical Class/Discussion + Quiz
Course Type	Technical
Textbook and References Textbook	4) Thomas's Calculus (10th edition), Ross L. Finney, Maurice D. Weir and Frank R. Giordano, Higher Education Press, 2004.07. 5) Single Variable Calculus (7th Edition), J. Stewart, Brooks Cole Cengage Learning, 2012. 6) Multivariable Calculus (7th Edition), J. Stewart, Brooks Cole Cengage Learning, 2012.
References/Articles	
Course Description	Calculus gives the students of science and engineering all the basics knowledge they need for calculation. At the end, they have a strong training with the analytic calculus methods, what is essential to all other science courses and further education they are expected. In the exercises class, they can develop their ability to work in a team; it is also a way for them to go from the passive way of the lecture to an active way and at the same to assimilate the methods exposed; teacher is here to help them bypass the difficult points of executing by themselves.
Course Arrangement (Chapters/hours)	
Chapter 7: Integration Techniques, L'Hopital's Rule, and Improper Integrals 12 hours	7.1 Basic Integration Formulas 7.2 Integration by Parts 7.3 Partial Fractions 7.4 Trigonometric Substitutions 7.5 Integral Tables, Computer Algebra Systems, and Monte Carlo Integration 7.6 L'Hopital's Rule 7.7 Improper Integrals
Chapter 8: Infinite Series 18 hours	8.1 Limits of Sequences of Numbers 8.2 Subsequences, Bounded Sequences, and Picard's Method 8.3 Infinite Series

	8.4 Series of Nonnegative Terms 8.5 Alternating Series, Absolute and Conditional Convergence 8.6 Power Series 8.7 Taylor and Maclaurin Series 8.8 Applications of Power Series 8.9 Fourier Series 8.10 Fourier Cosine and Sine Series
Chapter 9: Vectors in the Plane and Polar Functions 10 hours	9.1 Vectors in the Plane 9.2 Dot Products 9.3 Vector-Valued Functions 9.4 Modelling Projectile Motion 9.5 Polar Coordinates and Graphs 9.6 Calculus of Polar Curves
Chapter 10: Vectors and Motion in Space 12 hours	10.1 Cartesian (Rectangular) Coordinates and Vectors in Space 10.2 Dot and Cross Products 10.3 Lines and Planes in Space 10.4 Cylinders and Quadric Surfaces 10.5 Vector-Valued Functions and Space Curves 10.6 Arc Length and the Unit Tangent Vector T 10.7 The TNB Frame; Tangential and Normal Components of Acceleration 10.8 Planetary Motion and Satellites
Chapter 11: Multivariable Functions and Their Derivatives 20 hours	11.1 Functions of Several Variables 11.2 Limits and Continuity in Higher Dimensions 11.3 Partial Derivatives 11.4 The Chain Rule 11.5 Directional Derivatives, Gradient Vectors, and Tangent Planes 11.6 Linearization and Differentials 11.7 Extreme Values and Saddle Points 11.8 Lagrange Multipliers 11.9 Partial Derivatives with Constrained Variables 11.10 Taylor's Formula for Two Variables
Chapter 12: Multiple Integrals 18 hours	12.1 Double Integrals 12.2 Areas, Moments and Centres of Mass 12.3 Double Integrals in Polar Form

	12.4 Triple Integrals in Rectangular Coordinates 12.5 Masses and Moments in Three Dimensions 12.6 Triple Integrals in Cylindrical and Spherical Coordinates 12.7 Substitutions in Multiple Integrals
Chapter 13: Integration in Vector Fields 18 hours	13.1 Line Integrals 13.2 Vector Fields, Work, Circulation, and Flux 13.3 Path Independence, Potential Functions, and Conservative Fields 13.4 Green's Theorem in the Plane\ 13.5 Surface Area and Surface Integrals 13.6 Parametrized Surface 13.7 Stokes' Theorem 13.8 Divergence Theorem and a Unified Theory
Experimental & Practical Section	N/A
Hours	
Learning Outcomes	
	Having finished the second part, students should master the transcendental functions and how to solve the basic differential equations, and more techniques for integration and limits in chapter 7. They should not only know how to determine the series is absolutely or conditionally convergent, or divergent, but also master the series of functions, such as power series, Taylor series, and Fourier series. Chapter 9 to 10 is about the vectors in Plane and Space; students should master the definitions and operations of vectors and functions in space, and know how to express curves, planes, surfaces in different coordinates.
Other Information	This module follows Advanced Mathematics 1.
Assessment Profile	
Grading Policy	100 grades, every semester
Coursework	Daily quizzes, worksheets, homework, etc. 30%
Practical experiments	None

Examination (written)	Middle Exam 30%, Comprehensive Final Exam 40%

Module title	Linear Algebra
Summary Information	
Module Code	NXC3002
Class Hours/Credit(CN/UK)	48 Hours/3 credits/15 credits
Responsible Institution	NPU
Opening Semester	Fall
Teaching Profile	Lecture + Practical Class/Discussion + Quizzes
Course Type	Technical
Textbook and References	Steven J. Leon, Linear Algebra with Applications (Eighth Edition), China Machine Press, 2012
Textbook	
References/Articles	(1) Elementary Linear Algebra, 7th Edition, Larson. Gilbert Strang, (2) Introduction to Linear Algebra, 3rd edition, Wellesley-Cambridge Press, 2003. (3) Student Guide to Linear Algebra with Applications, ISBN 0-13-600930-1. (4) A special Web site to accompany the 8th edition: www.pearsonhighered.com/leon (5) The collection of software tools (M-files) downloaded from the ATLAST Web site: www.umassd.edu/specialprograms/atlast
Course Description	Linear algebra is an important component of undergraduate mathematics. The course content covers fundamental concepts of linear algebra such as solving linear system of equations, vector/matrix algebraic theory, determinant and its properties, vector space, linear transformations, orthogonality, eigenvalues, eigenvectors and applications to linear differential equations. Furthermore, elementary linear algebra is a valuable introduction to mathematical abstraction and logical reasoning because the theoretical development is self-contained, consistent, and so accessible to most students.
Course Arrangement (Chapters/hours)	
Chapter 1: Matrices and Systems of Equations 8 hours	1.1 Systems of linear Equations 1.2 Row Echelon Form 1.3 Matrix Arithmetic

	1.4 Matrix Algebra 1.5 Elementary Matrices 1.6 Partitioned Matrices
Chapter 2: Determinants 8 hours	2.1 The Determinant of a Matrix 2.2 Properties of Determinants 2.3 Additional Topics and Applications
Chapter 3: Vector Spaces 11 hours	3.1 Definition and Examples 3.2 Subspaces 3.3 Linear Independence 3.4 Basis and Dimension 3.5 Change of Basis 3.6 Row Space and Column Space
Chapter 4: Linear Transformations 4 hours	4.1 Definition and Examples 4.2 Matrix Representations of Linear Transformations 4.3 Similarity
Chapter 5: Orthogonality 10 hours	5.1 The Scalar Product in R^n 5.2 Orthogonal Subspaces 5.3 Least Squares Problems 5.4 Inner Product Spaces 5.5 Orthonormal Sets 5.6 The Gram-Schmidt Orthogonalization Process
Chapter 6: Eigenvalues 5 hours	6.1 Eigenvalues and eigenvectors 6.2 Diagonalisation
Review – 2 hours	
Experimental & Practical Section	N/A
Hours	
Learning Outcomes	
	By this course, students will have a thorough understanding, not only of matrix theory and systems of linear equations, vector space, and eigenvalue etc., but also of practical computational methods that will help them in other academic subject such as mathematics and engineering.
Other Information	
Assessment Profile	

Grading Policy	100 grades
Coursework	Assignments 20%, Discussion/quizzes 20%
Practical experiments	None
Examination (written)	Mid-term Exam 15%, Final Exam 35%

Module title	Mathematical Modelling and Computing
Summary Information	
Module Code	NXC3005
Class Hours/Credit(CN/UK)	64 Hours/4 credits/15 credits
Responsible Institution	NPU
Opening Semester	Spring
Teaching Profile	Lecture + Practical Class/Discussion + Quizzes
Course Type	Technical
Textbook and References Textbook	Jeffery J. Leader, Numerical Analysis and Scientific Computation, Pearson, 2005
References/Articles	(1) Richard L. Burden, J.DouglasFaires. Numerical Analysis (9th Edition), Thomson (2) Laurene v. Fausett, Applied Numerical Analysis Using MATLAB, 2/E, Pearson, 2008
Course Description	This course is intended as a first course in Numerical Analysis taken by students majoring in mathematics, engineering, computer science, and the sciences. The teaching content covers fundamental methods for root-finding problems, direct methods and iterative methods for solving systems of linear equations and interpolation built with regard to a set of given data. The teaching model will emphasize the mathematical ideas behind the methods and the idea of mixing methods for robustness. The use of MATLAB is incorporated throughout the teaching period. The class helps them to realize that a method has limitations in its application which is at the origin of the variety of derivative ones. The purpose of this course is also to help the students to develop their logic, their ability to order the work in a systematic way.
Course Arrangement (Chapters/hours)	
Introduction – 1 hour	
Chapter 1: Nonlinear Equations 9 hours lectures + 8 hours practical lectures	1.1 Bisection and Inverse Linear Interpolation 1.2 Newton's Method 1.3 The Fixed Point Theorem 1.4 Quadratic Convergence of Newton's Method 1.5 Variants of Newton's Method 1.6 Brent's Method

