香港城市大學
City University of Hong Kong

College of Science and Engineering
科學及工程學院

Department of Physics and Materials Science
物理及材料科學系

Bachelor of Engineering (Hons) in Materials Engineering
材料工程學榮譽工學士

Student Handbook
2014-2015

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Introduction

This Handbook contains useful information for students enrolled in the Bachelor of Engineering (Hons) in Materials Engineering Major. Students are advised to familiarize themselves with this Handbook so as to obtain a general overview of their relationship to the Department. It is, however, intended to be read in conjunction with other official information produced by the City University of Hong Kong.

The Department of Physics and Materials Science

The world of science and technology in the new millennium is facing scientific challenges in the areas of Information Technology, Biotechnology, Nanotechnology, Energy and Environmental Science. In all these endeavors, materials issues are ubiquitous and the understanding of the underpinning physics is essential. In 1993, the City University of Hong Kong, recognizing the importance of these frontier challenges as well as the need for a synergism between education and research encompassing both physics and materials, formed the Department of Physics and Materials Science - the first of its kind in Hong Kong.

Over a ten-year period the Department has grown to a current size of 29 teaching staff. In addition, there are approximately 68 research students and 115 research and technical staff. The Department now offers two undergraduate majors, BSc (Hons) in Applied Physics and BEng (Hons) in Materials Engineering, with a total of about 279 full-time students. Moreover, the Department offers a taught Master of Science (MSc) degree in Materials Engineering and Nanotechnology with a total of approximately 70 students, as well as post-graduate degree programmes for Master of Philosophy (MPhil) and Doctor of Philosophy (PhD). The Department's objectives are threefold: to educate students with advanced knowledge and skills, to conduct innovative, especially applied, research and development leading to the advancement of science and technology, and to render professional services for the professional community in Hong Kong and the Pan Pearl River Delta region.

The academic degrees offered by the Department build upon foundation courses with problem-solving capabilities and advanced skills, thus enabling graduates to adapt effectively to the changing demands. The academic staff of the Department have all earned doctoral degrees from the world's leading academic institutions. Many acquired international reputation and substantial working experience in North America, Europe, Australia or China before joining the Department, bringing with them invaluable knowledge and skills for transfer to their students.

In response to the rapid advances in scientific knowledge and technologies, we maintain a high standard and a dynamic research team encompassing both applied and basic research activities. The Department excels in research over a wide range of topics, maintaining sustained collaborations with scientific communities in China, the USA, Japan, Australia and Europe. Our current research areas include: applied optics, environmental physics, computational materials science, surface science and engineering, functional materials and coatings, electroceramics, metals and alloys, polymer composites, electronic materials, magnetism and spintronics, superconductivity, plasma engineering, biomaterials, optoelectronics, photonics, smart materials, instrumentation and measurements, medical radiation physics, nanoscience and technology, nano-scale devices, molecular and bio-electronics, organic light emitting devices, shape memory alloys.

In the past five years, our research support totalled more than $136 million from external grants (including matching funds) in addition to about $80 million from internal sources. Our academic staff have published approximately 1400 technical papers in internationally refereed journals and delivered approximately 500 invited talks and conference presentations during the same period. Several outstanding research awards and recognitions have been granted to our staff such as IEEE/NPSS Merit Award, Friedrich Wilhelm Bessel Research Award, Fellowship of the American Physical Society, ASM International, AVS, IEEE, HKIE and the Institution of Mechanical Engineers. Our academic staff are professionally active through editorships of about thirty international journals, organization of a number of international conferences or symposia, contributions to committee functions in a number of local and international organizations and societies.

With well-equipped laboratories, sound curriculum degrees and advanced multi-media education facilities, the devoted staff of the Department of Physics and Materials Science welcome the new challenges and are ready to bring state-of-the-art education to all students entering our degrees.

Members of Staff, with Areas of Specialism

STAFF	AREAS OF SPECIALISM
Head of Department and Chair Professor of Physics	
Prof X L Wang BSc *Peking University, China* PhD *Iowa State University, USA* Fellow, American Physical Society Email : aphead@cityu.edu.hk (for departmental matters) xlwang@cityu.edu.hk	Neutron and synchrotron scattering Phase transformation, deformation, magnetism, residual stress determination Metallic glasses, nanostructured materials, magnetic shape memory alloys
Personal Secretary **Ms Sare W Y Lau** Email : sare.lau@cityu.edu.hk	
Chair Professor of Materials Engineering **Prof Paul K Chu** BSc *The Ohio State University, USA* MSc PhD *Cornell University, USA* Fellow, American Vacuum Society Fellow, Institute of Electrical and Electronics Engineers Fellow, American Physical Society Fellow, Materials Research Society Fellow, Hong Kong Institution of Engineers Email : paul.chu@cityu.edu.hk	Plasma science, implantation, processing and engineering Semiconductor materials and processing Biomedical materials and nanobiology Advanced materials, functional thin films, and nanomaterials
Chair Professors of Materials Science **Prof Joseph K L Lai** BA MA *Oxford University, UK* PhD *City University, UK* Fellow, Institute of Materials, Minerals and Mining, UK Chartered Engineer, UK Fellow, Institute of Physics, UK Chartered Physicist, UK Fellow, Institution of Mechanical Engineers, UK Fellow, Hong Kong Institution of Engineers Email : apjoelai@cityu.edu.hk	Properties of steels and aluminium Failure analysis of engineering components Temperature measurement Expert witness on accident investigations Litigations and arbitrations involving metals

Prof C S Lee
BSc(Eng) PhD *University of Hong Kong*
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Organic electronics
Nanoscaled materials
Solar cells and photodetectors

Chair Professor of Nuclear Engineering
Prof C H Woo
BSc (Special Honours) *University of Hong Kong*
MSc *University of Calgary, Canada*
PhD *University of Waterloo, Canada*
DSc *University of Hong Kong*
Fellow, Hong Kong Institution of Engineers
Email : chungwoo@cityu.edu.hk

