必修類 課程介紹
Introduction of Compulsory Courses

說明 Description：

此類必修課程共包括以下幾種：(共計 116 學分)
Compulsory courses can be categorized as follows：(A total of 116 credits)

(a) 一般性共同科目：8學分，含大學中文(2)、英文領域(6)。
General courses：8 credits, including College Chinese(2) and English(6)

(b) 通識教育科目：20 學分，核心必修10-15學分，選修科目5-10學分。
General education courses：20 credits, including 10-15 credits of core courses and 5-10 credits of elective courses.

(c) 工學院共同科目：27學分，含微積分(6)、普通物理及實驗(8)、工程圖學(2)、資訊系統應用一、二、三(1,1,1)、工程數學(6)、工程導論(2)。
General courses for the College of Engineering：30 credits, including Calculus(6), General Physics and Laboratory(8), Engineering Drawing(2), Computer Systems & Applications(1,1,1), Engineering Mathematics(6), Introduction to Chemical Engineering(2)

(d) 化工系科目：61學分，含普通化學及實驗(8)、物理化學及實驗(10)、有機化學及實驗(10)、化學工程導論(1)、輸送現象及單元操作一、二(6)、化工熱力學(3)、化學反應工程(3)、程序設計(3)、單元操作實驗(2)、質能均衡(3)、化工單操(3)、儀器分析及實驗一(3)、程序控制(3)、生物技術概論(3)。
Courses for the Department of Chemical Engineering：58 credits, including General Chemistry and Laboratory(8), Physical Chemistr and Laboratory(10), Organic Chemistry and Laboratory(10), Introduction to Chemical Engineering(1), Transport Phenomena and Unit Operations I, II(6), Chemical Engineering Thermodynamics(3), Chemical Reaction Engineering(3), Process Design(3), Unit Operation Laboratory(2), Material and Energy(3), Chemical Engineering Unit Operations(3), Instrumental Analysis and Lab. I(3), Process Control(3) and Introduction to Biotechnology (3).

註：括弧內之數字為學分數。
Note：the number inside the parenthesis is the credit number.

必修類 課程之時程安排
Schedule of Compulsory Courses

年級	上學期科目	學分數	年級	下學期科目	學分數
大一	普通化學及實驗一 General Chemistry and Laboratory I	4	大一	普通化學及實驗二 General Chemistry and Laboratory Ⅱ	4
	普通物理及實驗一 General Physics and Laboratory I	4		普通物理及實驗二 General Physics and Laboratory Ⅱ	4
	微積分一 Calculus I	3		微積分二 Calculus Ⅱ	3
	化學工程導論 Introduction to Chemical Engineering	1		質能均衡 Material and Energy Balance	3
	工程圖學 Engineering Drawing	2		資訊系統應用一Computer Systems & Applications I	1
	工程導論 Introduction to Chemical Engineering	2		服務學習 Service Learning	0
	服務學習 Service Learning	0		英文領域 English	2
	英文領域 English	2		中文 College Chinese	2
大二	工程數學一Engineering Mathematics I	3	大二	工程數學二 Engineering Mathematics Ⅱ	3
	有機化學及實驗一Organic Chemistry and Laboratory I	5		有機化學及實驗二Organic Chemistry and Laboratory Ⅱ	5
	物理化學一 Physical Chemistry I	3		物理化學二及物理化學實驗一 Physical Chemistry Ⅱ and Laboratory I	5
	資訊系統應用二Computer Systems & Applications Ⅱ	1		資訊系統應用三Computer Systems & Applications III	1
	英文領域 English	2			
大三	輸送現象及單元操作一 Transport Phenomena and Unit Operations I	3	大三	輸送現象及單元操作二 Transport Phenomena and Unit Operations Ⅱ	3
	化工熱力學 Chemical Engineering Thermodynamics	3		化工單操 Chemical Engineering Unit Operations	3
	物理化學實驗二Physical Chemistry Laboratory Ⅱ	2		程序控制 Process Control	3

	儀器分析及實驗一 Instrumental Analysis and Lab.I	3			
	化學反應工程Chemical Reaction Engineering	3			
	生物技術概論 Introduction to Biotechnology	3			
大四	程序設計 Process Design	3			
	單元操作實驗 Unit Operation Laboratory	2			

※其中通識教育科目20學分未列入，各位同學可在自己認為適當的時間選修。

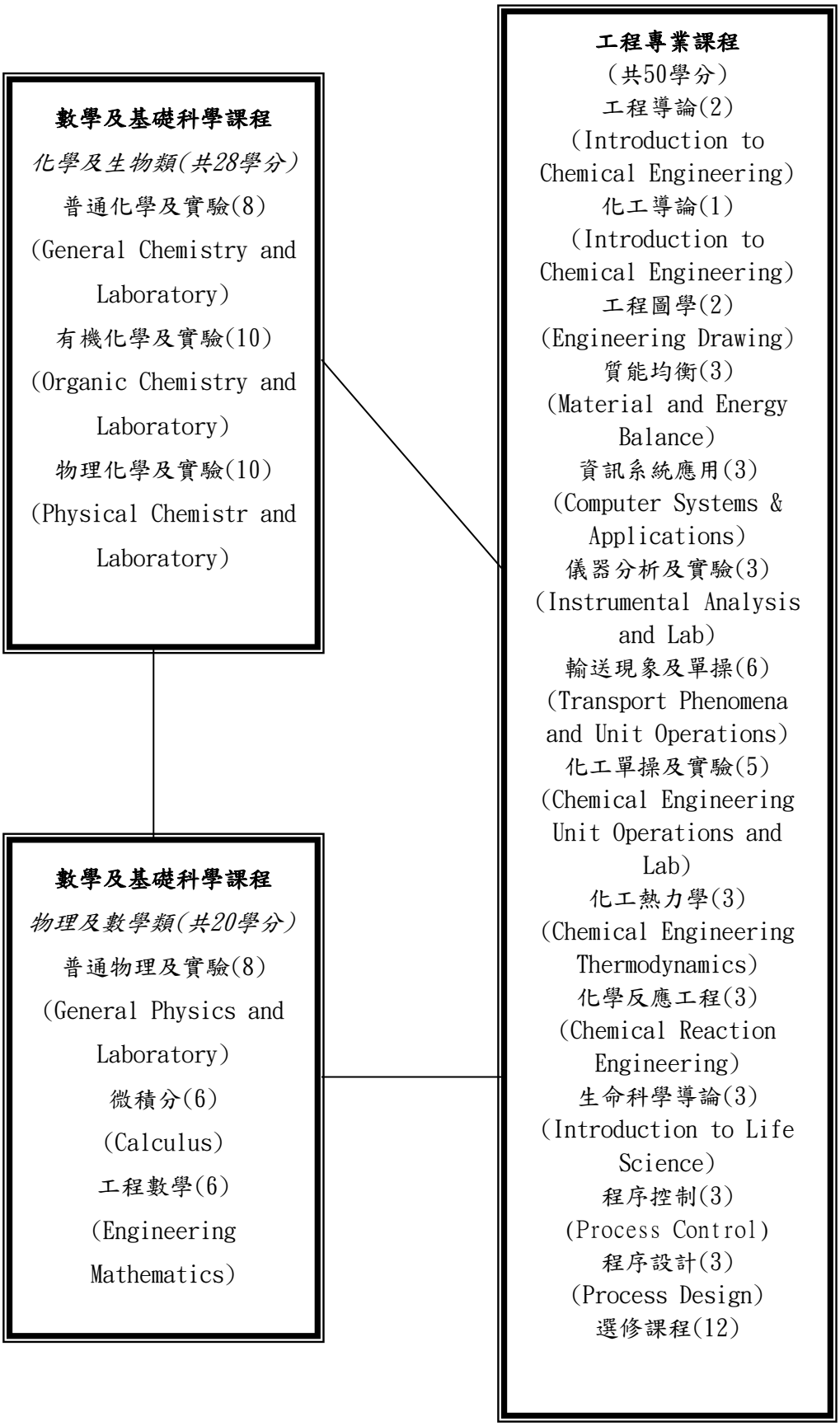
20 credits of general education courses are excluded. Students can decide to take these courses according to their own schedule.

※擋修規定：Course prerequisite rules：

1. 89.9.1起實施科目（須於89.4月預選前輸入電腦程式中）
   a. CHE2110工程數學一(Engineering Mathematics I)（擋修：MATH1010微積分一(Calculus I)及MATH1040微積分二(Calculus II)皆50分（含）以上）
   b. CHE2120工程數學二(Engineering Mathematics II)（擋修：CHE2110工程數學一(Engineering Mathematics I) 50分（含）以上）
2. 90.9.1起實施科目（須於90.4月預選前輸入電腦程式中）
   a. CHE3090儀器分析及實驗一(Instrumental Analysis and Lab.(I))（擋修：CHEM2410物理化學I(Physical Chemistry I)及CHEM2412物理化學II(Physical Chemistry II)皆50分（含）以上）
   b. CHE3520輸送現象與單元操作一(Transport Phenomena and Unit Operations(I))（擋修：CHE2110工程數學一(Engineering Mathematics I)及CHE2120工程數學二(Engineering Mathematics II)皆50分（含）以上）
   c. CHE3530輸送現象與單元操作二(Transport Phenomena and Unit Operations (II))（擋修：CHE3520輸送現象與
      單元操作一(Transport Phenomena and Unit Operations(I))
      50分（含）以上）
   d. CHE4060化工單操(Chemical Engineering Unit Operation)（擋修：CHE1140質能均衡(Material and Energy Balance） 60分（含）以上）
3. 91.9.1起實施科目（須於91.4月預選前輸入電腦程式中）
   a. CHE4150程序設計(Process Design)（擋修：CHE4060化工單操(Chemical Engineering Unit Operation)50分（含）以上）
4. 92.2.1起實施科目
   a. CHE3100儀器分析與實驗二(Instrumental Analysis and Lab
      (II))（擋修：CHEM2410物理化學I (Physical Chemistry I)及
      CHEM2412物理化學II (Physical Chemistry II)皆50分（含）
      以上）
5. 97.9.1起實施科目
   a.CHE2410物理化學一(Physical Chemistry I)(擋修:CHEM1010普通化學一(General Chemistry I),CHEM1020普通化學二(General Chemistry II),MATH1040微積分二(Calculus II)曾修)
   b.CHE2420物理化學二(Physical Chemistry II) (擋修:CHEM1010普通化學一(General Chemistry I),CHEM1020普通化學二(General Chemistry II),MATH1040微積分二(Calculus II)曾修)
6. 100.2.1起實施科目