	1.7 Effects of Finite Precision Arithmetic 1.8 Newton's Method for Systems 1.9 Broyden's Method
Chapter 2: Linear Systems 8 hours lectures + 6 hours practical lectures	2.1 Gaussian Elimination with Partial Pivoting 2.2 The LU Decomposition 2.3 The LU Decomposition with Pivoting 2.4 The Cholesky Decomposition 2.5 Condition Numbers 2.6 The QR Decomposition 2.7 Householder Triangularization and the QR Decomposition 2.8 Gram-Schmidt Orthogonalization and the QR Decomposition 2.9 The Singular Value Decomposition
Chapter 3: Iterative Methods 6 hours lectures + 2 hours practical lectures	3.1 Jacobi and Gauss-Seidel Iteration 3.2 Sparsity 3.3 Iterative Refinement 3.4 Preconditioning 3.5 Krylov Space Methods 3.6 Numerical Eigenproblems
Chapter 4: Polynomial Interpolation 4 hours lectures + 2 hours practical lectures	4.1 Lagrange Interpolation Polynomial 4.2 Piecewise Linear Interpolation 4.3 Cubic Splines 4.4 Computation of the Cubic Spline Coefficients
Chapter 5: Numerical Integration 8 hours lectures + 4 hours practical lectures	5.1 Closed Newton-Cotes Formulas 5.2 Open Newton-Cotes Formulas and Undetermined Coefficients 5.3 Gaussian Quadrature 5.4 Gauss-Chebyshev Quadrature 5.5 Radau and Lobatto Quadrature 5.6 Adaptivity and Automatic Integration 5.7 Romberg Integration
Chapter 6: Differential Equations 2 hours lectures + 2 hours practical lectures	6.1 Numerical Differentiation 6.2 Euler's Method 6.3 Improved Euler's Method 6.4 Analysis of Explicit One-Step Methods 6.5 Taylor and Runge-Kutta Methods 6.6 Adaptivity and Stiffness 6.7 Multi-Step Methods
Chapter 7: Nonlinear	7.1 One-Dimension searches

Optimisation	7.2 The Method of Steepest Descent 7.3 Newton Methods for Nonlinear Optimization 7.4 Multiple Random Start Methods 7.5 Direct Search Methods 7.6 TheNelder-Mead Method 7.7 Conjugate Direction Methods
Chapter 8: Approximation Methods	8.1 Linear and Nonlinear Least Squares 8.2 The Best Approximation Problem 8.3 Best Uniform Approximation 8.4 Applications of the Chebyshev Polynomials
Review – 2 hours	
Experimental & Practical Section	N/A
Hours	
Learning Outcomes	
	After successfully completing the course, students will be able to not only master basic computing methods and their mathematical theorems, but also enjoy study, develop their logic and improve their practical capability in Matlab. Furthermore, they can choose an appropriate method to address an engineering problem on a computer.
Other Information	
Assessment Profile	
Grading Policy	100 grades
Coursework	Lecture attendance 10%
Practical experiments	Computing work 20%
Examination (written)	Mid-term Exam 30%, Final Exam 40%

Module title	General Physics
Summary Information	
Module Code	NXC3001
Class Hours/Credit(CN/UK)	82 hours/5 credits/15 credits
Responsible Institution	NPU
Opening Semester	Fall
Teaching Profile	50 hours lectures, 32 hours practicals
Course Type	Technical
Textbook and References Textbook	Physics for scientists and engineers with modern physics, Douglas C. Giancoli, Higher Education Press. 2004.
References/Articles	[1] Hugh D. Yound and Roger A. Freedman (2011). Sears and Zemansky's University Physics with Modern Physics [2] R. P. Feynman (2013). The Feynman Lectures on Physics
Course Description	General Physics is an important fundamental theory course for students in the major of BEng Materials Science and Engineering & BEng Polymer Materials and Engineering. This course not only helps students to obtain the necessary physical fundamental knowledge, but also generates important impacts on further study of new materials science theory, knowledge and technologies in the future. On the other hand, through the study of this course, the students can obtain the methods to think and solve problems in the field of materials science and engineering.
Course Arrangement (Chapters/hours)	
Chapter 1/1 hour	1.2 Dimensions 1.3 Vectors and scalars 1.4 Matrix Algebra
Chapter 2/2 hours	2.1 Position and Displacement 2.2 Velocity 2.3 Acceleration 2.4 2D and 3D motion 2.5 Relative Motion
Chapter 3/2 hours	3.1 Newton's Laws 3.2 Some Particular Forces 3.3 Applying Newton's Laws

Chapter 4/2 hours	4.1 Work and Power 4.2 Kinetic Energy & Work-Energy Principle 4.3 Conservative and Nonconservative Forces 4.4 Potential Energy 4.5 Conservation of Energy
Chapter 5/3 hours	5.1 Linear Impulse and Momentum 5.2 Impulse-Momentum Theorem and Conservation of Momentum 5.3 Newton's 2nd Law for the Motion of the Centre of Mass 5.4 System of Variable Mass
Chapter 6/3 hours	6.1 Concepts of Simple Harmonic Motion 6.2 Expression Methods of Single Harmonic Motion 6.3 Energy in Single Harmonic Motion 6.4 Pendulums 6.5 Superposition of Oscillations
Chapter 7/3 hours	7.1 Simple Harmonic Waves 7.2 Wave Equation 7.3 Energy and Power of Waves 7.4 Interference of Waves 7.5 Standing Waves 7.6 The Doppler Effect
Chapter 8/2 hours	8.1 Coherent Light 8.2 Double-slit Interference 8.3 Thin-film Interference
Chapter 9/2 hours	9.1 Diffraction of Light 9.2 Diffraction Gratings 9.3 Polarized Light 9.4 X-Ray Diffraction
Chapter 10/2 hours	10.1 Temperature & Thermometer 10.2 The Ideal Gas Law 10.3 Pressure and Temperature of Ideal Gas 10.4 The Maxwell's Distribution Laws 10.5 Mean Free Path
Chapter 11/2 hours	11.1 The First Law of Thermodynamics 11.2 Some Special Cases of the First Law of Thermodynamics 11.3 The Efficiencies of Real Engines 11.4 Entropy and the Second Law of

	Thermodynamics
Chapter 12/5 hours	12.1 Electric Field and Its Principle of Superposition 12.2 Gaussian's Law and Its Applications 12.3 Electric Potential and Its Principle of Superposition 12.4 Loop-Law and Its Applications
Chapter 13/4 hours	13.1 Conductor 13.2 Capacitor and Capacitance 13.3 Dielectrics 13.4 Energy Stored in an Electric Field
Chapter 14/1 hour	14.1 Electric Current 14.2 Electric Current Density 14.3 Microscopic View of Ohm's Law
Chapter 15/5 hours	15.1 Magnetic Flux and Gauss's Law 15.2 The Magnetic Force on a Charge 15.3 Magnetic Force on a Current-Carrying Wire 15.4 Magnetic Field Due to Current 15.5 Ampere's Law 15.6 Magnetic Materials
Chapter 16/5 hours	16.1 The Law of Electro-Magnetic Induction 16.2 Motional & Induced EMF 16.3 Self and Mutual Induction 16.4 Energy Stored in a Magnetic Field 16.5 Displacement Current & Ampere-Max Law 16.6 Maxwell's Equation
Chapter 17/2 hours	17.1 The Postulates of Relativity 17.2 The Relativity of Simultaneity, Time and Length 17.3 Relativistic Momentum and Mass 17.4 Energy and Mass
Chapter 18/3 hours	18.1 Planck's Quantum Hypothesis 18.2 The Photoelectric Effect & Compton Effect 18.3 Wave Nature of Matter &The Hydrogen Atom 18.4 Schrodinger's Equation
Experimental & Practical Section	This experimental class consists of two-hour for introductory including error and uncertainty, and

	30-hours for ten experiments.
Hours	Contents
2	Error and Uncertainty
	Preliminary Physics Experiments
3	1. The Speed of Sound
3	2. Young's Modulus of Steel Wire
3	3. Specific Heat of Aluminum via Mixing Method
3	4.Moment Inertia via Trilinear Torsion Pendulum
3	5. Magnetic Flux Measurement via Haul Effect
3	6. Measurement of High Resistance via RC Discharging Method
	Multidisciplinary and Modern Experiments
3	7. Measurement of Micro-deformation via Bridge Circuit
3	8.Michelson Interferometer
3	9.Design Thermometer Based on Thermistor
3	10. Holography
Learning Outcomes	
	The students should not only to obtain the necessary physical fundamentals in lecturers, but also generate important impacts on the study of new theory, new knowledge, and new technologies in the future study and work. In physics experiments, students will get basic training in the theory, method and skill of physics experiment, and preliminary understanding of primary process and basic approach of scientific experiment. It is fundamentally important to develop and improve students' quality and ability to carry out scientific research independently.
Other Information	The student should have some familiarity with the basics of Higher Mathematics. Lectures through PowerPoint Presentation (PPT) and blackboard writing.
Assessment Profile	

Grading Policy	100 grades
Coursework	20%
Practical experiments	30%
Examination (written)	50%

Module title	Engineering Design Methods
Summary Information	
Module Code	NXC4008
Class Hours/Credit(CN/UK)	56 Hours/3.5 credits/15 credits
Responsible Institution	NPU
Opening Semester	Fall
Teaching Profile	40 hours Lectures / 16 hours design practice
Course Type	Technical
Textbook and References	???
Textbook	Bella Martin, Bruce M. Hanington (2012) Universal methods of design: 100 ways to research complex problems, develop innovative ideas, and design effective solutions, Rockport Publishers, ISBN 9781592537563
References/Articles	
Course Description	Short description: This module will introduce the ideas of design control and the design cycle. It will examine how 3D computer aided engineering can be used to create detailed design drawings, create simple assemblies, manufacture prototypes, real parts and also how analytical models such as finite element analysis geometries can be used to evaluate designs. A wide range of different processing techniques such as moulding, forming, cutting, welding, turning and milling will be examined. Various different strategies such as failure mode and effect analysis (FMEA) that can be used to evaluate the design risk, especially in areas with extensive legislation in place, to determine 'safe' design.
Course Arrangement (Chapters/hours)	
Chapter 1:	Measurement of length, volume, mass. The role of inspection and statistical process control techniques in ensuring a robust design and manufacturing process.
Chapter 2:	Ensuring robust and safe design practice is followed using techniques like Failure mode and effect analysis (FMEA) in design. Understanding the role of legislation to ensure safety standards in the design of devices.
Chapter 3:	Using engineering analysis tools such as stress analysis to evaluate designs