Nuclear Materials
Reactor aging due to irradiation damage

Chair Professor of Photonics Materials
Prof Andrey L Rogach
Diploma *Belarusian State University, Belarus*
PhD *Belarusian State University, Belarus*
Dr habil *Ludwig-Maximilians University, Munich, Germany*
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Nanoscience and nanotechnology
Advanced functional materials
Optical spectroscopy

Professor and Associate Dean (CSE)
Prof Robert K Y Li
BA BAI MA PhD *Dublin University, Ireland*
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Polymer engineering
Composite materials

Professor and Assistant Dean (CSE)
Prof C H Shek
BSc(Eng) PhD *University of Hong Kong*
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Phase transformation in metallic materials
Nanostructured materials
Bulk metallic glasses

Professors
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Semiconductor physics
Photonics technology
Nanoscience and nanotechnology
Spintronics
Superconductivity

Prof S C Tjong
BSc *National Taiwan University, Taiwan*
MSc PhD *University of Manchester, UK*
Chartered Engineer, UK
Chartered Scientist, UK
Fellow, Institute of Materials, Minerals and Mining, UK
Fellow, Hong Kong Institution of Engineers
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Surface science
Electron microscopy
Polymer composites
Biomaterials
Nanostructured materials

Prof Lawrence C M Wu
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PgDMS *University of West of England, UK*
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Engineering failure analysis
Lead-free interconnections
Nano-materials for solar cells and biosensors

Prof Peter K N Yu
BSc PhD *University of Hong Kong*
Chartered Scientist, UK
Chartered Physicist, UK
Fellow, Institute of Physics, UK
Chartered Radiation Protection Professional
Member, Society of Radiological Protection, UK
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Radiation biophysics
Medical physics
Biointerfaces

Prof R Q Zhang
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Surface, interface and microstructures of functional materials
Vapor-solid interactions
Computational materials science
Nanoscience

Prof W J Zhang
BSc MSc PhD *Lanzhou University, China*
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Surface and interface analysis
Thin films
Diamond and superhard materials
Nanomaterials

Associate Professors

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Integrated photonics
Sensors and sensing systems
Numerical methods

Dr C Y Chung
BSc(Eng) PhD *University of Hong Kong*
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Metallic materials
Shape memory alloy
Powder metallurgy
Battery materials

Dr A L Roy Vellaisamy
BSc *St Xavier's College, India*
MSc *Loyola College, India*
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Molecular electronics
Molecular self-assembly
Photonics
Nano-materials science
Bio-electronics
Renewable energy (solar and fuel cells) and printed electronics

Dr Z K Xu
BSc *Shanghai University of Science and Technology, China*
MSc *California State Polytechnic University at Pomona, USA*
PhD *University of Illinois at Urbana-Champaign, USA*
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Electron microscopy
Materials characterization
Processing of advanced materials
Electroceramics

Assistant Professors

Dr Jun Fan
BEng *Tsinghua University, Beijing, China*
MSc *McMaster University, Hamilton, Canada*
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Theoretical and computational materials science and biophysics
Assembly molecular self-assembly
Structure, function and dynamics of cell membranes and proteins
Molecular dynamics simulations
Phase field modeling
Free energy calculations

Dr Derek Ho
M.A.Sc. B.A.Sc., *University of British Columbia, Canada*
Ph.D., *University of Toronto, Canada*
Member, *Institute of Electrical and Electronics Engineers (IEEE)*
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Smart arrayed sensors for optical, chemical, and electrical biosensing
Instruments for fluorescence spectroscopy, bioluminescence imaging, and lenseless microscopy
Fully-integrated lab-on-a-chips and microsystems
Electronics for implantable, wearable, and handheld medical diagnostics
CMOS circuits and systems for signal processing, control, and computation
Microelectronic, nanoelectronic, and optoelectronic devices

Dr Johnny C Y Ho
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Synthesis and characterization of nano-structured materials
Assembly and heterogeneous integration of nano-materials
Nano-scale devices and processing for technological applications (electronics, energy-harvesting, photonics, sensors)

Dr Condon Lau
BSE, *Princeton University, USA*
MSc PhD *Massachusetts Institute of Technology, USA*
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Optics
Nuclear magnetic resonance
Biophysics
Spectroscopy
Imaging

Dr Y Y Li
BSc *Peking University, China*
MSc PhD *University of California, San Diego, USA*
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Electrochemical nanofabrication
Functional porous nanomaterials
Sensors
Electrode materials
Smart biomaterials

Dr Antonio Ruotolo
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Magnetism and spintronics
Superconductivity
Semiconductor oxides
Thin film technology
Nano-lithography

Dr Suresh M Chathoth
MSc *Andhra University, India*
MPhil *University of Madras, India*
MTech *National Institute of Technology Karnataka, India*
PhD *Technical University of Munich, Germany*
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Neutron scattering
Dynamics of liquid in confinements
Energy storage
Glass transition

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Advanced materials for photovoltaic application
Solution processed electronic materials
Semiconductor device physics
Spectroscopy techniques

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Luminescent nanomaterials
Photon upconversion
Optical spectroscopy

Dr Chunyi Zhi
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PhD *IOP, CAS, China*
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BN/BCN nanomaterials
Thermally conductive electrically insulating polymer composites for heat dissipation
Energy related electrochemical & photoelectrochemical devices
Nanomaterials for sewage treatment

Emeritus Professor
Prof Czeslaw Z Rudowicz
Institute of Physics,
West Pomeranian University of Technology, Poland

Quantum mechanics
Condensed matter physics
Magnetism
Electron magnetic resonance
Crystal (Ligand) field theory
Computational physics
Scientific databases