   高分子半導體及其元件(Electroluminescent Polymer Semiconductors and Devices)(擋修：CHE5795有機光電(Organic Electronics) 或 CHE5002分子工程二(Molecular Engineering (II)) 70分(含)以上。

課程分析Course Analysis



選修類課程分類
Elective courses and categories

(A) 尖端製程 Advanced Process technology

ChE 4130	基礎電化學 (Fundamental Electrochemistry)	2
ChE 4530	全球氣候變遷 (Climate Change)	3
ChE 4912	創造力培育、創意激發與發明 (How to Innovate/invent and Manage Ideas)	3
ChE 4920	全球化競爭下之智慧財產策略與管理 (Intellectual Property Strategy and Management for Global Competition)	3
ChE 4985	化工產業論壇 (Chemical Industry Forum)	1

(B) 尖端材料 Advanced Materials

ChE 3710	基礎高分子化學 (Polymer Chemistry Fundamentals)	2
ChE 3720	基礎高分子物性 (Introduction to Polymer Physics)	2
ChE 4120	材料科學 (Materials Science)	3
ChE 4310	電路板基礎工程 (Engineering Fundamentals of Printed Circuit Boards)	3
ChE 4312	電子構裝技術與材料 (Electronic Packaging technology and materials)	2
ChE 4940	光電材料與元件基礎 (Fundamentals of Optoelectronic Materials and Devices)	2

(C) 能源與環境 Energy and Environmental Technology

ChE 2540	化學工業安全概論 (Introduction to Chemical Process Safety)	2
ChE 3010	能源科技與環境概論 (Introduction to Energy Technology and Environment)	2

(D) 生物技術 Biotechnology

ChE 4400	製藥工程導論 (Introduction to Industrial Pharmacy)	3
ChE 4552	生物技術概論 (Introduction to Biotechnology)	3
ChE 4553	基礎細胞生物學 (Fundamentals of Cell Biology)	3

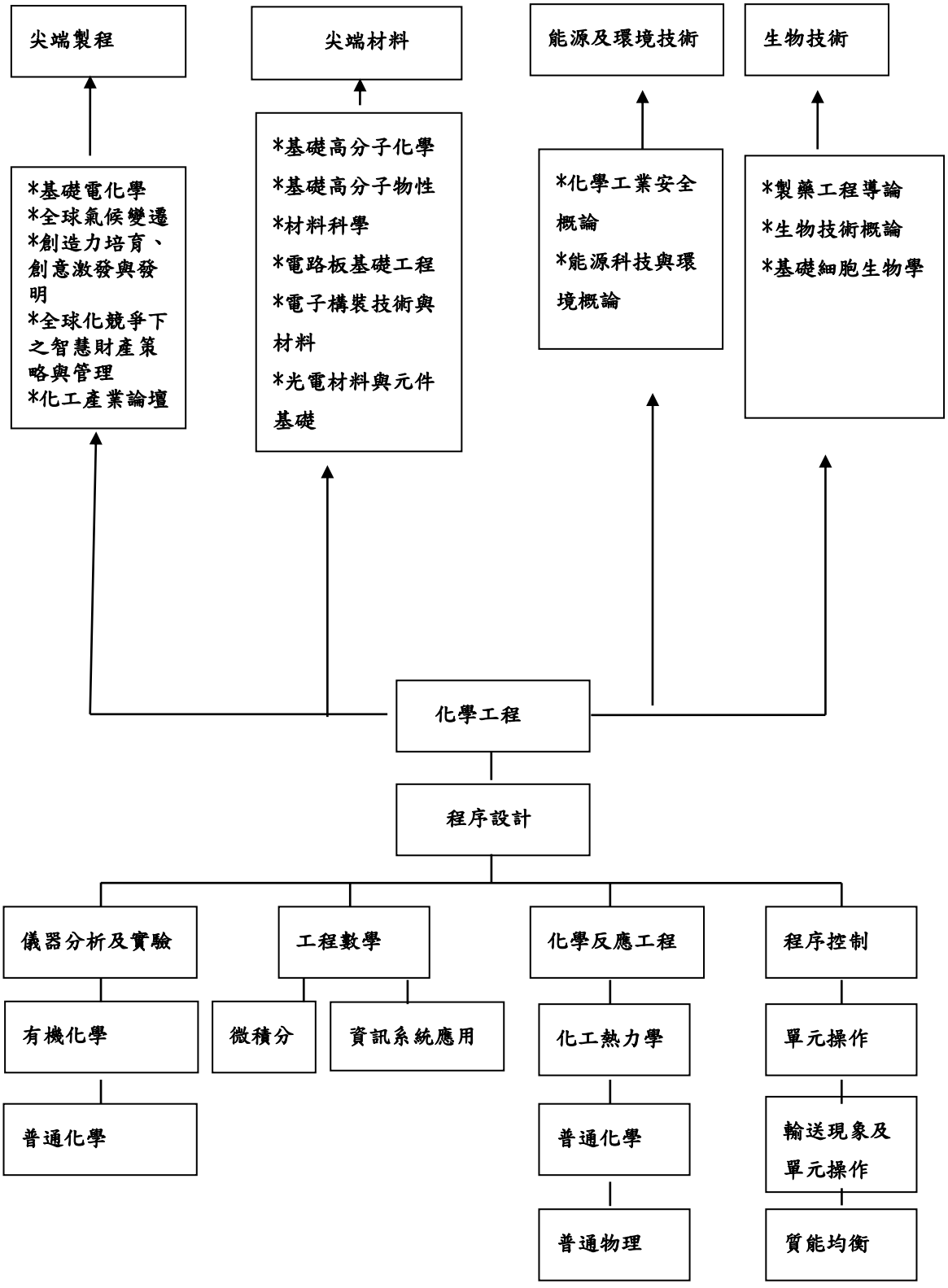
選修類 課程之時程安排
Schedule of Elective Courses

	上學期First semester	下學期Second semester
大一		
大二	ChE 2540 化學工業安全概論2 (Introduction to Chemical Process Safety)	
大三	ChE 3010能源科技與環境概論2 (Introduction to Energy Technology and Environment) ChE 3710 基礎高分子化學2 (Polymer Chemistry Fundamentals)	ChE 3720 基礎高分子物性2 (Introduction to Polymer Physics)
大四	ChE 4120 材料科學3 (Materials Science) ChE 4530 全球氣候變遷3 (Climate Change) ChE 4552 生物技術概論3 (Introduction to Biotechnology)	ChE 4130 基礎電化學2 (Fundamental Electrochemistry) ChE 4310 電路板基礎工程3 (Engineering Fundamentals of Printed Circuit Boards) ChE 4312電子構裝技術與材料2 (Electronic Packaging technology and materials) ChE 4400 製藥工程導論3 (Introduction to Industrial Pharmacy) ChE 4553 基礎細胞生物學3 (Fundamentals of Cell Biology) ChE 4912 創造力培育、創意激發與發明3 (How to Innovate/invent and Manage Ideas) ChE 4920全球化競爭下之智慧財產策略與管理3 (Intellectual Property Strategy and Management for Global Competition) ChE 4940光電材料與元件基礎2 (Fundamentals of Optoelectronic Materials and Devices) ChE 4985 化工產業論壇1 (Chemical Industry Forum)

＊90學年度(含)以後入學之新生，生物技術概論(Introduction to Biotechnology)、光電材料與元件基礎(Fundamentals of Optoelectronic Materials and Devices)列為學生必選科目，學生畢業前必選其一。(98入學新生，增加能源科技與環境概論(Introduction to Energy Technology and Environment)三選一，舊生不適用) Students who enrolled after Academic Year 2001 must take Introduction to Biotechnology, or Fundamentals of Optoelectronic Materials and Devices in order to graduate. Students who enrolled after Academic Year 2009 must take Introduction to Biotechnology, Fundamentals of Optoelectronic Materials and Devices, or Introduction to Energy Technology and Environment in order to graduate.

＊專題研究限大三下以後才可選修，專題研究一(Undergraduate Research I) 1 學分，專題研究二(Undergraduate Research Ⅱ) 1 學分，第一次選修應選專題研究一，第二次選修應選專題研究二。(102.5.13通過)。

課程設計


尖端製程
尖端材料
能源及環境技術
生物技術
*基礎電化學
*全球氣候變遷
*創造力培育、創意激發與發明
*全球化競爭下之智慧財產策略與管理
*化工產業論壇
*基礎高分子化學
*基礎高分子物性
*材料科學
*電路板基礎工程
*電子構裝技術與材料
*光電材料與元件基礎
*化學工業安全概論
*能源科技與環境概論
*製藥工程導論
*生物技術概論
*基礎細胞生物學
化學工程
程序設計
儀器分析及實驗
工程數學
化學反應工程
程序控制
有機化學
微積分
資訊系統應用
化工熱力學
單元操作
普通化學
普通化學
輸送現象及單元操作
普通物理
質能均衡

清華化工系尖端製程領域選修課程一覽表

Elective courses in the area of Advanced Process technology for the Department of Chemical Engineering, National Tsing Hua University

(A) 宗旨

尖端製程或曰程序工程，為化工系的傳統領域。在過去主要應用在石化工業，也就是生產眾多高分子上游原料的工業，對於民生生活品質的提昇貢獻至鉅。在另一方面，近年來政府所一再推動的特用化學品產業，除了需要化學合成的技術外，亦必依賴精密先進的化工製程技術，如此才可能製造出具競爭力且高附加價值的化學產品。本領域內所提供之諸課程，即在奠定選修同學在化工製程方面的相關基礎知識。

(A) Objective

Advanced Process technology is a traditional subject of the Chemical Engineering Department. In the past, many of the processes in this area were applied to petrochemical industries, where most of the raw materials for polymers were produced. Hence, they are significantly important to our society, especially the improvement in the quality of life. Recently, the government of Taiwan has been promoting industries that produce special chemicals. Besides the advanced chemical synthesis technologies, topnotch chemical engineering processes are also essential to produce high competitive and high value-added chemical products. The courses offered in this area are aimed to deliver the fundamental knowledge of chemical engineering process to students taking the course.