Chapter 4:	3D CAE to generate detailed 2D drawings
Chapter 5:	3D CAE to generate simple assemblies of multiple components to evaluate
Chapter 6:	3D CAE to generate simple finite element models
Chapter 7:	3D CAE to generate simple tool paths for machining operations
Chapter 8:	Manufacturing of prototypes and products, using additive manufacturing techniques such as rapid prototyping, vacuum forming, compression moulding, injection moulding, laser cutting and simple casting
Chapter 9:	The use of a variety of machining operations such as turning, milling and other fabrication techniques
Chapter 10:	Design for assemble and fabrication (?)
Chapter 11:	The role of kinematics, ergonomics and anthropometrics in design
Experimental & Practical Section	Practical examples that include:
Hours	Using the CAE software in a design setting
	Use rapid prototype to test design
Learning Outcomes	
Other Information	
Assessment Profile	
Grading Policy	100 grades
Coursework	
Practical experiments	
Examination (written)	

Module title	Mechanical Modelling – Solid Mechanics

Summary Information	
Module Code	NXC4012
Class Hours/Credit(CN/UK)	56 Hours/3.5 credits/15 credits
Responsible Institution	NPU
Opening Semester	Spring
Teaching Profile	40 hours Lectures / 6 hours tutorial example classes/10 hours computer simulation of stress analysis
Course Type	Technical
Textbook and References	R. C. Hibbeler, S. C. Fan (2004) Statics and mechanics of materials, Prentice Hall, ISBN 0131290118
Textbook	
References/Articles	
Course Description	This course introduces principal modelling techniques in solid mechanics focusing on micromechanical aspects of materials science. Fundamental concepts (e.g. Newton's laws, force/movement, stress/strain, energy/work, statics/dynamics, friction/creep/fatigue etc.) will be studied to derive mechanical models for the description of the behaviour of materials. This module develops concepts of stresses and strains in components and how they may be designed to prevent failure. It considers plane stress and strain conditions, using matrix notation to describe these conditions and the failure criteria that may be applied to these systems. It also considers complex bending conditions in asymmetric and composite beams and the stability of struts. Corresponding applications for real-life design tasks are finally discussed to get insight into basic mechanics-based material selection criteria and examples drawn from applications in aerospace, mechanical and medical engineering.
Course Arrangement (Chapters/hours)	
Chapter 1	Plane stress and strain, Stress and Strain Tensors: General stress tensor for a Cartesian element.
Chapter 2	Symbols and sign convention. Principal stresses and strains. Maximum shear stress. Use of matrices, determinants and eigenvalues and their application to stress and strain fields
Chapter 3	Contact stresses and stress concentrations, geometrical discontinuities

Chapter 4	Mechanical modelling of materials: Linear elasticity, non-linear elasticity, plasticity, material hardening
Chapter 5:	Failure criteria: yield criteria, Tresca, von Mises failure criteria
Chapter 6:	Forces and moments, deformation, speed and acceleration.
Chapter 7:	Newton's Laws, energy, work, friction, power, impulse etc.
Chapter 8:	Free body diagrams, equlibrium and boundary conditions.
Chapter 9:	Bars, beams (bending, torsion), plates and membranes.
Chapter 10:	Shear force and bending moment diagrams.
Chapter 11:	Bending theory: normal and shear stresses on beam sections. Beam deflection. Beams of arbitrary cross-section subject to multiaxial bending, cross-moment of area, principal second moments of area, composite sections, bending beyond yield. Principal of superposition, the deflection of beam under bending load
Chapter 12:	Stability of struts: Stresses due to axial loads and bending, short struts, Euler cases, buckling lengths, influence of imperfections, theory of 2nd order bending
Chapter 13:	Criteria for material selection.
Experimental & Practical Section	
Hours	
Learning Outcomes	
Other Information	

Assessment Profile	
Grading Policy	100 grades
Coursework	
Practical experiments	
Examination (written)	

Module title	Thermodynamics and Fluid Dynamics
Summary Information	
Module Code	NXC4122
Class Hours/Credit(CN/UK)	56 Hours/3.5 credits/15 credits
Responsible Institution	NPU
Opening Semester	Spring
Teaching Profile	40 hours Lectures / 16 hours tutorial example classes
Course Type	Technical
Textbook and References Textbook	G Rogers and Y Mayhew (1992) Engineering Thermodynamics, Work and Heat Transfer, 4th Ed Longman Scientific ISBN 978-0582045668 F White (2011) Fluid Mechanics, McGraw Hill ISBN 978-0071311212
References/Articles	
Course Description	This module formally introduces the fundamental principles of general non-equilibrium thermodynamics; it examines applications of single-constituent fluids, and provides background for all applications in engineering. Then the module examines the properties of fluids and the laws governing their static and dynamic behaviour, including pressure and types of flow behaviour. Examples are given that are related to the flow of fluid in pipes as might be used in the processing of polymers.
Course Arrangement (Chapters/hours)	
Chapter 1	Introduction to General Thermodynamics. Historical perspective and utility of the pedagogical approach.
Chapter 2	Thermodynamic system, state, property, specific, extensive and intensive properties. Energy, adiabatic process, first law, work, adiabatic availability.
Chapter 3	Equilibria, second law, thermodynamic reservoir, available energy (exergy), entropy, temperature, pressure, work interaction and heat interaction.
Chapter 4	Energy-entropy graphical representations.

Chapter 5: Introduction to Fluid Properties	Density, compressibility. Viscosity; Newtonian and non-Newtonian fluids. Pressure and shear stresses. Ideal fluid.
Chapter 6: Fluid Statics	Measurement of pressure. Variation of pressure in constant and variable density fluids. Determination of magnitude and position of pressure force on plane and curved surfaces.
Chapter 7: Fluid dynamics	Types of flow, laminar and turbulent. Pathlines, streamlines and streamtubes. Flow near a solid boundary. Equations of conservation of mass, energy and momentum with applications. Dynamic forces on immersed bodies, pipe bends, vanes.
Chapter 8: Dimensional Analysis & Physical Modelling	The Buckingham -theorem. Dimensionless numbers. Geometric, kinematic and dynamic similarity and application to physical modelling.
Chapter 9: Laminar Flow	Laminar flow between plates and through pipes. Couette and Poisseulle flows.
Chapter 10: Flow in Pipes	Experiments of Reynolds. Relationship between Reynolds number, friction factor and roughness in pipe flow; the Moody diagram. Local losses in pipes.
Experimental & Practical Section	
Hours	
Learning Outcomes	
Other Information	
Assessment Profile	
Grading Policy	100 grades
Coursework	

Practical experiments	
Examination (written)	

Module title	Materials Science 1 – Structure and Properties
Summary Information	
Module Code	QXU4000
Class Hours/Credit(CN/UK)	56 hours/3.5 credits/15 credits
Responsible Institution	QMUL
Opening Semester	Fall
Teaching Profile	40 hours lectures, 16 hours tutorials
Course Type	Technical
Textbook and References Textbook	M Nelkon, P Parker (1995). Advanced Level Physics. 7th Edition. QC23 NEL / ISBN:043592303X W D Callister (1977). Materials Science and Engineering. 7thEdition. TM100 CAL / ISBN:0471134597
References/Articles	N/A
Course Description	Introduction of Atomic structure and inter-atomic bonding; structure of crystalline solids; imperfections in solids; diffusion; mechanical properties of metals; phase diagrams; phase transformations in metals; organic materials; development of microstructure and alteration of mechanical properties.
Course Arrangement (Chapters/hours)	
1	Atomic structure and interatomic bonding
2	Structure of crystalline solids
3	Imperfections in solids
4	Diffusion
5	Mechanical properties of metals
6	Dislocations and strengthening mechanisms
7	Failure
8	Phase diagrams
9	Phase transformations in metals
10	Development of microstructure and alteration of mechanical properties
Experimental & Practical Section	N/A

Hours	
Learning Outcomes	
	Students will be encouraged to develop a sound understanding of the important topics in materials science. To importantly illustrate the relationships between microstructure and properties. They will be encouraged to think about how microstructures and properties can be manipulated to achieve desired properties. They will understand the structure of materials, phase equilibria and phase transformations; characterisation of composition and microstructure of materials; chemistry, thermodynamics and kinetics
Other Information	
Assessment Profile	
Grading Policy	
Coursework	20%
Practical experiments	
Examination (written)	80%

Module title	Molecules to Materials
Summary Information	
Module Code	QXU4001
Class Hours/Credit(CN/UK)	56 hours/3.5 credits/15 credits
Responsible Institution	QMUL
Opening Semester	Spring
Teaching Profile	40 hours lectures, 16 hours tutorials
Course Type	Technical
Textbook and References	Brown et al. Chemistry the central science,12th int Ed, Pearson / ISBN:978-1-292-02152-2 Barrett et al. Structure and Bonding: RSC(tutorial chemistry texts), 2001, Royal Society of Chemistry ISBN:978-0854046478 Maskill. Mechanisms of Organic Reactions (Oxford Chemistry Primers), 1996, Oxford University Press, ISBN: 978-0198558224 West. Basic Solid State Chemistry, 2nd Edition, 1999, Wiley-Blackwell, ISBN: 978-0471987567
Textbook	
References/Articles	
Course Description	The role of chemistry in materials science. The module will begin with the description of chemical bonding in atomic systems. Students will be given an understanding of how atomic orbitals are derived and what they actually mean. This will be used as a basis to explain group and period behaviour in the periodic table. This will be developed further into molecular bond systems such as hybrid bonding (Sp3, Sp2 etc) as well as very basic descriptions of molecular orbital theory. Students will learn how to use these concepts to define molecular shape and behaviour. Students will also learn how these shapes and bond types are important in chemical reactions that form materials, for example polymer synthesis. This will be done by providing a discussion on basic organic chemistry reaction mechanisms. The module will continue to show how bonding changes in materials, band theory will be introduced and described using semiconductor materials as an example. Unusual behaviours which are the result of quantum effects on bonding will also be described, for example quantum dots.
Course Arrangement	