Honorary Professors
Prof Nathan W T Cheung
Professor Emeritus, Department of Electrical Engineering and Computer Sciences, University of California, Berkeley, USA

Microelectronics technologies
Surface science and nanoscience
LED and photovoltaic

Prof Y W Mai
Center for Advanced Materials, Technology, School of Aerospace Mechanical and Mechatronic Engineering, University of Sydney, *Australia*

Advanced engineering materials including bio, nano and functionally graded materials
Fracture and fatigue mechanics
Fiber composites science and technology
Tribology and surface engineering
Failure mechanics and analysis

Adjunct Professors

Prof Yeshayahu Lifshitz
Materials Engineering Dept,
Technion – Israel Institute of
Technology, Israel

Silicon and other semiconducting nanowires
Ion-beam structuring of materials
Diamond and diamond like carbon and related materials
Ion interactions with materials
Space environmental effects on materials
Electronic devices and systems

Prof L J Wan
Professor of Chemistry,
Director, Institute of Chemistry,
Chinese Academy of Sciences

Nanoscience and technology
Molecular assembly and device
Materials chemistry
Electrochemistry
Scanning probe microscopy

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BEng (Honours) in Materials Engineering

Major Leader

Major Leader: Dr C Y Chung
Deputy Major Leader: Dr Z K Xu & Dr Johnny Ho

Major Aims and Features

The role of materials in our society is much more important than most of us have realized. Our lives would be endangered by storms in the absence of concrete and steel. Our visual defects cannot be easily corrected without glass. The launching of satellites and space shuttles would not be possible without heat-resistant materials and semiconductors.

Our comfortable lives are intimately associated with the discovery, selection and processing of natural and synthetic materials. Materials Engineering deals with the advancement in the understanding and manipulation of materials, which is always the forerunner to the progression of technology.

The recent rapid advances in nanomaterials technology has opened up new opportunities for the prosperous career development of materials engineers.

Accreditation for Professional Status

The BEng (Hons) degree in Materials Engineering has been accredited by the Hong Kong Institution of Engineers (HKIE) as an award satisfying the academic requirements for its route to Corporate Membership (MHKIE).

Career Prospects

In a study entitled "Technology Road Maps for Hong Kong" conducted for the Industry Development Board of the Hong Kong SAR Government, materials technology has been identified as one of the four major areas which offer good opportunities for future development. In 2004, the Innovation and Technology Commission of the Hong Kong SAR Government proposed Nanotechnology and Advanced Materials as one of the 13 technology focus areas in Hong Kong. Graduates with a materials-related degree are highly qualified to pursue a wide range of careers in industrial and business sectors.

Examples are agencies that conduct materials characterization and testing, construction industries, education, manufacturers of electronic components and semiconductor manufacturing, metals related industries, plastics related industries, product design and development, quality control, research degree opportunities, and technical marketing.

- Agencies that conduct materials characterization and testing
- Construction industries
- Education
- Manufacturers of electronic components and semiconductor manufacturing
- Metals related industries
- Ceramics related industries
- Plastics related industries
- Product design and development
- Quality control
- Research degree opportunities
- Technical marketing

Duration of Study

Students shall complete the degree and major requirements within the stipulated maximum period of study (i.e., 8 years for Normative 4-year degree, 6 years for Advanced Standing I, and 5 years for Advanced Standing II), inclusive of any change of majors, periods of leave of absence and suspension of studies. The maximum period of study for individual double degrees shall be stipulated by the cognizant academic units.

Assessment and Progression

Students are assessed through a variety of methods, creating ample opportunity to demonstrate their abilities. The means of assessment vary from course to course but typically include coursework as well as the more traditional written examinations. Coursework consists of written assignments, tutorials, projects and laboratories. Examinations are held at the end of each course where there is an examination component.

With effect from September 2003, a student has to obtain at least 30% of the maximum marks in the final examination in order to pass a course (i.e., D or above) where there is an examination component in the assessment.

When a student's Semester Grade Point Average (SGPA) or Cumulative Grade Point Average (CGPA) falls below 1.7, he/she will be considered as having academic difficulties. The student should then consult the Tutor or Programme/ Major Leader for advice. If the CGPA is too low, the College Examination Board may terminate the student's study.

Calculation of Grade Point Average:

Semester Grade Point Average (SGPA)	The GPA calculated for all the courses taken in one semester, including failed courses, but excluding courses graded I, X or P.
Cumulative Grade Point Average (CGPA)	$CGPA = \frac{\sum_{i=1}^{n} G_i U_i}{\sum_{i=1}^{n} U_i}$ Where G is the grade point awarded and U the credit units earned for the i^{th} course.

A student who believes that his/her ability to attend an examination, or in-course assessment with a weighting of 20% or above, has been adversely affected by circumstances beyond his/her control may submit a mitigation request with the scanned relevant supporting documents (e.g. medical certificate) to the Department via AIMS no later than 5 working days from the scheduled date for completing the affected examination or assessment. It is the student's responsibility to hand in the original copies of all the required documents to the Department by the aforesaid deadline as well.

Upon receipt of a mitigation request (including the original copies of the required documents), the Department will investigate the case, in consultation with the course-offering academic unit (if appropriate). Only compelling reasons such as illness, hospitalization, accident, family bereavement or other unforeseeable serious circumstances will be considered. If the case is substantiated, the Assessment Panel will then decide if a make-up examination or coursework or other alternative assessment will be offered to the student concerned. Only one make-up examination will be arranged per course per semester.

Late Submission of Assessment Tasks

20% of the marks obtained by the student will be deducted each day linearly for late submission of assessment tasks across the Department.

Award Classification

Students who enrolled in or after 2010/11 will follow the following award boundaries starting from 2010/11.