(B) 課程說明

由於本領域為傳統化學工業的核心，其最重要之基礎即為本系諸多之必修課程，例如質能均衡(Material and Energy Balance)、輸送現象及單元操作(Transport Phenomena and Unit Operations)、化工熱力學(Chemical Engineering Thermodynamics)、化學反應工程(Chemical Reaction Engineering)、程序控制(Process Control)及程序設計(Process Design)等課程。至於研究所的課程，則多屬於大學部基礎課程之延伸，例如高等輸送現象(Advanced Transport Phenomena)、高等反應工程(Advanced Reaction Engineering)、高等化工熱力學(Advanced Chem. Engineering Thermodynamics)等科目；屬於程控領域的高等程序控制(Advanced Process Control)；屬於單元操作領域之超臨界流體技術(Supercritical Fluid Technology)等科目；屬於觸媒領域之非均勻系催化動力學(Heterogeneous Catalysis Kinetics)等；以及模擬領域之最適化方法(Engineering Optimization)等科目。

(B) Course introduction

Since this area is the core of the traditional chemical industry, the fundamental knowledge is covered mostly by many of the compulsory courses offered by the Department of Chemical Engineering, such as Material and Energy Balance, Transport Phenomena and Unit Operations, Chemical Engineering Thermodynamics, Chemical Reaction Engineering, Process Control, and Process Design. As for the courses for undergraduate students, they are the extension of the fundamental courses offered for the undergraduate students. These courses include Advanced Transport Phenomena, Advanced Reaction Engineering, Advanced Chem. Engineering Thermodynamics, Advanced Process Control (belongs to the area of process control), Supercritical Fluid Technology (belongs to the area of unit operation), Heterogeneous Catalysis Kinetics (belongs to the area of catalysis), and Engineering Optimization (belongs to the area of computer simulation).

(C) 大學部/研究所尖端製程領域相關課程(C) Courses in the area of advanced process technology for undergraduate/graduate students

上　學　期　　下　學　期

大學部

ChE 4530 全球氣候變遷 (3) (Climate Change)	ChE 4130 基礎電化學 (2) Fundamental Electrochemistry
	ChE 4985化工產業論壇 (1) (Chemical Industry Forum)
	ChE 4912創造力培育、創意激發與發明(3) (How to Innovate/invent and Manage Ideas)

研究所

ChE 5010 高等化工熱力學 (3) (Advanced Chem. Engineering Thermodyn	ChE 5050 高等輸送現象 (3) (Advanced Transport Phenomena)
ChE 5020 製程與品質之統計管制 (3) (statistical process/quality control)	ChE 5080 化工原理二 (3) (Chemical Engineering Principles Ⅱ)
ChE 5030 高等化學反應工程 (3) (Advanced Chemical Reaction Engineering)	ChE 5081 化學工廠之設計、運作與管理 (2) (Design, Operation and Management of Chemical Plants)
ChE 5070 化工原理一 (3) (Chemical Engineering Principles I)	ChE 5125 實驗設計與品質工程 (3) (Experimental Design and Quality Engineering)
ChE 5170 高等程序控制 (3) (Advanced Process Control)	ChE 5152 化學產品創意設計 (2) (Creative Design and Development of Chemical Products)
ChE 5980 超臨界流體技術 (3) (Supercritical Fluid Technology)	ChE 5360 最適化方法 (3) (Engineering Optimization)
ChE 5128 觸媒工程 (3) (Catalysis Engineering)	

(D) 可供諮詢教授名單

如果同學們對於本領域所列之課程有問題時，可向以下諸位教授請益：
汪上曉、呂世源、周更生、劉大佼、鄭西顯、談駿嵩、姚遠、衛子健、蔡德豪。

(D) Professors for consulting services

If students have any question regarding to course selection, the following professors can provide the consulting services needed：
SHAN-HILL WONG, SHIH-YUAN LU, KAN-SEN CHOU, TA-JO LIU, SHI-SHANG JANG, CHUNG-SUNG TAN, YUAN YAO, TZU-CHIEN WEI, DE-HAO TSAI.

清華化工系高分子科學與工程領域選修課程一覽表

Elective courses in the area of polymer science and engineering for the Department of Chemical Engineering, National Tsing Hua University

(A) 宗旨

本修課指導之主要目的，在於規劃清華化工系內所開設之有關高分子領域的課程，以協助並指導有興趣於此的同學們，依序選讀相關諸課程，培養在高分子科學與工程方面的專業知識，以為未來深造或就業之基礎。

(A) Objective

The purpose of this course selection guideline is to organize polymer related courses offered by the Department of Chemical Engineering, National Tsing Hua University and to provide assistance to students who are interested in taking these courses. The objectives of these courses are to cultivate students with the fundamental knowledge of Polymer Science and Engineering, so that they can obtain the skills needed for their post graduate studies or future career.

(B) 課程說明

高分子領域的課程，大致可分為四類，分別為：

- 高分子化學類的課程
- 高分子物性類的課程
- 高分子加工類的課程
- 尖端(特用)高分子類的課程

其中在大學部，本系在各種類別中都提供一門基礎性、入門性的課程，供同學選修，以奠定基礎；而在相關的必修課程中，有機化學、物理化學以及儀器分析與實驗的課程，對於未來選讀高分子領域的課程及研究，都也十分重要，算是基礎性的科目。

至於在研究所內，高分子化性、高分子物性、高分子加工以及尖端(特用)高分子等四大類，同學們可依照自己的興趣，安排選讀，以充實相關的知識與技術。

(B) Course introduction

Courses in the area of polymers basically can be divided into 4 categories as follows：

- Courses in polymer chemistry
- Courses in polymer physics
- Courses in polymer processing
- Courses in advanced (special) polymers

The Department of Chemical Engineering offers one fundamental course in each category to provide undergraduate students with the basic knowledge needed. In the compulsory courses, Organic Chemistry, Physical Chemistry, and Instrumental Analysis and Lab are important courses for students who are planning to take polymer courses or perform studies in the area of polymer science.

As for graduate students, they can select any courses in the 4 categories (polymer chemistry, polymer physics, polymer processing, and advanced (special) polymers) freely depending on their interests to widen their knowledge and skills.

(C) 大學部高分子領域相關課程(C) Courses in the area of polymers for undergraduate students

選修部份

上　學　期　　下　學　期

三年級

ChE 3710 基礎高分子化學 (2) (Polymer Chemistry Fundamentals)	ChE 3720 基礎高分子物性 (2) (Introduction to Polymer Physics)

四年級

ChE 4120 材料科學 (3) (Materials Science)	ChE 4310 電路板基礎工程 (3) (Engineering Fundamentals of Printed Circuit Boards)
	ChE 4940 光電材料與元件基礎 (2) (Fundamentals of Optoelectronic Materials and Devices)

(D) 研究所高分子領域相關課程

I. 高分子化學相關類別科目

上　學　期　　下　學　期

ChE 5453 高分子設計與合成 (3) (Polymer Design and Synthesis)	ChE 5330 同步輻射在物質結構上的應用 (2) Synchrotron applications in structural analysis
	ChE 5800 高分子實驗 (2) (Polymer Laboratory)

II. 高分子物性相關類別科目

上　學　期　　下　學　期

	ChE 5452 高分子分析技術 (3) (Polymer Characterization)
	ChE 5465 高等高分子物理 (3) (Special Topics in Condensed Polymer Physics)
	ChE 5810 電子顯微鏡於軟物質研究之應用 (3) (Applications of Electron Microscopy in soft Matter)
	ChE 5840 固態燃料電池特論 (3) (Topics in Solid State Fuel Cells)
	ChE 5845 固態離子學特論 (2) (Topics in Solid State Ionics)
	ChE 5870 高分子黏彈性 (3) (Polymer Viscoelasticity)

III. 高分子加工相關類別科目

上　學　期　　下　學　期

	ChE 5680 複合材料製程與檢測實驗 (3)(Processing and Characterization of Composite Materials and Lab.)
	ChE 5485 高分子工業概論(3) (Introduction to Polymer related Industries)

IV. 尖端(特用)高分子相關類別科目

上 學 期	下 學 期
ChE 5001 分子工程一 (3) (Molecular Engineering (I))	ChE 5002 分子工程二 (3) (Molecular Engineering (II))
ChE 5470 軟凝體科學 (3) (Soft Condensed Matter)	ChE 5180高分子生物材料 (3) Macromolecules as Biomaterials
ChE 5560 高分子複合材料 (3) (Polymer Composites)	ChE 5455 熱固性高分子特論 (3) (Crosslinked and Thermosetting Polymers)
ChE 5795 有機光電 (3) (Organic Electronics)	CChE 5475 嵌段共聚物物理學 (3) (Block Copolymer Physics)
	ChE 5690 奈米高分子複合材料 (3) (Nano Polymer Composites)
	ChE 5794 高分子半導體及其元件 (3) (Electroluminescent Polymer Semiconductors and Devices)
	ChE 5796 有機光電特論 (2) (Special Topics in Organic Electronics)

(E) 可供諮詢教授名單

如果同學們對於所列之基礎類別科目內容有問題時，可由以下名單得知應向那位教授請益:

1. 高分子化學: 陳壽安、陳信龍、劉英麟
2. 高分子物性: 陳壽安、李育德、陳信龍、何榮銘、蘇安仲、Masaki Horie
3. 高分子加工: 李育德、張榮語、馬振基、劉大佼
4. 尖端(特用)高分子: 陳壽安、馬振基、蘇安仲、Masaki Horie、劉英麟、王潔

(E) Professors for consulting services

If students have any question regarding to course selection, the following professors can provide the consulting services needed:

1. Polymer chemistry: SHOW-AN CHEN, HSIN-LUNG CHEN, YING-LING LIU
2. Polymer physics: SHOW-AN CHEN, YU-DER LEE, HSIN-LUNG CHEN, RONG-MING HO, AN-CHUNG SU, MASAKI HORIE
3. Polymer processing: YU-DER LEE, RONG-YEU CHANG, CHEN-CHI M. MA, TA-JO LIU
4. Advanced (special) polymers: SHOW-AN CHEN, CHEN-CHI M. MA, AN-CHUNG SU, MASAKI HORIE, YING-LING LIU, JANE WANG

清華化工系尖端材料領域選修課程一覽表
Elective courses in the area of advanced materials for the Department of Chemical Engineering, National Tsing Hua University

(A) 宗旨

在本系尖端材料領域內，除高分子類課程外，另有部份課程屬於無機材料類別，也在此說明，以協助同學選讀。

(A) Objectives

In the area of advanced materials, the Department of Chemical Engineering offers not only polymer related courses but also inorganic material related courses. Introduction to these courses are provided as follows for students.