(Chapters/hours)	
Experimental & Practical Section	N/A
Hours	
Learning Outcomes	
	The main aim of the module is to give students a good grounding in the important role of chemistry in materials synthesis and materials science. The module will focus on understanding the fundamental principles behind chemical bonding and chemical reactions and how these change from simple atoms through molecular systems to large scale materials. The module will be practically focused with multiple problem solving aspects related to the real world, for example: 1) Period and Group behavior of elements 2) Important reactions in polymer synthesis. 3) The behavior of semiconductor materials 4) Size effects in materials. 5) Structure and bonding as a way of controlling structure property relationships.
Other Information	
Assessment Profile	
Grading Policy	
Coursework	20%
Practical experiments	
Examination (written)	80%

Module title	Materials Science 2 – Processing and Applications
Summary Information	
Module Code	QXU4006
Class Hours/Credit(CN/UK)	56 hours/3.5 credits/15 credits
Responsible Institution	QMUL
Opening Semester	Spring
Teaching Profile	40 hours lecturers, 16 hours tutorials
Course Type	Technical
Textbook and References	W D Callister (2007). Materials Science and Engineering An Introduction. 7th. Wiley. / ISBN:9780471736967
Textbook	
References/Articles	
Course Description	This course extends what was taught in MAT100/QXU4000 and now covers the properties, processing and applications of materials. In particular the processing and application of metals, polymers and ceramics including their electrical, thermal, magnetic and optical properties. Applications and processing of metal alloys; structure and properties of ceramics; applications and processing of ceramics; polymer structures; characteristics, applications, and processing of polymers.
Course Arrangement (Chapters/hours)	
	The course will follow chapters 11-15 and 18-21 in Materials Science and Engineering an Introduction by WD Callister.
	Applications and processing of metal alloys
	Structure and properties of ceramics
	applications and processing of ceramics
	polymer structures
	characteristics, applications, and processing of polymers
	electrical properties
	thermal properties
	magnetic properties
	optical properties

Experimental & Practical Section	N/A
Hours	
Learning Outcomes	
	Students will be able to relate crystallographic structure and microstructure to physical properties.
	Students will understand industrial processes for producing polymers, ceramics and metal alloy components.
	Students' understanding of the underlying physics will be sufficient to explain the structural and functional properties of materials.
Other Information	
Assessment Profile	
Grading Policy	
Coursework	20%
Practical experiments	
Examination (written)	80%

Module title	Surfaces and Interfaces
Summary Information	
Module Code	QXU5010
Class Hours/Credit(CN/UK)	56 hours/3.5 credits/15 credits
Responsible Institution	QMUL
Opening Semester	Fall
Teaching Profile	40 hours lectures, 8 hours practicals, 16 hours tutorials
Course Type	Technical
Textbook and References Textbook	JE House (2007) Principles of Chemical Kinetics, 2 edition, Academic Press / ISBN:978-0123567871 G Price (1998) Thermodynamics of Chemical Processes (Oxford Chemistry Primer), Oxford University Press / ISBN:978-0198559634 P Atkins (2009) Physical Chemistry, 9th Edition, Oxford University Press / ISBN: 9781429218122
References/Articles	
Course Description	This course gives fundamentals in surface and interface science. It covers definition of surface and interfaces, surface free energy, different types of interfaces, adsorption, capiliarity, molecular basics of surface activity and its application to adhesion, wetting, emulsion and colloids. Main surface characterisation techniques are to be taught in the course. The module includes lab work where the students get some experience in preparation and characterisation of materials surfaces.
Course Arrangement (Chapters/hours)	
	General concepts (definition of surfaces and interfaces, surface free energy, adsorption)
	The molecular basis of surface activity
	Long range attractive forces
	Capillarity
	Solid surfaces
	Liquid-fluid interfaces
	Adsorption at solid-liquid interfaces
	Emulsions and Colloids
	Wetting and Spreading

	Adhesion
	Charge transfer across interfaces
	Characterisation techniques
Experimental & Practical Section	
Hours	The characterisation of surfaces and interfaces using one or more of the following techniques:
	Atomic force microscopy,
	Quartz crystal microbalance
	Contact angle measurement
Learning Outcomes	
	Students will develop knowledge regarding the characterisation of materials surfaces and interfaces
	Students will develop knowledge regarding the physio-chemical and topological nature of materials surfaces and interfaces
Other Information	
Assessment Profile	
Grading Policy	
Coursework	20%
Practical experiments	
Examination (written)	80%

Module title	Polymer Chemistry
Summary Information	
Module Code	QXU5031
Class Hours/Credit (CN/UK)	64 hours/4 credits/15 credits
Responsible Institution	QMUL
Opening Semester	Fall
Teaching Profile	Lectures 40 hours, Practical Classes 8 hours, Tutorials 16 hours
Course Type	Technical
Textbook and References Textbook	R J Young and P A Lovell ((1991)). Introduction to Polymers. 2nd Edition. Chapman and Hall, London. / ISBN:0412306409 Polymer chemistry: an introduction Date: 1999, Edition: 3rd ed, ISBN: 0195124448
References/Articles	N/A
Course Description	This course examines the physical and mechanical properties of polymers in relation to their molecular structure. This focuses on the structure of macromolecules, transitions in polymers, rubber elasticity, viscoelasticity, mechanical properties of polymers, processing of polymers, polymer blends and filled polymers. Students will be able to classify, describe and discuss the effects of molecular structure (e.g. secondary interactions, chain stiffness, molar mass and molar mass between crosslinks or entanglements) and morphology (e.g. in blends or semi-crystalline materials) of polymers on their glass transition temperature, melting temperature, mechanical properties and processability. They will be able to select an appropriate processing method for a wide variety of polymeric end-products. They will be able to have a basic understanding of fundamental polymer physics concepts.
Course Arrangement	
	Structure of macromolecules: structure of polymers, classification of polymers: bulk, engineering and speciality polymers, structure of the main chain, degree of polymerisation and chain length, side groups, chain interactions, network formation, calculation of number average molar mass, weight average molar mass and z-average molar mass, influence of molar mass

	distribution on properties, influence of polymer structure on chain regularity and chain conformation.
	The influence of polymer structure on chain stiffness, random coil conformation, end-to-end distance and natural draw ratio.
	Transitions in polymers: glass transition temperature, melt temperature, secondary transitions, crystallisation.
	Influence of temperature on volume and modulus (logE-T plot) for semi-crystalline and amorphous polymers.
	Influence of chain stiffness, side groups and chain interactions on Tg.
	Miscible blends, immiscible blends and phase behaviour, copolymers, fillers and their effect on properties. Influence of polymers structure on melting temperature, influence of chain orientation on Tm.
	Influence of polymer structure on crystallisation, optimal crystallisation temperature, influence of crystallinity on stiffness and high temperature properties of polymers.
	Influence of entanglement and crosslink density on rubber plateau modulus (entropy elasticity), influence of molar mass and time-scale (viscoelasticity) on rubbery plateau.
	Liquid state, influence of molar mass on viscosity, influence of molar mass and molar mass distribution on melt flow behaviour and processing.
	Deformation behaviour of polymers: amorphous and semi-crystalline polymers, viscoelasticity, modulus, yielding, necking, draw and strain hardening, influence of polymer structure (e.g. secondary interactions, chain stiffness, molar mass and molar mass between entanglements) on stress-strain curve, effect of physical ageing on stress-strain behaviour, influence of entanglement network on maximum extensibility (maximum draw-ratio).
	Crazing of glassy polymers, toughening mechanisms, multiple crazing, theory of viscoelasticity, durability, stress relaxation and creep behaviour.
	Basics of polymer processing: injection moulding, extrusion, blow moulding, film blowing, fibre spinning, thermoforming.

	An introduction to functional polymers such as conductive polymers and liquid crystals for applications such as displays, sensors, solar cells, etc.
Experimental & Practical Section	
Hours	Contents
8 hours practical classes	
Learning Outcomes	
	Students will be able to classify, describe and discuss the effects of molecular structure and morphology of polymers on their glass transition temperature, melting temperature, mechanical properties and processability
	Students will be able to select an appropriate processing method for a wide variety of polymeric end-products
	Students will have a basic understanding of fundamental polymer physics concepts
Other Information	
	Students will be able to classify, describe and discuss the effects of molecular structure and morphology of polymers on their glass transition temperature, melting temperature, mechanical properties and processability
Assessment Profile	
Grading Policy	
Coursework	16 hours (20%)
Practical experiments	
Examination (written)	2.5 hours (80%)