1st Class	CGPA ≥ 3.50
2nd Upper	CGPA 3.00-3.49
2nd Lower	CGPA 2.50-2.99
3rd Class	CGPA 2.00-2.49
Pass	CGPA 1.70-1.99

Late Drop

Students can add or drop a course during the add/drop period prescribed by the University. After the add/drop deadline, requests for late drop of courses will only be approved under exceptional circumstances, and such late requests must be submitted no later than the end of the teaching period for the relevant semester/term for approval by the Head of the course-offering academic unit.

Communication Channels

There are various channels of communication between students and the Department. On an informal basis, students having academic difficulties with a course are encouraged to approach the lecturer or tutor concerned. Tutors are also available for students having general academic problems.

A formal consultative process between students and staff exists in the Department in the form of a Joint Staff/Student Consultative Committee (JSSCC), to which two student representatives from each cohort of each mode will be nominated. The Committee meets at least once a semester. During the meeting, discussions are confined to matters of a general academic nature and the welfare of students. Students can express their views on the content and organization of the programme and identify any areas of difficulty.

Besides the JSSCC, students are also represented in the Programme Committee. One student representative from each programme cohort will be elected as member of the Committee. The Programme Committee meets at least once a semester and is charged with the responsibility of monitoring the operation and performance of the programme.

Major Structure and List of Courses offered in Academic Year 2014/15

To complete BEng (Hons) in Materials Engineering and earn the award, students must obtain credits in major, Gateway Education and College Requirement.

Normative 4-year degree *(Minimum credit units for graduation: 120; Maximum credit units permitted for students: 144)*	**Advanced Standing I** (Note 1) *(Minimum credit units for graduation: 90; Maximum credit units permitted for students: 114)*	**Advanced Standing II (Senior-year Entry)** (Note 2) *(Minimum credit units for graduation: 60; Maximum credit units permitted for students: 84)*
120 CUs Gateway Education: 30 College Requirements: 15 Major Requirements (Core + Elective): 72 (45+27/48+24) Free Elective:3	**93 CUs** Gateway Education: 21 College Requirements: waived Major Requirements (Core + Elective): 72 (45+27/48+24) Free Elective: 0	**78 CUs** Gateway Education: 12 College Requirements: waived Major Requirements (Core + Elective): 66 (39+27/42+24) Free Elective: 0

A set of core courses in the following areas are required for the Materials Engineering Major:

General Physics, Mathematics, Computer Programming, Engineering Graphics, Solid Mechanics, Properties and Processing of Materials, Workshop, Materials Testing and Characterization, Thermodynamics, Kinetics, Engineering Design, Dissertation

Elective course in the following areas are available for students' selection:

Fracture, Stress Analysis, Building Materials, Ceramic & Electroceramics, Polymer and Nanocomposite Materials, Electronic Packaging, Environmental Degradation, Failure Analysis, Microelectronic Materials and Processing, Simulation and Modelling in Materials Science, Thin Film Technology and Nanocrystalline Coatings, Smart and Functional Materials, Nanostructures and Nanotechnology, Solar Cell and Energy Materials, Biomedical Materials and Devices

Degree Requirement

1. Gateway Education

(Please refer to http://www.cityu.edu.hk/edge/ge/ge_requirements.htm.)

	Normative 4-year Degree	**Advanced Standing I** (Note 1)	**Advanced Standing II (Senior-year Entry)** (Note 2)
English	6 credit units • GE1401 University English (3 CUs); and • Discipline-specific English (3 CUs)	6 credit units • GE1401 University English (3 CUs); and • Discipline-specific English (3 CUs)	3 credit units • Discipline-specific English (3 CUs)
GE1501 Chinese Civilisation – History and Philosophy	3 credit units	3 credit units	Not compulsory requirement
Area requirements: Area 1: Arts and Humanities Area 2: Study of Societies, Social and Business Organisations Area 3: Science and Technology	21 credit units *(A minimum of 3 credit units from each of the three areas)*	6 credit units	3 credit units
College/School-specified Courses	N/A	6 credit units^	6 credit units *[Any courses not within the Major Requirements (including core courses and electives)]*

^College-specified courses for Advanced Standing I Students

Course Code	Course Title	Credit Units	Remarks
CS1302	Introduction to Computer Programming	3	Students taking Major elective *AP3114 Computational Methods for Physicist and Materials Engineers* or *AP4172 Simulation and Modelling in Multidisciplinary Sciences* may apply for exemption. They are required to complete any course of 3 credits (**NOT within the major requirements including core courses and electives)** to replace the exempted credits.
MA1201/ MA1301	Calculus and Basic Linear Algebra II/ Enhanced Calculus and Linear Algebra II	3	

2. Chinese Language Requirement

Depending on the entry qualifications and the level of attainment in the Chinese language subject as determined by the University, students may be required to take one or more additional Chinese courses and/or major-specific Chinese courses in fulfilment of the Chinese Language Requirement. http://www6.cityu.edu.hk/arro/content.asp?cid=165 (section 4.12):

From 2012 cohort onwards, students are required to satisfy the Chinese Language Requirement as follows:

(i)	Students with an HKDSE score below 4 in Chinese, or an HKALE AS Chinese Language and Culture score below D	CHIN1001 University Chinese I*
(ii)	Students with an HKDSE score of 4 or above in Chinese or an HKALE AS Chinese Language and Culture score D or above, or those who have successfully completed CHIN1001 University Chinese I	No requirement
(iii)	Students whose qualifications do not fall within (i) and (ii) above	No requirement

*The 3 credit units of CHIN1001 University Chinese I will NOT be counted towards the minimum credit units required for graduation and will NOT be included in the calculation of CGPA.

3. College Requirement

Normative 4-year degree students of the College of Science and Engineering are required to earn 15 CUs in fulfilment of the College requirements.