(B) 課程說明

對於尖端材料有興趣的同學，在本系大學部可選讀入門性質的材料科學課程，以及專業的電子構裝課程。其它的相關課程，基本上可以考慮至材料系選讀，俾獲得較完整的訓練。在研究所方面，則有陶瓷粉末處理的選修課程，供同學選修。對陶瓷材料而言，由於多半經過粉體階段，所以在化工單操內的粉粒體技術可算是基礎部份。

(B) Course introduction

For students who are interested in advanced materials, they can select the fundamental material science courses and electronic packaging courses. For other areas, students could consider taking courses in the Department of Materials to attain more comprehensive training. For graduate students, they could consider taking Ceramic Powder Processing as the elective course. For ceramic materials, since most of them involve powders, the fundamental knowledge will be covered by Unit Operation course (powder technologies) offered by the Department of Chemical Engineering.

(C) 大學部/研究所尖端材料領域相關課程

(C) Courses in the area of advanced materials for undergraduate/graduate students

大學部

上 學 期	下 學 期
ChE 4120 材料科學 (3) (Materials Science)	ChE 4312 電子構裝技術與材料 (2) (Electronic Packaging technology and materials)
	ChE 4940 光電材料與元件基礎 (2) (Fundamentals of Optoelectronic Materials and Devices)

研究所

Che 5145 奈米材料科學 (2) (Science and Engeneering of Nanomaterials)	ChE 5550膠體界面科學與科技特論(3) (Introduction to Colloid and Interface Science & Technology)
	ChE 5700 陶瓷粉末處理 (2) (Ceramic Powder Processing)
	ChE 5750 材料相平衡 (2) (Phase Equilibria of Materials)

(D) 可供諮詢教授名單

如果同學們對於以上所列課程，或者本校其它系所開設之本領域課程有疑問時，可向以下諸位教授請益：

周更生、陳信文、呂世源、胡啟章、段興宇、蔡德豪

(D) Professors for consulting services

If students have any question regarding to course selection, the following professors can provide the consulting services needed：

KAN-SEN CHOU, SINN-WEN CHEN, SHIH-YUAN LU, CHI-CHANG HU, HSING-YU TUAN, DE-HAO TSAI.

清華化工系能源與環境技術領域選修課程一覽表

Elective courses in the area of energy and environmental technologies for the Department of Chemical Engineering, National Tsing Hua University

(A) 宗旨（能源）

能源問題是我們跨入二十一世紀所面臨的最嚴重考驗之一，身為化學工程師，無論在研究或生產的領域中，都不應該忘記"能"的重要性，因此本系為同學規畫有關能源技術的一系列課程，協助同學在關於能量的觀念，能源的形式，能源的開發，省能的製程及節能的材料等課題，獲得有系統的學習機會。

(A) Objective （energy）

Energy issue is the biggest challenge that mankind has faced since the beginning of the 21st Century. As a chemical engineer, we should always keep in mind the importance of "energy" whether in performing research or production. In this regard, the Department of Chemical Engineering offers a series of energy related courses to students. By taking these courses, students will have a better understanding on topics such as the forms of energy, the development of energy, and energy-saving processes as well as materials.

(B) 課程說明（能源）

建議同學必選修"能源科技與環境概論(Introduction to Energy Technology and Environment) "，該課程係針對能源的形式、能源的開發、能源的政策、省能製程與能源材料的應用等議題，做一完整的介紹與討論。其它同學可以就興趣選修"石油化學工業(Petroleum Chemistry) "，以進一步增加此領域之相關知識。

(B) Course introduction （energy）

It is recommended that students can take Introduction to Energy Technology and Environment. This course will provide students with a comprehensive introduction on topics such as the forms of energy, the development of energy, energy policies, and energy-saving processes as well as materials. Students, if interested, may also take Petroleum Chemistry to broaden their knowledge in related field.

(C) 大學部/研究所能源技術領域相關課程(C) Courses in the area of energy technologies for undergraduate/graduate students

	上　學　期	下　學　期
大學部	ChE 3010 能源科技與環境概論 (2) (Introduction to Energy Technology and Environment)	
研究所	ChE 5121 石油化學工業 (3) (Petroleum Chemistry)	ChE 5120 電化學分析技術與應用(3) (Electrochemical Analytical Techniques and Applications)

ChE 5122 綠能發展與環境控制 (2) (Green Energy Development and Environmental Control)	ChE 5420 非均勻系催化動力學 (3) (Heterogeneous Catalysis Kinetics)
ChE5820電化學能源 (2) (Electrochemical Energy Storage and Conversion)	

(D) 可供諮詢教授名單（能源）

如果同學們對於本領域所列之課程有問題時, 可向以下諸位教授請益:

黃大仁、陳信文、胡啟章、段興宇、沈若樸。

(D) Professors for consulting services （energy）

If students have any question regarding to course selection, the following professors can provide the consulting services needed:

TA-JEN HUANG, SINN-WEN CHEN, CHI-CHANG HU, HSING-YU TUAN, CLAIRE ROA-PU SHEN

(A) 宗旨（環境）

注重環保安全與衛生，不但是本系的基本信念，而且也必將成為二十一世紀所有產業必須遵循的政策。對於化工系而言，開發高效率的污染防治技術和無公害的新製程，是解決化學產業發展與環境保護的扞格及達成永續經營理想的唯一途徑。本課程指導的目的即在於介紹同學選修有關環境技術的系列課程，使由污染防治技術入門，進而建立污染預防以及清潔生產技術的觀念與作法，俾使我化學工程的技術能在符合環保健康安全的基礎上，發揮其服務人類的功能。

(A) Objective （environment）

Paying great respect to Environmental safety and health not only is the basic philosophy of the Department of Chemical Engineering, but also a policy that all industries have to follow in the 21st Century. As for the Department of Chemical Engineering, our job is to develop highly efficient pollution prevention technologies and new processes that are hazard-free. This is the only way to maintain the development of chemical industry and at the same time achieve the goal of sustainable operation. The purpose of this course selection guideline is to introduce environmental technology related courses to students. Students taking these courses will attain the fundamental technologies for pollution prevention, so that ideas and approaches relating to clean production can be established. These courses also allow chemical engineering skills to bring about their effect of serving mankind while complying with the requirements for environmental safety and health.

(B) 課程說明（環境）

在本系的環境技術領域課程中，各有一門討論廢水、廢氣、固體廢棄物以及有害廢棄物的處理技術課程，以提供完整的污染防治技術內容。在安全方面的課程則為化學工業安全概論(Introduction to Chemical Process Safety)，讓同學瞭解從污染預防觀點，化學工程師可以貢獻的地方。此外也建議選修儀器分析與實驗II(Instrumental Analysis and Lab.(II))之課程，學習儀器分析的知識與技巧，這對於環境技術而言，應算是必備的技術之一。

(B) Course introduction（environment）

In the area of environmental technologies, the courses offered by the Department of Chemical Engineering include topics such as the treatment of wastewater, exhaust gas, solid waste, and hazardous waste to provide comprehensive skills for pollution prevention. For safety related topics, students can take Introduction to Chemical Process Safety to understand more about what chemical engineers can do in the area of pollution prevention. It is also recommended that students could take Instrumental Analysis and Lab.(II) to learn knowledge and skills about instrumental analysis, which is one of the essential tools in the area of environmental technologies.

(C) 大學部/研究所環境技術領域相關課程(C) Courses in the area of environmental technologies for undergraduate/graduate students

上　學　期　　下　學　期

大學部

ChE 2540　化學工業安全概論　(2) (Introduction to Chemical Process Safety)	
ChE 3010 能源科技與環境概論 (2) (Introduction to Energy Technology and Environment)	

研究所

	ChE 5740 汽車廢氣控制　(2) Automotive emissions control

(D) 可供諮詢教授名單（環境）

如果同學們對於本領域所列之課程有問題時, 可向以下諸位教授請益:
周更生、馬振基、黃大仁、陳信文、鄭西顯、談駿嵩。

(D) Professors for consulting services （environment）

If students have any question regarding to course selection, the following professors can provide the consulting services needed:
KAN-SEN CHOU, CHEN-CHI M. MA, TA-JEN HUANG, SINN-WEN CHEN, SHI-SHANG JANG, CHUNG-SUNG TAN

清華化工系生物技術領域選修課程一覽表

Elective courses in the area of biotechnology for the Department of Chemical Engineering, National Tsing Hua University

(A) 宗旨

生物科技的進步迅速，帶動生物醫藥相關產業，如食品、醫藥、醫療器材、環保等產業的快速成長。在化工領域中，生化工程與生醫工程，均為生物技術的實際應用及工業生產的重要學門。對此領域有興趣的同學，可參考以下之指導，修習有關生物基礎及工程應用的課程，以奠定未來發展的基礎。

(A) Objective

The advances in biotechnologies have promoted the growth of biomedicine related industries such as food, medicine, medical equipment, and environmental protection industries. In chemical engineering, biochemical engineering and biomedical engineering are both important subjects that involve practical application and industrial production of biotechnologies. Students who are interested in this area should refer to the following guideline to select appropriate biology and engineering related courses to build up their fundamental knowledge needed in the future.

(B) 課程說明

在所建議選修的諸課程當中，大致分為基礎類以及應用類別，其中基礎類別的課程，為生命科學系以及輻生所所開設的課程，而應用類別的課程，則可以分為工業應用，醫學應用以及環境應用等方面。由於無論那一種應用，都將使用許多先進的儀器。
** 部份內容與生物技術有關

(B) Course introduction

The suggested courses can be divided into fundamental courses and application courses. Fundamental courses are mostly offered by the Department of Life Sciences and the Department of Radiation biology. Application courses can be further categorized into industrial application, medical application, and environmental application. Regardless of which application, many advanced instruments will be used.
** Part of the materials are related to biotechnology

(C) 大學部生物技術領域相關課程(C) Courses in the area of biotechnology for undergraduate students

上學期	下學期
ChE 4552 生物技術概論 (3) (Introduction to Biotechnology)	ChE 4400 製藥工程導論 (3) (Introduction to Industrial Pharmacy)
	ChE 4553 基礎細胞生物學 (3) (Fundamentals of Cell Biology)

(D) 研究所生物技術領域相關課程

ChE 5040 生物產業特論 (3) (Special Topics in Biotechnology Industries)	ChE 5153 生質燃料技術特論 (2) (Biofuel Technology)
ChE 5412 人工器官與組織工程 (3) (Artificial Organs and Tissue Engineering Lab.)	ChE 5900 分子生物技術 (3) (Molecular Biotechnology)
ChE 5890 工業微生物學 (3) (Industrial Microbiology)	
ChE 5126 代謝工程與生質化學品概論 (3)(Metabolic engineering and renewable chemical production)	

(E) 可供諮詢教授名單

如果同學們對於本領域所列之課程有問題時, 可向以下諸位教授請益:
朱一民、宋信文、胡育誠、沈若樸。

(E) Professors for consulting services

If students have any question regarding to course selection, the following professors can provide the consulting services needed:
I-MING CHU, HSING-WEN SUNG, YU-CHEN HU, CLAIRE ROA-PU SHEN

清華化工系必修課程大綱

E 1001 工程導論 2 學分
Introduction of Engineering

由工學院四系（化工、動機、材料、工工)與電機系資深教授簡介各系特色及教育目標，使學生對不同之工程應用有基本認識。

The senior faculty members from Chemical Engineering, Power Mechanical Engineering, Materials Science and Engineering, Industrial Engineering and Engineering Management and Electrical Engineering introduce the scope and education disciplines to students for fundamental knowledge of engineering areas.