Module title	Physical Properties of Polymers
Summary Information	
Module Code	QXU5032
Class Hours/Credit(CN/UK)	64 hours/4 credits/15 credits
Responsible Institution	QMUL
Opening Semester	Fall
Teaching Profile	40 hours lectures, 8 hours practicals, 16 hours tutorials
Course Type	Technical
Textbook and References Textbook	R J Young and P A Lovell (1991). Introduction to Polymers. 2nd Edition. Chapman and Hall, London. / ISBN:0412306409 Polymer chemistry: an introduction Date: 1999, Edition: 3rd ed, ISBN: 0195124448
References/Articles	
Course Description	This course examines the physical and mechanical properties of polymers in relation to their molecular structure. This focuses on the structure of macromolecules, transitions in polymers, rubber elasticity, viscoelasticity, mechanical properties of polymers, processing of polymers, polymer blends and filled polymers.
Course Arrangement (Chapters/hours)	
	Structure of macromolecules: structure of polymers.
	Classification of polymers: bulk, engineering and speciality polymers, structure of the main chain, degree of polymerisation and chain length, side groups, chain interactions, network formation.
	Calculation of number average molar mass, weight average molar mass and z-average molar mass, influence of molar mass distribution on properties.
	The influence of polymer structure on chain regularity and chain conformation.
	The influence of polymer structure on chain stiffness, random coil conformation, end-to-end distance and natural draw ratio.
	Transitions in polymers: glass transition

	temperature, melt temperature, secondary transitions, crystallisation.
	Influence of temperature on volume and modulus (logE-T plot) for semi-crystalline and amorphous polymers.
	Influence of chain stiffness, side groups and chain interactions on Tg.
	Miscible blends, immiscible blends and phase behaviour, copolymers, fillers and their effect on properties. Influence of polymers structure on melting temperature, influence of chain orientation on Tm.
	Influence of polymer structure on crystallisation, optimal crystallisation temperature, influence of crystallinity on stiffness and high temperature properties of polymers.
	Influence of entanglement and crosslink density on rubber plateau modulus (entropy elasticity), influence of molar mass and time-scale (viscoelasticity) on rubbery plateau.
	Liquid state, influence of molar mass on viscosity, influence of molar mass and molar mass distribution on melt flow behaviour and processing.
	Deformation behaviour of polymers: amorphous and semi-crystalline polymers, viscoelasticity, modulus, yielding, necking, draw and strain hardening, influence of polymer structure (e.g. secondary interactions, chain stiffness, molar mass and molar mass between entanglements) on stress-strain curve, effect of physical ageing on stress-strain behaviour, influence of entanglement network on maximum extensibility (maximum draw-ratio).
	Crazing of glassy polymers, toughening mechanisms, multiple crazing, theory of viscoelasticity, durability, stress relaxation and creep behaviour.
	Basics of polymer processing: injection moulding, extrusion, blow moulding, film blowing, fibre

	spinning, thermoforming.
	An introduction to functional polymers such as conductive polymers and liquid crystals for applications such as displays, sensors, solar cells, etc.
Experimental & Practical Section	
Hours	
Learning Outcomes	
	Students will be able to classify, describe and discuss the effects of molecular structure (e.g. secondary interactions, chain stiffness, molar mass and molar mass between crosslinks or entanglements) and morphology (e.g. in blends or semi-crystalline materials) of polymers on their glass transition temperature, melting temperature, mechanical properties and processability. They will be able to select an appropriate processing method for a wide variety of polymeric end-products. They will be able to have a basic understanding of fundamental polymer physics concepts.
Other Information	
Assessment Profile	
Grading Policy	
Coursework	20%
Practical experiments	
Examination (written)	80%

Module title	Polymer Characterisation
Summary Information	
Module Code	NXC5013
Class Hours/Credit(CN/UK)	56 Hours/3.5 credits/15 credits
Responsible Institution	NPU
Opening Semester	Spring
Teaching Profile	40 hours Lectures / 16 hours tutorial example classes
Course Type	Technical
Textbook and References Textbook	J.M.G. Cowie, Valeria Arrighi (2007) Polymers: Chemistry and Physics of Modern Materials, 3rd Ed, CRC Press ISBN: 978-1-4200-0987-3 John Scheirs (2000) Compositional and Failure Analysis of Polymers: A Practical Approach, Wiley ISBN 9780471625728 Arza Seidel(2008) Characterization and Analysis of Polymers, Wiley ISBN 9780470233009
References/Articles	
Course Description	This course introduces the major techniques for the characterisation of polymeric materials to study their mass and molecular structure, morphology, thermal properties and related phase changes. The course presents the principles and application of vibrational spectra, nuclear magnetic resonance, mass spectrometry, chromatography, thermal analysis methods, optical, electron and scanning probe microscopy, X-ray diffraction. Investigation strategies are considered for characterising the structure, composition, morphology and properties of polymeric materials.
Course Arrangement (Chapters/hours)	
Chapter 1: / 4 hours	1. Brief introduction about this course. 2. Brief introduction about vibrational spectroscopy: coverage, first principles calculations of molecular vibrational frequency, sample preparation, internal reflectance methods, influencing factors. 3. Fourier Transform Infrared Spectroscopy (FTIR) 4. Ultraviolet Spectroscopy (UV) 5. Raman Spectroscopy (RS)

	6. Fluorescence Spectroscopy (FS)
Chapter 2: / 4 hours	1. Brief introduction about nuclear magnetic resonance (NMR) analysis: definition, principle, sample preparation, influencing factors, limitations, application. 2. ^{1}H NMR (Common) 3. ^{13}C NMR (Common) 4. ^{15}N/^{19}F/^{29}Si/^{31}P NMR 5. Two Dimensional NMRs (^{1}H-^{1}H homonuclear correlation; ^{13}C-^{1}H heteronuclear correlation)
Chapter 3: / 4 hours	1. Brief introduction about mass spectrometry (MS) analysis: definition, principle, sample preparation, influencing factors, limitations, application. 2. Field Ionization (FI) 3. Field Desorption (FD） 4. Time of Flight Mass Spectrum (TOF MS)
Chapter 4: / 4 hours	1. Brief introduction about chromatography analysis: definition, principle, sample preparation, influencing factors, limitations, application. 2. Gas Chromatography (GC) 3. Liquid Chromatography (LC) 4. Gel Permeation Chromatography (GC) 5. Size Exclusion Chromatography /Multi angle Laser Light Scattering (SEC/MALLS)
Chapter 5: / 8 hours	1. Brief introduction about thermal analysis: definition, principle, sample preparation, influencing factors, limitations, application. 2. Differential Scanning Calorimetry (DSC) 3. Thermogravimetric Analyzer (TA) 4. Dynamic Mechanical Analyzer (DMA)
Chapter 6: / 6 hours	1. Brief introduction about microscopic analysis: definition, principle, sample preparation, influencing factors, limitations, application. 2. Light microscopy and polarising light microscopy 3. Scanning Electron Microscope (SEM) 4. Transmission Electron Microscope (TEM) 5. Atomic Force Microscope (AFM)
Chapter 7: / 6 hours	1. Brief introduction about X-ray diffraction analysis:

	definition, principle, sample preparation, influencing factors, limitations, application. 2. X-ray diffraction 3. Wide Angle X-ray Diffraction (WAXD) 4. Small Angle X-ray Scattering (SAXS)
Chapter 8: /4 hours	Progress in polymer characterisation – new techniques
Experimental & Practical Section	16 hours of practical laboratories
Hours	2 hours per topic – examples x8 topics
Learning Outcomes	
Other Information	
Assessment Profile	
Grading Policy	100 grades
Coursework	
Practical experiments	
Examination (written)	

Module title	Elastomer Materials
Summary Information	
Module Code	NXC5014
Class Hours/Credit(CN/UK)	56 Hours/3.5 credits/15 credits
Responsible Institution	NPU
Opening Semester	Spring
Teaching Profile	40 hours Lectures / 16 hours laboratory practicals
Course Type	Technical
Textbook and References	Jiri George Drobny (2014) Handbook of Thermoplastic Elastomers 2nd Ed, Elsevier, ISBN 978-0-323-22136-8
Textbook	
References/Articles	
Course Description	This course will examine how rubber-based materials behave and how their properties can be exploited to deliver a range of engineering functions. Developing from the basic theory to more complex phenomena this module provides a detailed overview of elastomers and their application for use in industry.
Course Arrangement (Chapters/hours)	
Chapter 1 Introduction of Rubber & elastomer 6 hours	• History of rubber material development(from natural rubber to modern industry applications) • Elastomer Nomenclature • Definition of Elastomer & Rubber • Elastomer Property
Chapter 2 Polymer chemistry of synthetic elastomer 4 hours	• Polymerization reaction in Rubber • Polymerization method for synthetic rubber
Chapter 3 Rubber structure & property Failure 10 hours	• Thermodynamic foundations, transitions between crystalline, glassy and rubbery states • The physics of rubber elasticity, entropy spring elasticity theory, hyper-elastic models for rubber, macro-molecular networks and the interaction with fillers to change mechanical behaviour

	· Strength criterion for rubbers, energetics approach to toughness, tearing energy, testing methods that can predict failure · Swelling and thermal & chemical ageing of rubbers, failure modes that can arise in normal service such as oxidation, ozonolysis, swelling by chemicals and heat build-up · Inelastic behaviour, creep, stress relaxation, dynamic modulus and damping, non-linear stress-strain effects (Payne and Mullins) · Rubber friction, contact mechanics, interfacial energetics in the frictional sliding of rubber, abrasion and wear
Chapter 4: Rubber processing methods 6 hours	Sources of rubber (natural and synthetic), rubber processing and compounding,
Chapter 5: Rubber product design 8 hours	· Selection of rubber matrix · Additives (filler, protective agents, vulcanizing chemicals) · Case study of rubber product
Chapter 6 Physical & chemical analytical method 6 hours	· Physical (Visco-elastic behavior,Elasticmodules,tensile stress-strain) · Chemical (FTIR,Thermal analysis) · Testing rubber materials and components
Experimental & Practical Section	16 hours of practical laboratories
Hours	
Learning Outcomes	
Other Information	
Assessment Profile	
Grading Policy	100 grades
Coursework	
Practical experiments	20%