Course Code	Course Title	Level	Credit Units	Remarks
Normative 4-year Degree				
Mathematics (6 credit units)				
MA1200 / MA1300	Calculus and Basic Linear Algebra I / Enhanced Calculus and Linear Algebra I	B1	3	
MA1201 / MA1301	Calculus and Basic Linear Algebra II / Enhanced Calculus and Linear Algebra II	B1	3	
Computing (3 credit units)				
CS1102 / CS1302	Introduction to Computer Studies / Introduction to Computer Programming	B1	3	

Science (6 credit units) *Choose **two** from the following three subject areas:*				
Physics				
AP1201	General Physics I	B1	3	
Chemistry				
BCH1100	Chemistry	B1	3	
Biology				
BCH1200	Discovery in Biology	B1	3	
Advanced Standing I (Note 1)				
College Requirement waived.				
Advanced Standing II (Senior-year Entry) (Note 2)				
College Requirement waived				

Major Requirement (72 credit units for Normative 4-year degree students; 72 credit units for Advanced Standing I students; 66 credit units for Advanced Standing II students)

For students admitted to the Major in Academic Year 2014/15

1. Core Courses:

- Normative 4-year degree students (45 or 48 credit units);
- Advanced Standing I students (45 or 48 credit units);
- Advanced Standing II students (39 or 42 credit units).

Course Code	Course Title	Level	Credit Units	Remarks
AP1202	General Physics II	B1	3	Students with Grade D or above in HKAL Physics OR students with equivalent qualification may apply for exemption. They are required to complete any course of 3 credits to replace the exempted credits. Advanced Standing II students are not required to take this course
AP1203 #	General Physics III	B1	3	Advanced Standing II students are not required to take this course.
AP2102	Introduction to Materials Engineering	B2	3	
AP2104	Mechanics of Solids	B2	3	
AP2243	Workshop Practice	B2	3	
AP3109	Kinetic Processes in Engineering Materials	B3	3	
AP3169	Materials Testing Techniques	B3	3	
AP3171	Materials Characterization	B3	3	

	Techniques			
AP3172	Electronic Properties of Solids	B3	3	
AP3190	Thermodynamics of Materials	B3	3	
AP3244	Design Laboratory	B3	3	
AP4116 / FS4003 / FS4004	Dissertation CES Placement Project Overseas Research Internship Scheme	 B4	6/ 6/ 9*	*Students who completed *FS4004 Overseas Research Internship Scheme* can take 3 credit units elective less to fulfill the major requirement.
EE3013	Engineers in Society	B3	0	
MA2158 / MA2170 / MA2172 / MA2177 / MA2181	Linear Algebra and Calculus Linear Algebra and Multi-variable Calculus Applied Statistics for Sciences and Engineering Engineering Mathematics and Statistics Mathematical Methods for Engineering	 B2	 3	
MBE2016	Engineering Graphics	B2	3	

2. Electives:

- **Normative 4-year degree students (24 or 27 credit units);**
- **Advanced Standing I students (24 or 27 credit units);**
- **Advanced Standing II students (24 or 27 credit units).**

Course Code	Course Title	Level	Credit Units	Remarks
Group A (Fundamental Electives): at least 12 credit units from this group of courses				
AP2105 #	Engineering Mechanics: Dynamics	B2	3	
AP3110	Deformation and Fracture	B3	3	
AP3111	Ceramic Processing and Microstructure Development	B3	3	
AP3113	Polymer Engineering	B3	3	
AP3114	Computational Methods for Physicist and Materials Engineers	B3	3	
AP3130 #	Biomaterials	B3	3	
AP4170	Environmental Degradation	B4	3	
Group B (Specialized Electives)				
AP4114	Stress Analysis	B4	3	
AP4118	Composite Materials – with An Introduction to Nanocomposites	B4	3	
AP4121	Thin Film Technology and	B4	3	

	Nanocrystalline Coatings			
AP4124	Failure Analysis and Case Studies	B4	3	
AP4126	Electroceramics	B4	3	
AP4127 #	Smart Sensors: From Engineering to Applications	B4	3	
AP4171	Electronic Packaging and Materials	B4	3	
AP4172	Simulation and Modelling in Multidisciplinary Sciences	B4	3	
AP4175	Advanced Technology in Biomedical Devices	B4	3	
AP4176	Energy Materials for the Current Century	B4	3	
AP4177	Smart and Functional Materials: Selection and Application	B4	3	
AP4178	Nanostructures & Nanotechnology	B4	3	
AP4253	Photonic Materials Physics	B4	3	
AP4280	Advanced Optics Laboratory	B4	3	
AP4307	Building Materials	B4	3	
AP4714	Special Topics in Materials Science and Engineering	B4	3	
FS4002 #	Industrial Attachment Scheme	B3	3	

Remarks: Course(s) under the major requirements may be waived for students of Advanced Standing I/II, depending on their academic qualifications.

Note 1: For students with recognized Advanced Level Examinations or equivalent qualifications.

Note 2: For Associate Degree/Higher Diploma graduates admitted to the senior year.

Availability subject to approval (Please check the update on http://www.ap.cityu.edu.hk/index.aspx?id=20061213174918&lang=e)

Recommended Study Plan

A suggested course schedule for BEng (Hons) Materials Engineering

(For **HKDSE** students admitted in year 2014/15)

Year 2

Sem A (credit unit)		**Sem B (credit unit)**		**Summer (credit unit)**	
AP1202	General Physics II (3)	#AP1203	General Physics III (tba) (3)	AP2243	Workshop Practice (3)
AP2102	Introduction to Materials Engineering (3)	AP3169	Materials Testing Techniques (3)		
MA2158/ MA2170/ MA2172/ MA2177/ MA2181	Linear Algebra and Calculus (3)/ Linear Algebra and Multi-variable Calculus (3)/ Applied Statistics for Sciences and Engineering (3)/ Engineering Mathematics and Statistics (3)/ Mathematical Methods for Engineering (3)	MBE2016	Engineering Graphics (3)		
**AP1200*	*Foundation Physics*				
**AP1201*	*General Physics I*				
**BCH1100*	*Chemistry*				
Sub-total = 9 units		Sub-total = 9 units		Sub-total = 3 units	
Year 2 Total = 21 units					