◎化學工程部份:
Chemical Engineering

1.化學工程的內涵
What is Chemical Engineering and what is a Chemical engineer?

2.化學工程的基本觀念
The Principals in Chemical Engineering

3.化學工程與石化工業
Petroleum refine and Petrochemical Industries

4.化學工程與光電產業
Photo-electric and semiconductor industries

5.化學工程師的社會責任--環境保護
Chemical engineer's social responsibility – environmental protection

CHE 1140 質能均衡 3 學分
Material and Energy Balance

化學工程運算 Calculation in chemical engineering

質量與能量傳遞及均衡之原理 Principles of materials and energy balance

應用於化學工業製造程序之分析與計算 Calculation of materials and energy balance in chemical engineering units.

This course will introduce the concept and calculation of material and energy balance for the processes in chemical industry.

CHE 1160 化學工程導論 1 學分
Introduction of Chemical Engineering

介紹化工技術在化學工業及各行業應用之情形；目的在使學生能夠認識化學工程所涉及的廣大範圍，由日常生活用品至尖端科技如電子材料、複合材料、生醫科技等，本課程將由多位老師介紹各種化工知識與技術。

CHE 2110 工程數學一 3 學分
Engineering Mathematics I

Ordinary differential equations (ODEs), including first-order ODEs, second-order ODEs, higher-order ODEs, systems of ODEs; Series solutions of ODEs; Laplace transforms and its applications.

CHE 2120 工程數學二 3 學分

Engineering Mathematics Ⅱ

As continued from "Engineering Mathematics I", this course aims at establishing basic mathematical skills for applications in science and engineering disciplines, including linear algebra, vector calculus, Fourier analysis and partial differential equations.

CHE 2410 物理化學一 3 學分

Physical Chemistry (I)

The Physical Chemistry I will focus on chemical Thermodynamics

CHE 2420 物理化學二 3 學分

Physical Chemistry (II)

This course deals with quantum/statistical mechanics and atomic/molecular structure/spectroscopy at the introductory level.

CHE 3030 化工熱力學 3 學分

Chemical Engineering Thermodynamics

以介紹熱力學基本定律及其在化工上之應用為主，課程內容包括：第一及第二定律，內能、功及熱概念之說明，熱力學性質之間及其與可量測的數據如壓力－容積－溫度及比熱的關係導演，逸壓和活性度等觀念之建立，相平衡與化學反應平衡的分析等基本問題。

This class deals with the introduction of thermodynamic principle and its application on chemical engineering. The details of the course will include the first and second law of thermodynamics, internal energy, illustrating the concept of work and heat, demonstrating the relationship between thermodynamic property and measurable date such as P-V-T (pressure-volume-temperature) and specific heat, the concept of fugacity and activity, phase equilibrium, and analysis of equilibrium of chemical reaction,…etc.

CHE 3050 程序控制 3 學分

Process Control and Laboratory

1. To Study the dynamic behavior of manufacturing processes
2. To exam the feedback control theory and applications
3. To know the hardware and software of control elements
4. To learn the back principles of synthesis of feedback control loops

1. Students will have in depth understanding of the basic principles, process dynamics, feedback control design and synthesis.
2. Students will have some knowledge of hardware instrument, sensors and final control element.

CHE 3060 化工單操 3 學分

Chemical Engineering Unit Operations

本課程將介紹如何應用化學工程科學之原理（如質能結算、熱力學及輸送現象）分析及設計實際製程及裝備；內容以分離操作如蒸餾、吸收為主，兼及其他常見之程序。

This course employs the fundamental principles of chemical engineering

such as material balance, thermodynamics, transport phenomena to engineering design of chemical process unit operation equipments such as pump and compressors, dispersion and mixing, distillation,absorption, extraction, adsorption and chromatography, heat exchangers, drying etc. The ability to do dimensional analysis and scaleup, include safety margins, conform to standards, and employ computer aided design such as ASPEN Plus will be emphasized.

CHE3070 化學反應工程 3 學分
Chemical Reaction Engineering

介紹化學動力學及反應機構、動力學數據處理、理想反應器設計、停滯時間分佈、非等溫均相反應、非均相觸媒反應，非均相反應之質傳與效應等。

Introduction of chemical kinetics and reaction mechanism, kinetic data processing, ideal reaction design, dead-time distribution, non-isothermal homogeneous reactions, heterogeneous catalysts, heterogeneous mass transfer and the effect of the reaction.

CHE 3090 儀器分析及實驗一 3 學分
Instrumental Analysis and Lab. I

Instrumental analysis is linked with many fields of science and engineering. Due to the large number and diversity of instrumental methods, beginners typically will need a large amount of work to collect the necessary knowledge in order to understand of the fundamentals of the methods.

ChE 3090 Instrumental Analysis is an integrated course of lectures and laboratories and you will be exposed to a wide variety of analytical instrumentation and techniques.

CHE 3210 單元操作實驗 2 學分
Unit Operation Laboratory

進行傳統化學工業內所包括之各種單元操作之實驗，使學生可以從實驗學習過程中，瞭解各種單元操作之效用，並與化工單操及輸送現象及單操 I、II內所學之理論互相印証。實驗之項目包含：流體流動、填充床壓降、流體化床、濕壁塔、熱交換器、擴散係數量測、蒸餾、氣體吸收、乾燥、長晶等。

Conduct experiments on various unit operations in chemical industries, to help students to appreciate the theories and true operations (in small scale)) of the various unit operations taught in related courses.

The items of experiments include: fluid flow, pressure drop in packed column, fluidized bed, wetted wall column, heat exchanger, measurement on diffusion coefficient, distillation, gas absorption, drying and crystallization.

CHE3520 輸送現象及單元操作一 3 學分
Transport Phenomena and Unit Operations I

課程內容以流體力學之理論及相關之操作為主，包括：流體物性之介紹、shell momentum balance 、恆溫下連續方程式及運動方程式之建立、laminar flow、potential flow、turbulent flow、邊界層理論、界面動量傳送與摩擦係數，及巨觀流體流動等現象。

The course covers the theories and applications of fluid mechanics, including viscosity and momentum transport mechanisms, shell momentum balances, equations of changes for isothermal systems, laminar flow, turbulent flow, boundary layer theories, interphase momentum transport and friction factors, macroscopic momentum balances, and polymeric liquids.

CHE3530 輸送現象及單元操作二 3 學分

Transport Phenomena and Unit Operations Ⅱ

課程內容以能量與質量傳送之理論及相關之操作為主，包括：物質導熱度與擴散係數之介紹、shell energy and mass balances、非恆溫混合物系統之連續方程式、運動方程式、能量方程式及質量平衡方程式之建立、在turbulent flow 中之能量及質量傳送、邊界層理論、界面能量與質量傳送、熱傳與質傳係數及巨觀能量與質量平衡。

This course includes the theory and operation of energy and mass transfer. We introduce thermal conductivity of material and diffusion coefficient, also build shell energy and mass balances、equation of continuity、equation of motion、equation of energy、equation of mass balance in non-isothermal mixture system. In turbulent flow, the energy and mass transfer、boundary theory、energy and mass transfer of interface、the coefficient of energy and mass transfer and macroscopic energy and mass balance are also induced.

CHE 4150 程序設計 3 學分

Process Design

介紹化學工業製造程序的形成步驟，綜合化工系修過的專業知識從事製造程序之分析設計與可行性評估。指定題目給同學們，進行全程之設計研究，並提學期報告；培養學生從事產品製造及製程設計之能力。

Based on the acquisition of basic knowledge of chemical engineering, this course mainly focuses on the analysis, design and evaluation of the industrial chemical processes. The students will be assigned several topics for research and discussion. During this semester, the students can learn how to design a process and manufacture chemical products.

課程介紹 – 選修類- 課程選課指導

說明:

1、有鑑於近年來化學工業之多元化，因此增列此一選修類課程之選課指導。主要目的是協助同學們各依自己的興趣，選修適當之本系或外系課程，以奠定各個特殊領域之基礎。

2、在本課程介紹之末尾，列有本系碩、博士班開設之諸課程，提供各位同學瞭解，未來深造時可以選擇之方向。

3、如果同學對於某一外系課程興趣甚濃時，請不妨考慮選擇該系為輔系或雙主修。

4、以下所建議之選修類課程，共可分為(a)尖端製程; (b)高分子科學與工程; (c)尖端材料; (d)能源與環境; (e)生物技術等五大類。

5、屬於化工系開設之諸科目，其授課內容請參考所附資料，以便決定選修與否。此外同學們宜多向導師或領域專業老師直接請教。

尖端製程領域課程大綱

CHE 4130 基礎電化學 2 學分
Fundamental Electrochemistry

1 Introduction & scope
2 Electrolysis
3 Electrolyte Properties
4 The Interface
5 Electrochemical Thermodynamics I
6 Electrochemical Thermodynamics II
7 Electrochemical Thermodynamics III
8 Review & buffer week
9 Midterm Exam
10 Electrochemical Kinetics I
11 Electrochemical Kinetics II
12 Electrochemical Kinetics III
13 Electrochemical Kinetics IV
14 Review & buffer week
15 Final Exam
16 Term paper presentation I
17 Term paper presentation II
18 Term paper presentation III

CHE 4530 全球氣候變遷 3 學分
Climate Change

本課共來自原科院、人社院、科管院及工學院四位老師就大氣的組成和架構、氣候變遷起因及衝擊、溫室氣體排放數據、溫室氣減量政策與技術、溫室氣體減量成本、氣候變遷調適措施與影響評估等，作一講解。

The instructors in this course come from Nuclear Science, College of Humanities and Social Science, College of Technology Management, and College of Engineering. The contents of this course relate to the composition and structure of atmosphere, the origin of climate change and its impact, the amount of greenhouse gases emissions, the policy and technology for reduction of the greenhouse gases, the cost of greenhouse gases reduction, the adaptation of climate changes, and the assessment of the mitigation policies and measures.