Examination (written)	80%

Module title	Polymer Degradation
Summary Information	
Module Code	NXC5028
Class Hours/Credit(CN/UK)	56 Hours/3.5 credits/15 credits
Responsible Institution	NPU
Opening Semester	Fall
Teaching Profile	40 hours Lectures / 16 hours laboratory practicals
Course Type	Technical
Textbook and References Textbook	Krzysztof Pielichowski, James Njuguna (2005) Thermal Degradation of Polymeric Materials, Rapra Technology Ltd, ISBN 1-85957-498-X Scott G.: Mechanisms of Polymer Degradation and Stabilization. Elsevier S.P., Essex 1990. (CS) Hawkins W.L.: Polymer Stabilization. Wiley-Interscience, New York 1972. (CS)
References/Articles	
Course Description	This course will examine the principal types of degradation that lead to ageing or reduced performance in polymeric materials as a function of their operating environment as well as strategies for material stabilisation. Degradation of polymeric materials is related to reactions occurring during processing, when polymers are subjected to heat, oxygen and mechanical stress, and during the useful life of the materials when oxygen and sunlight are the most important factors for degradation. The basic chemical and physical degradation mechanisms of of chain scission, free radical action, UV degradation, biodegradation, heat and stress and their kinetics are described. Degradation may also be induced by high energy radiation, ozone, atmospheric pollutants, mechanical stress, biological action, hydrolysis and many other influences. All these technological scenarios have in common certain basic chemical reactions. The course presents and analyses all the aspects of these processes.
Course Arrangement (Chapters/hours)	

Chapter 1:	Thermal degradation in inert media
Chapter 2:	Thermo-oxidative and photo-oxidative degradations
Chapter 3:	Biodegradation and chemical degradation
Chapter 4:	Mechanisms and kinetics of inhibited oxidations
Chapter 5:	Antioxidants and mechanisms of their action
Chapter 6:	Light stabilizers and mechanisms of their action
Chapter 7:	Degradation and stabilization of PVC
Chapter 8:	Polymers burning and modes of flame retardation
Chapter 9:	Softeners and lubricants
Chapter 10:	Antistatics and foaming agents
Chapter 11:	Colours - dyes, pigments and their use in reducing degradation
Chapter 12:	Fillers and reinforcements
Chapter 13:	Strategy of formulating complex additive systems, environmental aspects, recycling and waste liquidation
Experimental & Practical Section	16 hours of practical laboratories
Hours	
Learning Outcomes	

Other Information	
Assessment Profile	
Grading Policy	100 grades
Coursework	
Practical experiments	
Examination (written)	

Module title	Materials Selection in Design
Summary Information	
Module Code	QXU6002
Class Hours/Credit(CN/UK)	64 hours/4 credits/15 credits
Responsible Institution	QMUL
Opening Semester	Fall
Teaching Profile	40 hours Lectures, 8 hours of tutorials, 6 hours practical classes/workshops, 10 hours supervised time in studio/workshop
Course Type	Technical
Textbook and References	F A A Crane, J A Charles & Justin Furness (1997). Selection and Use of Engineering Materials. 3rd Edition. Butterworths-Heinemann. / ISBN:9780750632775 M F Ashby (2011). Materials Selection in Mechanical Design. 4th. Butterworth-Heinemann, Oxford. TM100 ASH / ISBN:1856176630
Textbook	
References/Articles	
Course Description	This module builds on QXU4011 (Introduction to Engineering Materials) to develop materials selection skills appropriate for engineering applications. Introducing material selection concepts including processing constraints in design. An appreciation of the interaction of processing and material related cost considerations and the need to adopt a simultaneous engineering approach. The use of design guides such as Ashby diagrams is a key skill developed in the module.

Course Arrangement (Chapters/hours)	N/A
	The relative mechanical properties of the basic material categories covering: stiffness; strength; density; thermal properties; corrosion; wear; bio-compatibility and cost.
	Review of materials selection for structures and shapes using design charts and Ashby Diagrams.
	Overview of general materials manufacturing routes: forming; machining; casting; moulding; and fabrication.
	Design and manufacture with metals: Consideration of basic processes and finishing operations, joining and assembly methods.
	Design and manufacture with plastics and composites moulding, extrusion, pultrusion, filament winding; resin transfer moulding. Assembly routes including adhesion, ultrasonic welding and mechanical fastening.
	Design and manufacture with ceramics. Including slip casting, powder routes and sol-gel processes.
	The interaction between processing and geometry; materials databases and the selection of appropriate design data; the use of CAE; rapid prototyping.
	Economic factors. Impact of part cost due to: volume of production; tooling; raw materials; energy. Lifetime cost considerations: cost of ownership: operation; repair and maintenance.
	Case Studies – for example: a) General engineering: Selection of materials for automotive and aerospace components b) Biomedical engineering: Medical devices, orthopaedic implants or prosthetic heart valves. c) Offshore engineering: pipeline design.
Experimental & Practical Section	
Hours	
Learning Outcomes	

	The module aims to provide an opportunity to: 1. Explore materials selection by considering geometric and manufacturing possibilities in relation to the design requirements. 2. Consider costs both from the standpoint of capital and material costs. 3. Embrace simultaneous engineering concepts ensuring that the design process, the selection of material and the choice of manufacturing routes are interdependent operations.
Other Information	
Assessment Profile	
Grading Policy	
Coursework	12%
Practical experiments	Computing – practical skills assessment 8%
Examination (written)	80%

Module title	Polymer Processing
Summary Information	
Module Code	NXC6018
Class Hours/Credit(CN/UK)	64 Hours/4 credits/15 credits
Responsible Institution	NPU
Opening Semester	Fall
Teaching Profile	40 hours Lectures / 14 hours tutorial example classes / 10 hours polymer processing laboratory
Course Type	Technical
Textbook and References Textbook	Donald G. Baird, Dimitris I. Collias (2014) Polymer Processing: Principles and Design, 2nd Ed, Wiley, ISBN: 978-0-470-93058-8
References/Articles	
Course Description	This course introduces the methods for processing polymers required to manufacture moulded products, thin films or fibres. The technologies for blending and shaping polymer materials are investigated, drawing on information from preceding modules in Thermodynamics and Fluid mechanics, Polymer Physics and Polymer Characterisation. The effect of the processing method, flow of material, heating and cooling rates and component shape on the resulting microstructure, residual stresses and materials properties are considered. The construction and operation of the machinery for processing polymers is studied together with practical experience in the polymer processing laboratory.
Course Arrangement (Chapters/hours)	
Introduction:	Polymer processing methods and their influence upon product performance
Chapter 1:	Review of polymer rheological properties and concept of melt flow index
Chapter 2:	Polymer blending methods, twin screw extruder, co-polymers, reinforced polymers
Chapter 3:	Injection moulding – properties of injection moulded products, influence of flow balance, gate location, ejection retention, product designing for effective cooling, parting line recognition, basic mould tool construction and moulding techniques
Chapter 4:	Compression moulding – properties of compression

	moulded products, designing for balanced cure and even thermal history, product release, compression mould tool construction and moulding techniques
Chapter 5	Blow moulding – properties of blow moulded products, stretch blow-up ratio, extrusion blow-up ratio, product design and use applications, mould tool construction
Chapter 6	Extrusion – properties of extruded products, product design criteria, shape, sizing, basic die construction (lay flat, tube, film and multilayer die designs)
Chapter 7	Vacuum forming – properties of vacuum formed products, wall section drawing, design applications, basic tool construction and manufacture.
	Film forming methods, solvent casting and spin coating, deposition and film drawing, film thickness, film structure and
	Polymer fibre manufacture methods, fibre drawing, melt spinning, electro-spinning
Experimental & Practical Section	16 hours of practical laboratories
Hours	
Learning Outcomes	
Other Information	
Assessment Profile	
Grading Policy	100 grades
Coursework	
Practical experiments	
Examination (written)	

Module title	Failure of Polymers
Summary Information	
Module Code	NXC6019
Class Hours/Credit(CN/UK)	48 Hours/3 credits/15 credits
Responsible Institution	NPU
Opening Semester	Fall
Teaching Profile	40 hours Lectures / 8 hours mechanical testing
Course Type	Technical
Textbook and References Textbook	John Scheirs (2000) Compositional and Failure Analysis of Polymers: A Practical Approach, Wiley ISBN 9780471625728
References/Articles	
Course Description	This module provides the student with an understanding of the most important failure mechanisms of polymers due to cracking, stress-corrosion and creep. The mechanisms of failure are studied together with the theoretical background to fracture parameters and their use in engineering applications. The module includes: Fracture mechanics concepts of crack extension force, strain energy release rate, stresses at the crack tip, stress intensity factor, solutions for engineering problems, elastic-plastic fracture mechanics and fracture energy. The interaction of stresses at the crack tip and the environmental factors are studied and the environmental conditions that can lead to this mode of failure. The important failure modes of creep and stress relaxation are addressed with respect both materials testing and to stresses on engineering components in service.
Course Arrangement (Chapters/hours)	
Chapter 1:	Morphological aspects of fracture: ductile and brittle failure and the effects of temperature and strain rate on the type of failure.
Chapter 2:	Modes of failure and crack loading.
Chapter 3:	Linear-elastic fracture mechanics concepts: Thermodynamic concepts and generalised energy criterion. Griffith's equation. Fracture energy and crack extension force. Practical application of the compliance method.
Chapter 4:	Stress distribution at the tip of a crack. Stress intensity

	factor and its use in design and failure prediction. Influence of a plastic zone at the tip of a crack.
Chapter 5:	Elastic-plastic fracture mechanics: The critical crack tip opening displacement and J-integral concepts.
Chapter 6:	Stress-corrosion cracking: conditions that lead to stress-corrosion failure, interaction of crack growth and environmental conditions, design to mitigate against stress-corrosion cracking.
Chapter 7:	Creep: Phenomenological aspects of creep and recovery in polymeric materials. Compounding effects of polymer degradation. Creep and stress relaxation tests and presentation of data. Theories of creep and application to different materials. Creep fracture. Development of creep resistant polymers.
Experimental & Practical Section	16 hours of practical laboratories
Hours	
Learning Outcomes	
Other Information	
Assessment Profile	
Grading Policy	100 grades
Coursework	
Practical experiments	
Examination (written)	