**Optional for students who would like to strengthen their background*

Availability subject to approval

Remarks: More update version please refer to
http://www.ap.cityu.edu.hk/index.aspx?id=20061213174918&lang=e for details

Year 3

Sem A (credit unit)		Sem B (credit unit)		Summer (credit unit)	
AP2104	Mechanics of Solids (3)	AP3109	Kinetic Processes in Engineering Materials (3)	FS4002 (elective B5)	Industrial Attachment Scheme (3)
AP3171	Materials Characterization Techniques (3)	#AP3244	Design Laboratory (tba) (3)		
AP3172	Electronic Properties of Solids (3)	Elective A2 (3)			
AP3190	Thermodynamics of Materials (3)	Elective A3 (3)			
Elective A1 (3)		Sub-total = 12 units		Sub-total = 3 units	
Sub-total = 15 units					
Year 3 Total = 27 or 30 units					

Availability subject to approval

Year 4

Sem A (credit unit)		Sem B (credit unit)	
AP4116	Dissertation (3)	AP4116	Dissertation (3)
EE3013	Engineers in Society (0)	Elective B3 (3)	
Elective A4 (3)		Elective B4 (3)	
Elective B1 (3)		Elective B5 (3)	
Elective B2 (3)			
Sub-total = 12 units		Sub-total = 9 or 12 units	
Year 4 Total = 21 or 24 units			

On top of the above 72 required credits in major requirement, students have to satisfy the degree requirement of 30 credits in Gateway Education and 15 credits in College Requirement as specified by the University and 3 credits Free Electives.

Brief Course Description
(Please refer to http://www.cityu.edu.hk/arro-cat/catalogue/current/catalogue_UC.htm?page=B/B_course_code_AtoZ_A.htm for pre-cursor and pre-requisite for each course.)

AP1201 General Physics I

Mechanics. Heat and gases. Waves. Optics.

AP1202 General Physics II

Electrical properties. Electric fields. Magnetism. Atomic physics.

AP1203 # General Physics III

Elasticity, equilibrium, conservation of linear momentum, collision in one and two dimensions, physics of fluid, photons, matter wave, atomic structure.

AP2102 Introduction to Materials Engineering

Introduction to materials science. Atomic structure and interatomic bonding. The structure of crystalline solids. Imperfections in solids. Mechanical properties of metals and structure of polymers. Dislocations and strengthening mechanisms. Corrosion of materials. Phase diagrams I. Phase diagrams II. Materials selection and processing. Electrical properties of materials. Magnetic and optical properties of materials.

AP2104 Mechanics of Solids

Concept of stress. Axial loading. Torsion. Shear and bending-moment diagrams. Pure bending. Transverse loading. Transformations of stress and strain.

AP2105 # Engineering Mechanics: Dynamics

Engineering mechanics dynamics: Vectors. Kinematics of a particle. Dynamics of a particle. Kinematics of a rigid body in plane motion. Dynamics of a rigid body in plane motion. Work and energy. Impulse and momentum. Mechanical vibrations.

AP2243 Workshop Practice

Machine shop and metal work training. Electronics training. Plastics technology training.

AP3109 Kinetic Processes in Engineering Materials

Surface/interface properties and phenomena. Diffusion in solids. Nucleation and growth of phase transformation. Spinodal decomposition. Transformation kinetics. Heat-treatment of carbon steel. Precipitation hardening of aluminium alloys. Recrystallization and annealing processing.

AP3110 Deformation and Fracture

Different types of mechanical failure and how they are influenced by various factors. Dislocation theory. Strengthening mechanism. Yield criteria. Brittle fracture. Fatigue. Time-dependent behaviour.

AP3111 Ceramic Processing and Microstructure Development

Overview of processing-structure-property relationship. Structure of ceramics. Synthesis of powders. Powder characterization. Sol-gel processing. Forming science. Sintering and microstructure development. Microstructure characterization methods. Processing-structure-property relations in ceramics.

AP3113 Polymer Engineering

Basic concepts of polymer science. Polymer melt rheology. Polymer processing. Rubber elasticity. Viscoelasticity. Yield and fracture. Additives. Polymers and their properties. Environmental considerations.

AP3114 Computational Methods for Physicists and Materials Engineers

Typical problems in physics and materials engineering. MATLAB as a programmable calculator. Flow control. User-defined functions and memory allocation. Uniformly distributed random numbers (optional). The normal distribution (optional). The bisection method. The Newton-Raphson method. Statistical description and analysis of data. Fourier analysis. Solving differential equations (an introduction).

AP3169 Materials Testing Techniques

The role of materials testing. Optical microscopy. Thermal analysis. X-ray diffraction. Molecular spectroscopy. Non-destructive tests.

AP3130 # Biomaterials

Introduction of biomaterials; properties of polymeric materials, ceramics, and metal materials for biomedical applications; surface properties and characterization of biomaterials; biomaterial qualities: strength, wear, and sterilization; biological response to foreign materials, biocompatibility; degradable materials; biomedical devices, failure, retrieval & evaluation; applications in nephrology, ophthalmology, orthopaedics, and dentistry

AP3171 Materials Characterization Techniques

General classification analytical techniques and major limitations, guidance for their choice. Scanning electron microscopy (SEM), environmental SEM, energy dispersive X-ray spectroscopy (EDS), wave dispersive spectroscopy (WDS) cathodoluminescence (CL). Crystallography and diffraction, real and reciprocal space. Transmission electron spectroscopy (TEM), bright and dark field imaging, high resolution TEM (HRTEM), selected area diffraction (SAD). Analytical techniques associated with TEM. Auger electron spectroscopy (AES), scanning Auger spectroscopy (SAM), X-ray photoelectron spectroscopy (XPS), ultraviolet photoelectron spectroscopy (UPS). Mass spectrometry, secondary ion mass spectrometry (SIMS). Rutherford backscattering spectroscopy (RBS), elastic recoil detection analysis (ERDA), proton induced X-ray emission (PIXE). Surface profiling, scanning probe microscopy (SPM), atomic force microscopy (AFM), scanning tunnelling microscopy (STM).