CHE 4912 創造力培育、創意激發與發明 3 學分
How to Innovate/invent and Manage Ideas

The success of any creative work depends not only on the ability to find good ideas, but on the skills for developing, managing and presenting those ideas to others. This course will explore different techniques for finding and developing ideas (such as group discussion and games), and apply them in common project and professional situations, such as presenting design briefs to potential clients. The goals are to practice with idea generation techniques, understand how innovative ideas were accepted in organization and learn how to manage good ideas and lead to successful project/products.

CHE 4920 全球化競爭下之智慧財產策略與管理 3 學分
Intellectual Property Strategy and Management for Global Competition

本課程將帶領同學進入智慧財產(Intellectual Property)、科技研發、與全球化競爭(Global Competition)等三大學門間交互作用的領域，其目的在於培養同學結合研發與智財之能力，作為建立國家競爭優勢所需之領導人才的基礎。本課程探討之智財範圍包括專利(Patents)，著作權(Copyright)，商標(Trademarks)，產業機密(Trade Secrets)，以及反托辣斯(Antitrust) 。

課程之重點如下：

各經濟體(台灣、中國大陸、美國、及歐盟)智財法律之基礎性介紹，以為同學建立正確之智財與競爭觀念。

研發策略與智財策略之建立執行、互為指導、與全球佈局。

以研發成果產生與獲得有效之智財。

以有效之智財作為競爭優勢之基礎。

以公眾利益為前提之全球競合準則。

CHE 4985 化工產業論壇 1 學分
Chemical Industry Forum

本課程主要為大四同學設計，在其畢業之前，以邀請本系在各行各業的傑出系友前來專題演講，藉由演講者現身說法，讓同學瞭解各行各業的特色，現況及未來發展遠景，其中尤以個人的心路歷程為要，以做為目前仍然在校同學的就業、深造選擇之參考. 本課程另一重要目的，則在於針對本系教育目標中，有關溝通、管理、創新、品格教育、涵養領袖能力等項目，希望藉由演講人士之演講，將個人發展的心路歷程以及經驗與同學分享，達到建立正確觀念與豐厚認知之效果。

課程進行方式: 第一週由老師講解授課方式，作業，評分等事宜，並討論工程教育認證的要件. 爾後每週邀請各行各業的系友，前來演講,現身說法，並與同學討論溝通，最後期末收集整理修課同學的心得意見。

This course is mainly designed for seniors before graduation. Alumni from different chemical industries as well as other industries will be invited to give talks about their industries and their own professional life. It is hoped that by providing talks in person, the speakers are able to give students about the various features of different industries. The students will then have a better view about their future.

Another objective of this course is to provide opportunities for the students to learn things from the speakers about communication, management, personal character, leadership, etc. such that the correct attitude can be firmly established before graduation. In the first week of the course, the teacher will introduce the objectives and agenda of this course, as well as general rules about grades. In the subsequent weeks, each speaker will talk about his/her field of job and the experience he/she likes to share with the students, who will write down summary and any personal feelings.

CHE 5010 高等化工熱力學 3 學分
Advanced Chem. Engineering Thermodynamics

Objectives of this course include (1) review of classical thermodynamics, (2) introduction of basic ideas of statistical mechanics, (3) treatments of advanced topics such as equations-of-state and phase transformation of solids, liquids, solutions, electrolytes, liquid crystals and block copolymers.

CHE 5020 製程與品質之統計管制 3 學分
Statistical Process/Quality Control

1. Students will have some knowledge of statistics.
2. Students will be in depth understanding of the basic concepts of satistical process/quality control.
3. Students will understand the principles of multivariate statistical analysis and can apply the methods to practical problems.

CHE 5030 高等化學反應工程 3 學分
Advanced Chemical Reaction Engineering

本課程在強化學生化學反應動力學與化學反應器之設計觀念，並對目前高科技產業常用之化學反應器與相關技術作介紹。另外，透過教材，作業與文獻的導讀，使學生能從事相關問題之研究。

Advanced Chemical Reation Engineering (ACRE) is the field that aims to study the rates and mechanisms of chemical reactions and the design of reacters in which they take place.

CHE 5050 高等輸送現象 3 學分
Advanced Transport Phenomena

首先複習基本物理定律，其次舉例說明目前各科技領域運用輸送現象原理解決問題之方式

CHE 5070 化工原理 (Ⅰ) 3 學分
Chemical Engineering Principles (I)

• Introduction to Engineering Principles and Units (2 weeks)
• Principles of Momentum Transfer and Overall Balances (5 weeks)
• Principles of Steady-State Heat Transfer (4 weeks)
• Principles of Mass Transfer (5 weeks)

CHE 5080 化工原理 (Ⅱ) 3 學分
Chemical Engineering Principles (II)

課程共分為兩個部份: 化工熱力學及反應工程。目的在於簡要介紹給非化工系同學, 使其了解化學工程學科中間熱力學以及反應工程兩部分的基本原理與應用. 配合上學期的化工原理一建構成化學工程的核心知識.

就熱力學基本原理及應用之解說, 內容包括:

1. 前言 2. 第一定律及基本觀念 3. 單一流體之PVT關係

4. 熱效應 5. 第二定律

反應工程部分：解說反應工程原理，內容包括：

1. Introduction: the rate concept and elementary reactions
2. Ideal reactors
3. Heterogeneous catalysis and transport limitation effects
4. Microkinetic analysis
5. Nonideal flow in reactors
6. Nonisothermal reactors

7. Reactors accomplishing heterogeneous reactions

The course is divided into two parts: Chemical Engineering Thermodynamics and Reaction Engineering. The purpose of this course is to give a brief introduction to students who are not major in Chemical Engineering to understand the basic principles and applications of Thermodynamics and Reaction Engineering. This course with Chemical Engineering Principles (I) construct the core knowledge of Chemical Engineering

Thermodynamics: Elucidate the basic principles of thermodynamics and application. The contents include:

1. Preface

2. The first law and basic concept

3. The PVT relationship of pure fluids

4. Heat effect

5. The second law

Reaction Engineering: Elucidate the principles of Reaction Engineering，the contents include：

CHE 5081 化學工廠之設計、運作與管理 2 學分
Design, Operation and Management of Chemical Plants

本課程內容包括兩大部分，第一部份為產品規劃選擇，公司設定方向及定位，第二部份為建廠與管理。

CHE 5125 實驗設計與品質工程 3 學分
Experimental Design and Quality Engineering

1. Quality engineering and concepts of robust design

2. Basic Concepts and Definitions for Statistics.

3. Latin Squares

4. Factorial Design

5. Fractional Factorial Design

6. Central Composite Design

7. Response Surface

8. Final reports

CHE 5128 觸媒工程 3 學分

The chemical and the biochemical industries rely on heterogeneous catalysts for many of their manufacturing processes. This course introduces students to the various aspects of the state-of-the-art catalytic technologies, including the material and the process innovations, the enabling catalyst manufacturing knowhow, as well as the resulting environmental and energy improvements. It addresses the key technical details to help students understand the innovative concepts.

CHE 5152 化學產品創意設計 2 學分
Creative Design and Development of Chemical Products

This course is designed for students who consider joiningindustry either in the laboratory or manufacturing environment. Students will learnhow to start from new product concept to commercialization. In the class, students will have

chance to find out if they want to study advanced degree such as MBA in the future. The course can help students with information so that they will have much better idea about new product commercialization. Students will learn from by doing in the class instead of taking examinations. Full attendance is encouraged.

CHE 5170 高等程序控制 3 學分
Advanced Process Control

由於化工程序常是多變數、非線性及具有時延性質，因此課程著重在上述問題的分析與控制系統的設計，同時也考慮最佳控制。課程包括座標系統之轉換、狀態空間表示法、矩陣分析、狀態空間解析、觀察度、控制度、穩定分析、最佳控制及數值解題方法等。

This course extends chemical process control problem to the areas of multi-variable, nonlinear and time-delay processes. We will focus the analyses of the control problems of the above processes. Meanwhile, the design of advanced process control systems will also take care. The details of the course will include transformation of state space system, matrices expression of process models, observability, controllability and stability analyses,…etc.. Optimal control and numerical analysis will be studied to solve these problems.

CHE 5360 最適化方法 3 學分
Engineering Optimization

本課程的目的為介紹各種最適化方法的原理及在化工領域的運用。

內容包括線性規劃、非線性無限制規劃，及一般性的非線性規劃之原理及數值解題方法。並且以包裝軟體及工程例題引導，使學生理解問題之列式及解題之方法。

This course is to introduce various optimization techniques and their applications to chemical engineering problems. The contents include numerical methods and theoretical approaches to linear programming, constrained and unconstrained nonlinear programming, …, etc.. The software and engineering examples will be discussed so that the students can readily implement to their own use.

CHE 5980 超臨界流體技術 3 學分
Supercritical Fluid Technology

本課就超臨界流體(以二氧化碳及水為主)之基本原理及應用範圍做一介紹。內容包括：平衡溶解度之量測及模擬、輸送係數、超臨界流體萃取、同分異構物之分離、脫附、結晶、反應及奈米材料製備等。

This course introduces the fundamentals and application of supercritical fluids including CO2 and water. The contents include measurement and modeling of equilibrium solubility, supercritical fluid extraction and desorption, separation of isomers, crystallization, reaction, transport coefficients under supercritical operations, and preparation of nanomaterials.

高分子科學與工程領域課程大綱

CHE 3710 基礎高分子化學 2 學分
Polymer Chemistry Fundamentals

本課程內容包括高分子概念及應用，並簡單介紹各種聚合反應，如逐步聚合反應，加成聚合反應，共聚合反應，高分子分解等；以及高分子工業合成程序，進而了解高分子的各種特性。

Fundamental Polymer Chemistry links to the basic concepts of polymer science, including polymer structures, preparation methods, basic measurement methods, and some typical polymeric materials. This is the basic course of polymer science for undergraduate students.