Module title	Polymer Product Design
Summary Information	
Module Code	NXC6020
Class Hours/Credit(CN/UK)	48 Hours/3 credits/15 credits
Responsible Institution	NPU
Opening Semester	Spring
Teaching Profile	40 hours Lectures / 8 hours computing laboratory using mould-flow software
Course Type	Technical
Textbook and References Textbook	M. Joseph Gordon (2002) Industrial design of plastics products, Wiley -Interscience ISBN 9780471231516
References/Articles	
Course Description	This module modules studies the engineering design and manufacturing factors that that need to be considered when making products from polymeric materials. The course explains the factors influencing polymer product design theory, polymer project management, prototyping and product assembly and finishing techniques. This module draws on the knowledge from previous modules in Thermodynamics and Fluid Mechanics and in Polymer Processing to understand how to design products that can be manufactured and perform successfully. The module includes topics on the management of work-flow, assembly and finishing techniques for complete product design.
Course Arrangement (Chapters/hours)	
Introduction (Part 1):	Polymer factors influencing design
Chapter 1:	Nature of plastics materials, including thermal use application ranges, polymer wall section flow ratio restrictions, polymer shrinkage ranges, component stressing, cooling time estimation and new product costing, processing energy / carbon footprint, recyclability
Chapter 2:	Polymer product design theory, including wall section changes, melt accumulation, stress raisers, residual stresses, wall thickness issues, base design, sidewall design, profile design, rim features, ribbing,

	intersections, coring, boss design
Chapter 3:	Constructing a polymer design requirement specification, including mechanical property requirement, thermal use range, environmental influences, sustainability influences, ergonomic and aesthetic considerations.
Introduction (Part 2):	Polymer project management, including costing, product development feedback loops and flow diagrams
Chapter 4:	Polymer product prototyping
Chapter 5:	Prototype tooling, construction materials and techniques
Chapter 6:	Prototype tooling, construction materials and techniques
Chapter 7:	Component prototyping techniques
Chapter 8:	Polymer product assembly and finishing techniques, including inserts, hot plate welding, vibration welding, ultrasonic welding, painting, foiling, plating, colouring.
Experimental & Practical Section	8 hours of computing laboratories using mould-flow software
Hours	
Learning Outcomes	
Other Information	
Assessment Profile	
Grading Policy	100 grades
Coursework	
Practical experiments	
Examination (written)	

Module title	Advanced Polymer Synthesis

Summary Information	
Module Code	QXU7033
Class Hours/Credit(CN/UK)	64 hours/4 credits/15 credits
Responsible Institution	QMUL
Opening Semester	Fall
Teaching Profile	40 hours Lectures, 8 hours of tutorials, 6 hours practical classes/workshops, 10 hours supervised time in studio/workshop
Course Type	Technical
Textbook and References	D.W. van Krevelen, KlaasteNijenhuis (2009) Properties of Polymers: Their Correlation with Chemical Structure, 4th Ed, Elservier ISBN 978-0-08-054819-7
Textbook	
References/Articles	
Course Description	This module will give students a thorough understanding and knowledge of polymer synthesis techniques and their main applications. It will focus on key areas for industrial applications: synthesis of high performance polymers, polymeric biomaterials, polymers used for energy production and in the micro-electronics area. At the beginning of the module, basic polymerisation methods and concepts will be reviewed, to enable students with different backgrounds to come to the same level in the field of polymer chemistry. Following lectures will focus on more advanced polymerisation methods and their use to synthesis functional materials with industrial applications.
Course Arrangement (Chapters/hours)	
Introduction:	Refresher course on basic polymerisation methods (polyesters, polyamides, polyurethanes, free radical polymerisations).
Chapter 1:	The basics of step growth (determination of molecular weight, polydispersity) and chain growth polymerisations (free radical, anionic and cationic, determination of molecular weight). Specific examples to illustrate basic polymer chemistry concepts.

Chapter 2:	Living free radical polymerisations (ATRP, RAFT, NMP). What is the concept of a controlled living polymerisation and what are the important parameters controlling these systems? Specific examples of ATRP, RAFT and NMP.
Chapter 3:	Polyester-based biomaterials synthesis (polylactides, polycaprolactone). What are polyester-based biomaterials and what are the main techniques used to synthesise them?
Chapter 4:	High performance polymers (PEEK, polyethersulfone, nafion). Why are high performance polymers needed and what specific chemistry do they involve?
Chapter 5:	Olefin metathesis polymerisations. Basics of metathesis chemistry and catalysts, use in polymer chemistry and applications.
Chapter6:	Conjugated polymer synthesis. What are conjugated polymers and what are their main types of applications? What are the main approaches to synthesise them?
Chapter 7:	Polymer bio-functionalisation. Why bio-functionalise materials? What are the main types of chemistry and approaches used to bio-functionalise materials?
Chapter 8:	Solid phase supported peptide synthesis. How are peptides synthesised? What are the main types of approaches in solid phase supported peptide synthesis?
Chapter 9:	Block copolymers synthesis. What are block copolymers? Basics of their self-assembly behaviour. How to synthesise block copolymers, especially making use of techniques discussed in lectures 2-6?
Chapter 10:	Advanced polymer architectures (dendrimers, comb-shaped polymers, supra-molecular polymers). Review the different types of polymer architectures and the synthetic approaches that allow their preparation. Discuss specific examples and their importance in real applications.

Chapter 11:	Surface-initiated polymerisations Why use surface initiation to generate polymer brushes? What are the main techniques used and how do they relate to techniques discussed in lectures 2-6?
Experimental & Practical Section	
Hours	
Learning Outcomes	
	The module aims to provide an opportunity to: 1. Explore materials selection by considering geometric and manufacturing possibilities in relation to the design requirements. 2. Consider costs both from the standpoint of capital and material costs. 3. Embrace simultaneous engineering concepts ensuring that the design process, the selection of material and the choice of manufacturing routes are interdependent operations.
Other Information	
Assessment Profile	
Grading Policy	
Coursework	20%
Practical experiments	
Examination (written)	80%

Module title	Environmental Properties of Materials

Summary Information	
Module Code	QXU6007
Class Hours/Credit(CN/UK)	56 hours/3.5 credits/15 credits
Responsible Institution	QMUL
Opening Semester	Fall
Teaching Profile	40 hours Lectures, 16 hours of tutorials/seminars
Course Type	Technical
Textbook and References	David F. Ciambrone, (1997) Environmental Life Cycle Analysis, CRC Press ISBN 9781566702140
Textbook	
References/Articles	
Course Description	This seminar based course will explore the economics of environmental management, as well as environmental politics, clean processing, recycling and eco-design, using a sophisticated life cycle analysis package. The course aims to integrate the knowledge acquired from a wide range and disparate set of different modules and in particular examine the whole life cycle environmental impact on the industrial process as a result of choosing a particular material, part or product in the design process. It is designed to equip design engineers in the future with the tools that will be required to make environmentally sound decisions in a continually changing and increasingly demanding legislative framework.
Course Arrangement (Chapters/hours)	
Introduction:	
Chapter 1:	Recycling - possibilities of recycling schemes for different types of materials like glasses, plastics and metals will be discussed.
Chapter 2:	Environmental politics - such as the EU end of life vehicle directive will be discussed as well as other political drivers for creating a sustainable society.
Chapter 3:	Ecodesign - the benefits of designing for recycling using a cradle to grave design methodology.
Chapter 4:	Examining in detail designs for single material or reduced number of materials systems that can be

	easily disassembled.
Chapter 5:	Life Cycle Analysis (LCA) - Detail of how the life cycle analysis is undertaken, including instruction in the use of appropriate life cycle analysis software.
Experimental & Practical Section	
Hours	
Learning Outcomes	
	Students will be able to express their understanding in their responses to questions not notified in advance to the satisfaction of an internal or external examiner appointed by the board of examiners. The achievement of a truly sustainable society requires fundamental changes in the way we develop, including the development of new environmentally safe materials and processing technologies. At the end of this module students will understand the environmental impact factors for a wide range of materials at different stages of their life. These stages include synthesis, production, use, recycling, and final disposal. Students will learn to deal with the complex interaction between the product and the environment during its life cycle and explore some of the critical guidelines and strategies that can be used to improve the environmental and commercial performance of products.
Other Information	
Assessment Profile	
Grading Policy	
Coursework	Report 20%
Practical experiments	
Examination (written)	2.5 hours 80%