AP3172 Electronic Properties of Solids

Fundamentals of electron theory. Electrical properties of materials. Optical properties of materials. Magnetic properties of materials.

AP3190 Thermodynamics of Materials

Systems and surroundings, state functions, process variables, extensive and intensive properties. The 1^{st} laws of thermodynamics. The 2^{nd} law of thermodynamics and heat engines. Thermodynamic variables and property relationships. Equilibrium. Phase rule and phase diagrams.

AP3244 # Design Laboratory

Physics measurement and investigation

AP4114 Stress Analysis

Introduction of stress and strain in 2/3D. Deformation, stress and strain fields, strain compatibility, stress equilibrium, Hookes' law in 3D, Hookes' law for plane stress and plane strain problems. Stress function approach. Airy's stress function in Cartesian and polar coordinates, boundary conditions, applications to simple two-dimensional problems, applications to axial symmetric problems. Energy methods. Strain gauge systems. Electrical-resistance strain gauges, types of strain gauge, strain gauge circuits, recording instruments, and strain gauge rosette. Optical methods of stress analysis. Moire interferometry, photoelasticity, coating methods, photoelastic coating and brittle coatings.

AP4116 Dissertation

The dissertation presents the students with an opportunity to demonstrate initiative and innovative abilities and to develop organizing and planning skills, together with skills involving documentation and presentations. Dissertation may relate to specific areas of the major, but designs that integrate major elements are strongly encouraged. Students will be expected to select a research project and to investigate an area to substantial depth, in a way that encourages application and integration of the knowledge gained through the course. The project will allow the students to build self-confidence, demonstrate independence, and develop a professional approach to solving problems in practice.

AP4118 Composite Materials – with An Introduction to Nanocomposites

Natural and synthetic fibre reinforced composites, thermosetting and thermoplastic matrices. Fibre-matrix interface. Micromechanics. Mechanics of laminae. Failure criteria. Processing of composites. Short fibre composites. Metal matrix and ceramic matrix composites. Biomimetic. Polymer nanocomposites.

AP4121 Thin Film Technology and Nanocrystalline Coatings

Definition of thin films. Environment and molecular and plasma processes in thin film deposition. Cold and thermal plasma. Requirement for substrate, substrate cleaning. Formation of thin films. Properties of thin films. Mechanical, electrical, thermal, chemical, and optical properties of thin films. Thermal evaporation. Laser ablation, synthesis of nanomaterials. Electrical discharges used in thin film deposition. Practical electric discharge configuration for deposition of thin films, direct current electric discharges, radio-frequency discharges, microwave discharges, electron cyclotron resonance plasma, matching units, floating potential, bias potential, plasma potential, effective bias, self-bias. Physical deposition techniques. Chemical vapor deposition techniques (CVD). Other processing technologies.

AP4124 Failure Analysis and Case Studies

General procedures of failure analysis, classification of failure sources. Methods and equipment for failure analysis. Failure mechanisms. Case studies. Laboratory exercise. Mini-project (role play).

AP4126 Electroceramics

A historical account of the discovery and development of ceramic materials for electrical and electronic applications, summary of various types of electroceramics along with fundamental concepts as well as general processes and their applications. Elementary solid state science. Measurement techniques. Fabrication of ceramics. Ceramic conductors. Dielectrics and insulators. Piezoelectric ceramics. Pyroelectric materials. Electro-optic ceramics. Magnetic ceramics.

AP4127 Smart Sensors: From Engineering to Applications

The Science of Measurement. Performance Characteristics. Measurement Uncertainty. Design and Implementation of Instruments and Sensors. Calibration of Sensors and Instruments.

AP4170 Environmental Degradation

Overview of electrode potential. Nernst equation. Pourbaix diagram. Anodic and cathodic protection. Electrode kinetics. Passivation. Forms of corrosion. Materials selection. Degradation of polymers.

AP4171 Electronic Packaging and Materials

Introduction to electronic packaging. Packaging materials and processes. Package reliability.

AP4172 Simulation and Modelling in Multidisciplinary Sciences

Basics of materials science. Numerical optimization methods. Molecular dynamics simulation. Monte Carlo methods.

AP4175 Advanced Technology in Biomedical Devices

Biomedical devices defined, types of biomedical devices. Background of biomaterials. Controlled release devices. Biosensors and diagnostic devices. BioMEMS and microfluidics. Molecular devices.

AP4176 Energy Materials for the Current Century

Photovoltaic devices. Fuel cells. Thermoelectric (TE) devices. Photosynthesis. Energy storage devices.

AP4177 Smart and Functional Materials: Selection and Application

Challenges in the science and technology of advanced materials – areas of applications, concept of smart materials, smart structures and adaptronics systems. Materials synthesis and microstructure. Properties of active materials and their assessment. Applications. Acceptance of new materials and systems in industry.

AP4178 Nanostructures & Nanotechnology

Introduction to nanomaterials & nanotechnology. Synthesis/Preparation of nanomaterials. Characterization of nanomaterials with emphasis on one dimensional nanomaterials, different characterization techniques. Properties and applications of one dimensional nanomaterials.

AP4253 Photonic Materials Physics

Light-matter interaction, constitutive relationships, Lorentz oscillator model. Photonic crystals. Metamaterials. Full-wave simulations.