1. The Science of Large Molecules
2. Step-Reaction Polymerization
3. Radical Chain Polymerization
4. Ionic and Coordination Chain Polymerization
5. Copolymerization
6. Polymerization Conditions and Polymer Reactions
7. Polymer Solutions
8. Measurement of Molecular Weight and Size

CHE 3720 基礎高分子物性 2 學分
Introduction to Polymer Physics

本課程內容包括高分子的分子量分布、形態、構型、結晶、玻璃轉化、溶液性質、黏彈性及機械性質等，透過這些主題的介紹，可進一步了解高分子材料結構與物性間的相關性。

This course includes molar mass discussion of polymer、configuration、conformation 、 crystallization 、 glass transition 、 solution properties 、 viscoelasticity and mechanical properties. Through the introduction of these topics, you can further understand the correlation between structure and physical properties of polymer materials.

CHE 4120 材料科學 3 學分
Materials Science

材料科學為探討材料之微觀結構與其物理，化學及機械性質之科學。本課程主要分為三部份：一、材料之微觀結構，原子鍵結與配位，晶體內之原子排列及晶體缺陷（特別是空位與差排之理論）；二、材料之熱力學及動力學：相圖、固體擴散及熱處理，此為控制與改變材料微觀結構之基礎；三、材料之性質：針對金屬、陶瓷、高分子及半導體等材料之結構特性，討論其相關之物理、化學及機械性質。

Materials science investigates the microstructures of materials, and their physical, chemical and mechanical properties. Three major topics are discussed in this course including : (a) microstructures, crystal structures and defects; (b) thermodynamics and kinetics, phase diagrams, solid state diffusion and heat treatments; and (c) physical, chemical and mechanical properties of metals,

ceramics, polymers, and semiconductors.

CHE 4310 電路板基礎工程 3學分
Engineering Fundamentals of Printed Circuit Boards

印刷電路板(PCB)為電子產業之重要基礎產業，目前由於個人電腦產業發達，加上通訊產品、消費數位產品、光電產品研發製造進步，PCB 產業各項產品例如主機板、通訊板、IC 基板載板、軟板等均蓬勃發展，供不應求，榮景可期，產業中急需大量人才。本課程介紹印刷電路板產業，瞭解印刷電路板之種類、設計、材料、製造程序、設備、技術、工程、應用、管理等以及未來發展方向。並將藉由業界參觀與邀請專家演講，以增加學生對印刷電路板實務之瞭解。

CHE 4940 光電材料與元件基礎 2 學分
Fundamentals of Optoelectronic Materials and Devices

教育化工系的同學，使認識光電材料與光電元件的基礎及其製程，俾便未來運用化學工程技術在這些相關的產業之中。內容主要分為三大部分: 光電材料與元件基本原理, 無機光電材料與元件、有機光電材料與元件。

Educate students in Department of Chemical Engineering to understand the basis of optoelectronic materials and optoelectronic components and the processing, enabling the future use of chemical engineering related industries.

The contents were divided into three parts: the basic principle of optoelectronic materials and components, inorganic optoelectronic materials and components. Organic optoelectronic materials and components.

CHE 5001 分子工程一 3 學分
(Molecular Engineering (I))

This course aims to hybridize quantum mechanics and solid-state physics to provide adequate theoretical basis for the understanding of the structure-property relationship of molecular systems and nano-materials.

CHE 5002 分子工程二 3 學分
(Molecular Engineering (II))

本課程與《分子工程(一)》為工學院分子工程學程碩士班必修課，將本學程四大重點(超分子結構調控、分子光電、分子流變與精密加工、分子模擬)做綜合性的介紹，使同學們對分子工程有全面性的瞭解，作為培養跨學門性質的高階研發人才的基礎；其中《分子工程(一)》涵括量子原理與光電性質，《分子工程(二)》則著重於分子動態、奈米材料與結構製程(bottom-up and top-down)。

Molecular Engineering (I) and (II) are the required courses for the master program of Molecular Engineering Program in the College of Engineering. The comprehensive contents of this course are to introduce the four points, control structure for super molecular, photoconductive molecular, molecular rheology with precision machining and molecular simulation. The course aims to integrate talents of students from various, particularly the molecular engineering science then develop the basis of the interdisciplinary or R & D talent. Molecular Engineering (I) includes Quantum principle and photoconductive properties. Molecular Engineering (II) is major Molecular dynamics, nanometer material and nanometer structure process from bottom-up and top-down.

CHE 5180 高分子生物材料 3 學分
Macromolecules as Biomaterials

This course covers the application of synthetic and natural macromolecules as biomaterial. Topics include molecular structure, polymer synthesis reactions, proteins, DNA and enzymes as functional materials, molecular surface engineering, multifunctional organic materials, including polymeric nanoreactors, conducting polymers and virus-mediated biomineralization. Students are expected to develop basic understanding of the role macromolecules as biomaterials.

CHE 5330 同步輻射在物質結構上的應用 2 學分
Synchrotron applications in structural analysis

本課程將介紹同步輻射在理解物質結構上的各種應用技術及相關原理。主要分為散射技術，光譜分析，影像技術三類.

CHE 5452 高分子分析技術 3 學分
Polymer Characterization

講授高分子材料研究各項現今使用廣泛之分析與表徵的設備及其原理，並結合實例說明建立分析法則。

This class deals with the research of polymer material nowadays including the principle, and analyzed /characteristic instrument. Also, combining the living example to explain and build up the analyzed principle.

CHE 5453 高分子設計與合成 3學分
Polymer Design and Synthesis

This course deals with polymer design and synthesis at the advanced level.

CHE 5455 熱固性高分子特論 3 學分
(Crosslinked and Thermosetting Polymers)

說明交聯與熱固性高分子的原理、反應、性質-結構關係、以及應用等

Introduction of the preparation, characterization and types of crosslinking reaction and thermosetting polymers. Discussion of the property-structure relationships, the properties for specified application, and the fields of application of crosslinked polymers.

CHE 5465 高等高分子物理 3 學分
(Special Topics in Condensed Polymer Physics)

本課程主要講解高分子的基本物理特性，內容包括：(1)高分子鏈構形統計力學、(2)高分子溶液熱力學、(3)高分子玻璃轉化現象、(4)高分子結晶形態學、(5)高分子結晶熱力學與動力學、(6)高分子黏彈性、(7)小角度散射解析高分子結構之應用。

This course introduces fundamental physical properties of polymer. The contents include：(1)The statistics of polymer chain conformation (2) Thermodynamics of polymer solution (3) Polymer glass transition (4) Morphology of polymer crystallization (5) Thermodynamics and dynamics of polymer crystallization (6) Polymer viscoelasticity (7) Application of polymer structure analysis by Small Angle Scattering.

CHE 5470 軟凝體科學 3 學分
Soft Condensed Matter

軟凝體(soft condensed matter)包括高分子、colloids、兩性分子與生物分子等材料，其性質與一般的液體與固體不同，決定軟凝體熱力學與動力學特性及性質的主要因素是在微觀與巨觀之間的介觀尺度結構，如分子在奈米尺度的構形與多分子自組裝形成的超分子奈米結構等。本課程主要介紹各種軟凝體的物理特性，包括軟凝體分子作用力，相轉化、colloidal dispersion，高分子，液晶，兩性分子與生物軟凝體等。

Soft condensed matter includes polymers, colloids, amphipathic and biological molecules; properties are different from normal liquids and solids. The mesoscopic structure determines the thermodynamics properties of soft condensed matter such as molecular conformation in the nano-scale and multi-molecular self-assembly of supramolecular nanostructures. In this course, physical aspects of soft condense matter are addressed, emphasizing relationship among intermolecular forces, nanostructural features, and phase transformation processes.

CHE 5475 嵌段共聚物物理學 3 學分
(Block Copolymer Physics)

1 Introduction
- 1.1 Introduction
- 1.2 Types of block copolymer
- 1.3 The structure of block copolymer melts, solids, solutions and blends
- 1.4 Techniques for studying block copolymers

2 Melt phase behaviour of block copolymers
- 2.1 Introduction
- 2.2 Experimental studies of the phase behaviour of block copolymers
- 2.3 Theories for the melt phase behaviour of block copolymers
- 2.4 Dynamic processes in block copolymer melts
- 2.5 Structure of thin ftlms of block copolymers

3 Block copolymers in dilute solution
- 3.1 Introduction
- 3.2 The critical micelle concentration
- 3.3 Experimental studies of block copolymer micelles
- 3.4 Theories for dilute block copolymer solutions
- 3.5 Computer simulations of block copolymer micelles
- 3.6 Ionic block copolymers
- 3.7 Dynamics in block copolymer solutions
- 3.8 Adsorption from block copolymer solutions

4 Block copolymers in semidilute and concentrated solutions
- 4.1 Introduction
- 4.2 Gelation in block copolymer solutions
- 4.3 Poly(oxyethylene)-containing block copolymers in solution
- 4.4 Styrenic block copolymers in solution
- 4.5 Theories for ordered block copolymer solutions

5 Solid state structure of block copolymers
- 5.1 Introduction
- 5.2 Structure formation in semicrystalline diblocks
- 5.3 Theories for crystallization in block copolymers
- 5.4 Crystallization kinetics in semicrystalline block copolymers
- 5.5 Crystallization in thin films
- 5.6 Structure formation in glassy block copolymers

6 Polymer blends containing block copolymers
- 6.1 Introduction

6.2 Experiments on binary block copolymer/homopolymer blends
6.3 Experiments on blends of block copolymers with two homopolymers
6.4 Experiments on blends of two block copolymers
6.5 Theories for binary block copolymer/homopolymer blends
6.6 Theories for blends of block copolymers with two homopolymers
6.7 Theories for blends of two block copolymers
6.8 Thin films

CHE 5485 高分子工業概論 3 學分

Intoduction to Polymer related Industries

本課程將邀請講師介紹台灣高分子產業，內容包含：

1.IC製程上的高分子
2.生醫高分子
3.紡織用高分子
4.LED高分子
5.太陽能及鋰電池用高分子
6.高分子液晶產業
7.聚醯亞胺(PI)的應用

CHE 5560 高分子複合材料 3 學分

Polymer Composite Materials

1.0 Introduction(Color Slides and /or Video Tape)
2.0 Basic fracture mechanics and some definitions
3.0 Fiber reinforcements in composites
4.0 Thermoset resins
5.0 Thermoplastic Resins
6.0 Fillers
7.0 Additives
8.0 Processing of fiber reinforced plastics
9.0 Design with fiber reinforced plastics
10.0 Concept of cleaner production, life cycle assessment(LCA)
11.0 Applications(Conventional and new developed)
12.0 Term paper presentation
13.0 Final Examination

CHE 5680 複合材料製程與檢測實驗 3 學分

Processing and Characterization of Composite Materials and Lab.