Module title	Composite Materials
Summary Information	
Module Code	QXU5030
Class Hours/Credit(CN/UK)	56 hours/3.5 credits/15 credits
Responsible Institution	QMUL
Opening Semester	Spring
Teaching Profile	40 hours lectures, 16 hours tutorials
Course Type	Technical
Textbook and References Textbook	D Hull (1996). An Introduction to Composite Materials. 2nd Edition. Cambridge University Press. TM130HNC / ISBN:0521388554
References/Articles	
Course Description	This module examines the role of composites in modern engineering. Starting from the manufacture of glass fibres, carbon fibres, aramid fibres, polyethylene fibres and extending to the manufacturing of polymers composites using processes including for example resin transfer moulding, compression moulding and pultrusion. In addition to fibre reinforced polymer composites, the module will also consider particulate filled composite materials and high temperature metal matrix composite materials. The module will cover the theory that is used to predict the stiffness and strength of composite components, with emphasis on exploring the roles of the three different components encountered in a composite materials of fibre (filler), matrix and the interface.
Course Arrangement (Chapters/hours)	
	Manufacture of glass fibres, carbon fibres, aramid fibres, polyethylene fibres
	Exploring how the strength and stiffness of fibres is influenced by defects and molecular orientation
	Considering how effective adhesion to various polymer matrices at the interface in composites can be made and the role of coupling agents.
	The various different manufacturing methods used with composites including: processing of

	thermoset composites, filament winding, thermoforming, textile preforms, resin transfer moulding (RTM), pultrusion, unidirectional prepreg manufacturing, autoclave processing, resin transfer moulding, sheet moulding compound (SMC), processing of thermoplastic composites, long fibre injection moulding (LFT), glass-mat-thermoplastics (GMT), compression moulding.
	Provide a framework for understanding the cost of manufacture.
	Examine the joining techniques used with composite systems.
	Exploring how stiffness and strength change with fibre length and fibre orientation on failure modes in unidirectional composites.
	The use of laminate plate theory to predict the stiffness of angle-ply laminates.
	Composite design focussing on the influence of anisotropy on weight efficiency of composites versus metals, unidirectional versus quasi-isotropic laminates, and lightweight sandwich design.
	Tensile and shear modulus of unidirectional, cross-ply and angle-ply laminates.
	Failure modes in unidirectional composites (longitudinal, shear, transverse, compression).
	influence of fibre matrix adhesion (interface) on failure modes and strength of longitudinal and transversely loaded composites
	The critical fibre length, strain magnification effects and the failure of short fibre composites.
	First and last ply failure modes in angle-ply laminates.
	Durability and fatigue behaviour of composites laminates versus metals.
Experimental & Practical Section	N/A
Hours	

Learning Outcomes	
	To allow students to understand the role of composites in modern engineering this module will focus on all aspects of materials selection, design and manufacturing with composites. The module will examine the use of fibre and particulate filled polymer systems as well as metal matrix composite systems. The module will focus on the use of composites used in aerospace engineering and other high tech uses such as in sports goods and automotive applications. The module will consider: 1. Material aspects such as fibres, matrices and interfaces 2. Manufacturing of polymer, ceramic and metal matrix composites 3. Design concepts a the micro- and macro-level as well as failure analysis of composite laminates 4. Joining, repair and inspection technologies
Other Information	
Assessment Profile	
Grading Policy	
Coursework	20%
Practical experiments	
Examination (written)	80%

Module title	Functional Polymers
Summary Information	
Module Code	QXU6034
Class Hours/Credit(CN/UK)	64 hours/4 credits/15 credits
Responsible Institution	QMUL
Opening Semester	Spring
Teaching Profile	40 hours Lectures, 16 hours of tutorials
Course Type	Technical
Textbook and References Textbook	Conducting Polymers, G. Inzelt, György: Springer Verlag 2 ed. 2012. Electroactive polymer (EAP) actuators as artificial muscles: reality, potential, and challenges, Y. Bar-Cohen (Ed.), SPIE Press 2001. Microfluidics and Microfabrication, S. Chakraborty, Springer 2009. Full text available via library website. D.W. van Krevelen, KlaasteNijenhuis (2009) Properties of Polymers: Their Correlation with Chemical Structure, 4th Ed, Elservier ISBN 978-0-08-054819-7
References/Articles	
Course Description	This module will give students a thorough understanding of the principles of functional behaviour in polymers and their main applications. At the beginning of the module, electronic structure of solids and vibrational behaviour will be reviewed. Key molecular structures and their functions will be studied, such as congugated polymers, blends and liquid crystal behaviour. The module will then focus on key areas for industrial applications: sensors and thin film display materials, conducting polymers and polymer transistors, opto-electronic polymers and organic solar cells, polymers used for energy storage applications and in the micro-electronics area, stimuli responsive polymers that respond to temperature or pH change.

Course Arrangement (Chapters/hours)	
Chapter 1:	Review of electronic structure
Chapter 2:	Molecular electronic structure
Chapter 3:	Vibrational structure
Chapter 4:	Phonons and photons
Chapter 5:	Functionalization, molecular structures and architectures for different applications
Chapter 6:	Semiconducting conjugated polymers and applications
Chapter 7:	Liquid-crystal polymers and their applications
Chapter 8:	Stimuli responsive polymers and their applications
Chapter 9:	Topological polymers and their applications
Experimental & Practical Section	
Hours	
Learning Outcomes	
	The aim of this module is to develop in the students a broad understanding of functional polymers such as conductive polymers and liquid crystals for applications such as displays, sensors, solar cells. The module aims to provide an understanding of the principles underlying functional polymer systems and to provide an overview of the properties and applications of functional polymers.
Other Information	
Assessment Profile	
Grading Policy	
Coursework	20%
Practical experiments	
Examination (written)	80%

Module title	Experiments in Materials 1
Summary Information	
Module Code	QXU4007
Class Hours/Credit(CN/UK)	56 hours/3.5 credits/15 credits
Responsible Institution	QMUL
Opening Semester	Fall
Teaching Profile	40 hours of laboratory practicals, 16 hours of tutorials
Course Type	Technical
Textbook and References	
Textbook	
References/Articles	
Course Description	This module aims to develop in the students an awareness of all aspects of the subject and professional life in the second year of the degree programme, with a follow-on module in the third year. Cognitive and transferable skills are developed in an integrated series of seminars, practical exercises and problem based learning case studies. All of the exercises draw on subject matter being taught within core course units in the relevant year.
Course Arrangement (Chapters/hours)	N/A
Experimental & Practical Section	
Hours	Scientific and laboratory practice
	Collection and recording of data
	Presentation of data
	Statistical methods, Significance tests, Uncertainty of measurement
	Reporting
	Scientific writing style
	Oral presentation
	Literature searching
	Problem solving strategies

	Creative thinking methods
	Group working methods microscopy
	Measurements of length, angle, time temperature, electrical resistivity
	Introduction to materials characterisation techniques
	Finding relationships from data
	Simple Structure-property relations
	Materials selection criterion and simple design exercises
Learning Outcomes	
	Students will learn how to measure, length, angle, temperature and electrical resistivity of a range of materials.
	Students will learn how to use microscopes and other characterisation techniques.
	Students will learn to recognise and characterise material behaviour.
Other Information	
Assessment Profile	
Grading Policy	
Coursework	100%
Practical experiments	
Examination (written)	

Module title	Experiments in Materials 2
Summary Information	
Module Code	QXU5017
Class Hours/Credit(CN/UK)	56 hours/3.5 credits/15 credits
Responsible Institution	QMUL and NPU
Opening Semester	Spring
Teaching Profile	40 hours of laboratory practicals, 16 hours of tutorials
Course Type	Technical
Textbook and References	J.J.C. Busfield and T. Peijs, (2003), Learning Materials in a Problem Based Course, UK Centre for Materials Education, Liverpool, UK C. Chatfield (1983), Statistics for Technology: A course in applied statistics, 3rd edition Chapman &Hall,/CRC Florida USA
Textbook	
References/Articles	
Course Description	This module aims to develop in the students an awareness of all aspects of the subject and professional life in the second year of the degree programme, building on the module in the second year. Cognitive and transferable skills are de veloped in an integrated series of seminars, practical exercises and problem based learning case studies. All of the exercises draw on subject matter being taught within core course units in the relevant year.
Course Arrangement (Chapters/hours)	N/A
Experimental & Practical Section	
Hours	Scientific and laboratory practice
	Collection and recording of data
	Presentation of data
	Statistical methods, Significance tests, Uncertainty of measurement
	Reporting
	Scientific writing style
	Oral presentation
	Literature searching

	Problem solving strategies
	Creative thinking methods
	Group working methods microscopy
	Measurements of length, angle, time temperature, electrical resistivity
	Introduction to materials characterisation techniques
	Finding relationships from data
	Simple Structure-property relations
	Materials selection criterion and simple design exercises
Learning Outcomes	
	The aim of this module is to develop problem solving strategies relevant to materials engineering and will enable students to express their understanding in written reports and oral presentations. Students will be able to search the literature and synthesize ideas from sources of information and develop their scientific practice and be able to collect, record and interpret complex sets of experimental data and use statistical methods to express uncertainty of measurements and scatter and significance in data. Students will be able to characterise material systems using both simple methods and advanced characterisation techniques. Students will gain experience with the concept of quality management systems and design control.
Other Information	
Assessment Profile	
Grading Policy	
Coursework	80% (Reports – 2 x 20%, Oral presentation 20%, Written assignment 20%)
Practical experiments	Practical skills assessment 20%
Examination (written)	

Module title	Polymer Engineering Project
Summary Information	
Module Code	QXU6035
Class Hours/Credit(CN/UK)	128 hours/8 credits/15 credits
Responsible Institution	QMUL and NPU
Opening Semester	Spring
Teaching Profile	
Course Type	Technical
Textbook and References	Individual reading for subject of project
Textbook	
References/Articles	
Course Description	The purpose of the project will be to provide in depth knowledge of a particular research area in Polymer Materials. There will be no set rules concerning format, which will depend on the nature of the subject and personal choice. The project will typically involve experimentation which will be carried out in an associated subject area chosen by a member of academic staff (supervisor). Time for experimentation is limited and considerable emphasis will be placed on the analysis, interpretation and discussion of the experimental results obtained.
Course Arrangement (Chapters/hours)	N/A
Experimental & Practical Section	
Hours	A prescribed syllabus is not available for this unit. The unit draws on and extends the transferable skills listed in the Departmental Skills Chart. The content and trajectory of individual projects are subject to the guidance of the academic advisors.

Learning Outcomes	
	The aim of this module is to develop in the students the ability to conduct research into a particular polymer materials science topic. They will use and develop the skills learned in Experiments in Materials 1 and 2, searching the literature, conducting practical experiments, analysing the results using statistical analysis techniques, and expressing their understanding in a written report and oral presentation.
Other Information	
Assessment Profile	
Grading Policy	
Coursework	70% Dissertation
Practical experiments	Oral presentation 30%
Examination (written)	