AP4280 Advanced Optics Laboratory

Four mini-projects will be chosen in 6 broad areas of study: principles of applied optics, liquid crystals and diffractive optics, optical fiber applications, interferometric techniques, CW and pulsed lasers, characterization of materials.

AP4307 Building Materials

General introduction to building materials. Steel frame construction. Cement. Aggregates. Design of concrete mix. Testing of concrete. Durability. Admixtures. Special concrete. Glass. Cladding. Materials for interior walls, partitions, ceiling and floorings.

AP4714 Special Topics in Materials Science and Engineering

Introduction to nanomaterials and nanotechnology. Synthesis/ Preparation of nanomaterials. Characterization of nanomaterials with emphasis on one dimensional nanomaterials. Properties and applications of one dimensional nanomaterials. Properties and applications of selected functional materials.

BCH1100 Chemistry

Atoms, Ions, and Molecules. Periodic table. Electronic structure of Atom. Chemical bonding. Stoichiometry. States of matters. Chemical kinetics and equilibrium. Thermochemistry. Acids and bases. Oxidation and reduction. Nuclear chemistry. Inorganic and organic chemistry. Biological chemistry.

BCH1200 Discovery in Biology

Microbiology of microorganism. Chemistry of life. DNA and biotechnology. Biology of cells. Evolution and biodiversity. Evolution and biodiversity. Plant Evolution and Diversity. Anima physiology. A brave new world.

CS1102 Introduction to Computer Studies

Logical operations. Binary arithmetic. Basic operations of computer, data, CPU, memory, bus, IO, peripherals. Programming concepts. Basic data types. Variables, expressions, and operations. Compound statements and control structures. Functions and parameters. Operating systems. File system. End-user computing. Databases. Data communication. Internet. Concepts of client-side and server-side scripting. Digital media, multimedia software tools. Basic computer security, virus, filtering and scanning tools.

CS1302 Introduction to Computer Programming

The development of algorithms, program design, programming language, control structures, data types, arrays, functions and parameters, composite data types, structured decomposition, programming style, program testing, introduction to recursion.

EE3013 Engineers in Society

Introduction to local industry. Society and engineering. Introduction to product engineering. Business fundamentals for engineers. Ethics in practice. Health and safety. Environmental control. Topics of current interest. Professional Career Advising

MA1200 Calculus and Basic Linear Algebra I

Polynomials. Mathematical induction. Binomial theorem. Coordinate geometry and conic sections. Basic trigonometry. Functions and inverses. Limits, continuity and differentiability. Techniques of differentiation, implicit, logarithmic and parametric differentiation. Successive differentiation. Applications of differentiation.

MA1201 Calculus and Basic Linear Algebra II

Definite and indefinite integrals. Techniques of integration, integration of rational functions, integration by substitution, integration by parts. Physical and geometric applications of integration. Vectors in R^2 and R^3. Scalar products, cross products, triple scalar products. Linear (in)dependence. Matrices. Determinants, cofactor expansion. Systems of linear equations, Gaussian elimination, Cramer's rule. Matrix inverses, Gauss-Jordan elimination method. Arithmetic of complex numbers. Polar and Euler forms. De Moivre's theorem and its applications.

MA1300 Enhanced Calculus and Linear Algebra I

Polynomials. Mathematical induction. Coordinate geometry and conic sections. Basic trigonometry. Functions and inverses. Limits of sequences and infinite series. Limits, continuity and differentiability of functions. Techniques of differentiation, implicit, logarithmic and parametric differentiation. Successive differentiation.

MA1301 Enhanced Calculus and Linear Algebra II

Basic theorems of differentiation. Applications of differentiation. Definite and indefinite integrals. Techniques of integration, integration by substitution, integration by parts. Improper integrals. Physical and geometric applications of integration. Vectors in R^2 and R^3. Scalar products, cross products, triple scalar products. Linear (in)dependence. Applications to equations of lines and planes. Matrices. Determinants, cofactor expansion. Systems of linear equations, Gaussian elimination, Cramer's rule. Matrix inverses, Gauss-Jordan elimination method. Arithmetic of complex numbers. Polar and Euler forms. De Moivre's theorem and its applications.

MA2158 Linear Algebra and Calculus

Eigenvalues and eigenvectors. Applications in elasticity. First-and second-order ordinary differential equations and applications. Vector calculus. Partial differentiation. Multiple integration. Gradient, divergence and curl. Theorems of Gauss, Stokes and Green. Applications in energy methods, stress and strain transformations, etc. Fourier series.

MA2170 Linear Algebra and Multi-variable Calculus

Complex numbers. Vectors, matrices and determinants. Linear dependence, orthogonality. Systems of linear equations. Eigenvalues and eigenvectors. Functions of several variables. Partial differentiation. Taylor series. Double integrals.

MA2172 Applied Statistics for Sciences and Engineering

Random variables. Distribution. Data and sample description. Estimation of parameters. Tests of hypothesis. Regression. ANOVA.

MA2177 Engineering Mathematics and Statistics

Ordinary differential equations. Fourier series. Laplace transforms. Random variables. Probability. Distributions. Data and sample description. Estimation of parameters. Test of hypothesis. Simple linear regression.

MA2181 Mathematical Methods for Engineering

Eigenvalues and eigenvectors. First- and higher order ordinary differential equations. Partial differentiation. Laplace transforms. Fourier series.

MBE2016 Engineering Graphics

Use of computer for engineering design drawing. Conventional representation of standard features. Orthographic projection. Isometric projection. Standard symbols on a working drawing. Dimensioning and tolerance applications. Sectioning. Assembly drawing.

Availability subject to approval

Detailed Course Description
Please refer to http://www.cityu.edu.hk/arro-cat/catalogue/current/catalogue_UC.htm?page=B/B_course_code_AtoZ_A.htm