I. INTRODUCTION

II. RESIN PREPARATION
1. Thermoset Resin
2. Thermoplastic
3. Viscosity
4. Mw, Mn, MWD, ...

III. FIBER PREPARATION
1. Single fiber test and characterization
2. Sizing & Desizing

IV. MECHANICAL PROPERTIES MEASUREMENT
1. Tensile Strength and Modulus
2. Flexural Strength and Modulus
3. Compression Strength and Modulus
4. Impact Strength

5. Fatigue
6. Creep
7. Short beam shear strength
8. Interlaminar shear strength (ILSS)

V. THERMAL PROPERTY and FIRE RESISTANCE TESTS
1. DSC
2. TGA
3. HDT
4. UL Test
5. L.O.I.
6. Toxicity
7. Smoke Density

VI. NONDESTRUCTIVE TESTS
1. Ultrasonic C-scan
2. X-ray
3. EMI, ESD, Tests

VII. Nano Powder and Nano Particle Prepration
1. Dispersion
2. Uniformity
3. Particle size distribution

VIII. Morphology
1. TEM
2. SEM
3. AFM etc.

IX. U.D.COMPOSITE PROCESSING
1. Prepreg (U.D.) - Drum Winding
2. Hand lay-up
3. Pultrusion
4. Extrusion

X. 2D & 3D COMPOSITE PROCESSING
1. Autoclave, Vacuum bag and Pressure bag
2. SMC, BMC
3. Lamination (Printed Circuit Board, PCB, CCL)
4. Vacuum and/or Compression Molding(Epoxy, Molding Compounds, EMC)
5. Injection Molding
6. Pultrusion (Rod, Tube, Pipe)
7. Filament Winding (Pressure Vessel, Structure Composites)

CHE 5690 奈米高分子複合材料 3 學分
Nano Polymer Composites

本課程旨在講授高分子基奈米複合材料之基本原理、奈米結構單元、奈米微粒、碳管、線材、塊材等之物性、化性。奈米高分子複合材料之製備、結構、性能與檢測方法。並介紹奈米高分子複合材料在民生化工、電子、光電、半導體、生醫、製藥、能源、環保等之應用。

This course contains: (1) Basic principles of Nano Science and Technology (2) Definitions of nanomaterials (particles, fibers and plates) (3) properties of nano polymer composite materials, (4) characterization methods, (5) Methods of preparation and fabrication, (6) Applications of nano polymer composites, (7)

Term paper and final examination.

CHE 5794 高分子半導體及其元件 3 學分

Semiconductive Polymers and Devices (2007.2.23)

Course content

1.Introduction

2.Conjugated polymers

3.Synthesis of conjugated polymers

5.Solution state: (a) Chain conformation; (b) Chain aggregation; (c) Optical properties

6.Solid state:

(a) Chain conformation; (b) Chain aggregation ; (c) Liquid crystalline state

(d) Amorphous state; (e) Crystalline state

7.Optical properties and emitting species

8.Charge transport property and mechanism and charge traps

9.Devices

(a)Light emitting diode (b)Field effect transistor (c)Solar cell (d)Memory device

(e)Radio frequency identification system (f)sensor

10.Interfacial contacts in semiconducting polymer devices

11.Flexible organic electronics

CHE 5795 有機光電 3 學分

Organic Electronics

有機光電產業是一個萌芽、發展中的產業，本課程是一門有機光電學的入門課程，內容包括:

1. 原理:共軛有機分子及高分子之共軛結構及其半導體特性、其摻雜態之導電及電化學特性、光電轉換特性、電荷遷移率之電場效應。
2. 應用: (1)元件方面:發光二極體及平面顯示器、電晶體、記憶體、電容器、可充電電池。(2)非元件方面:積體電路、抗靜電塗佈、感應標識、無線射頻識別。(3)軟性電子產品(為以上元件及非元件之整合)。
3. 加工方法: (1)乾式:真空熱蒸鍍、濺鍍。(2)濕式:旋轉塗佈、滾輪塗佈、網板印刷、噴墨印像、曝光顯影。

Organics electronics is a newly developing area in opto-electronics. This course is an introductory course and will consist of the following topics:

1. Introduction,
2. Photochemistry,
3. Materials Chemistry and physics
4. Emitting species and charge transport
5. Organic light emitting diode (OLED)
6. Polymer light emitting diode (PLED)
7. Organic field effect transistor (OFET, including small molecules and, Polymers)

8. Organic Solar Cell (including small molecules and Polymers)
9. Organic Momory Device
10. e-Book
11. Processing technology
12. Flexible electronics

CHE 5796 有機光電特論 2 學分
Special Topics in Organic Electronics

The course content of "special topics in organic electronics" (credit 2) involves recent advances in the organic and polymer electronic devices, including the following topics:
(1) light emitting diode,
(2) solar cell,
(3) thin film transistor,
(4) bio-electronic devices.
The teaching materials will be selected from recent literatures within 5 years involving new conjugated organic (and polymeric) materials and their hybrids with nano-particles, and new conceptual/ theoretical/ technological developments. It is expected that the students taking this course have already taken the courses of organic chemistry and physical chemistry (or solid state physics). It would be better if the student has taken the course "Organic Electronics" (ChE5795, 有機光電) or its equivalent such as 分子工程II (Molecular Engineering II) or courses related to organic electronics.
Each student will be asked to present "literature survey and discussion on special topic" twice. The average score from these two presentations will be taken as his final score.
There are two class hours each week.

CHE 5800 高分子實驗 2 學分
Polymer Laboratory

This lab course deals with synthesis and evaluation of conjugation polymers. Knowledge in polymer synthesis is preliminarily required. It has been lectured in a class "Polymer Design and Synthesis" for postgraduate students.

CHE 5810 電子顯微鏡於軟物質研究之應用 3 學分
Applications of Electron Microscopy in soft Matter

講授電子顯微鏡於軟物質材料研究各項現今使用廣泛之分析與表徵的設備及其原理，並結合實例與操作說明建立分析法則

Introduction; Electron Optics; Electron Beam-Specimen Interaction; Image Formation; Contrast Mechanisms; Specimen Preparation; Microtomy; Staining; Shadowing; Scattering and Diffraction; Structure Identification; Tomography

CHE 5840 固態燃料電池特論 3 學分
Topics in Solid State Fuel Cells

先修課程(prerequisite)：物理化學。

(一) 燃料電池通論

(二) 質子交換膜燃料電池(proton exchange membrane fuel cell,簡稱PEMFC)

(三) 直接甲醇燃料電池(direct methanol fuel cell, 簡稱DMFC)

(四) 固態氧化物燃料電池(solid oxide fuel cell, 簡稱SOFC)

1. 電解質ㄧ固態氧化物
2. 陽極材料
3. 陰極材料
4. 連接極材料
5. 直接甲烷SOFC (direct methane solid oxide fuel cell,簡稱DM-SOFC)
6. 一體化甲烷重組SOFC

CHE 5845 固態離子學特論 2 學分
Topics in Solid State Ionics

一、固態離子學(solid state ionics)簡介
二、氣體偵測器(gas sensor)之固態離子學
1. 氧化鋯(zirconia)氧偵測器(oxygen sensor)
2. 醫學應用
三、電池(battery)之固態離子學
1. 鋰離子導體(lithium ion conductor) – 鋰電池
2. 電極/電解質介面(electrode/electrolyte interface)
3. 氫離子導體(proton conductor) – 鎳氫電池
四、固態氧化物燃料電池(solid oxide fuel cell)之固態離子學
1. 氧離子導體(oxide-ion conductor) – oxygen-ion mobility
2. 電極材料 – 電極/電解質介面
3. 氫離子導體(proton conductor) – solid-state proton conductivity

CHE 5870 高分子黏彈性 3 學分
Polymer Viscoelasticity

(1) 粘性之定義及模式 (2) 自古典力學導出彈性模式,其應用及修正 (3) 描述粘彈性之模式,含積分或及微分式 (4) 測量粘彈性之實驗方法。

(1)Defination and model of viscosity (2) Figuring out elastic model from classical mechanics and its applications and modifications (3) Describing the model of viscoelasticity, inculding the integration and the differentiation (4) Experimental method for measuring viscoelasticity

尖端材料領域課程大綱

ChE 4120　材料科學　3 學分
Materials Science

材料科學為探討材料之微觀結構與其物理，化學及機械性質之科學。本課程主要分為三部份：一、材料之微觀結構，原子鍵結與配位，晶體內之原子排列及晶體缺陷（特別是空位與差排之理論）；二、材料之熱力學及動力學：相圖、固體擴散及熱處理，此為控制與改變材料微觀結構之基礎；三、材料之性質：針對金屬、陶瓷、高分子及半導體等材料之結構特性，討論其相關之物理、化學及機械性質。

Materials science investigates the microstructures of materials, and their physical, chemical and mechanical properties. Three major topics are discussed in this course including : (a) microstructures, crystal structures and defects; (b) thermodynamics and kinetics, phase diagrams, solid state diffusion and heat treatments; and (c) physical, chemical and mechanical properties of metals, ceramics, polymers, and semiconductors.

ChE 4312　電子構裝技術與材料　2 學分
Electronic Packaging technology and materials

電子構裝是將已製作完成的積體電路與其它相關的電子元件，共同連接於一系統中，並維持合宜的環境，以發揮此系統設計的功能。電子構裝工業屬於半導體工業的後段，與積體電路製造業相依相生。本課程將對電子構裝之製造流程與所用材料進行介紹，使學生對電子構裝領域有清楚完整的概念。學生未來可藉著此基礎，加上本身原有的專長，作為對電子構裝領域切入與貢獻之起始。

ChE 4940　光電材料與元件基礎　3 學分
Fundamentals of Optoelectronic Materials and Devices

教育化工系的同學，使認識光電材料與光電元件的基礎及其製程，俾便未來運用化學工程技術在這些相關的產業之中。內容主要分為三大部分: 光電材料與元件基本原理, 無機光電材料與元件、有機光電材料與元件。

Che 5145　奈米材料科學　2學分
Science and Engeneering of Nanomaterials

此門課的內容綜合了了化工、物理、化學、材料等知識來介紹奈米材料科學。含括的材料以無機的奈米材料為主。一開始將會複習與奈米材料科學有關的基礎材料科學原理、之後會進行導入奈米材料內容，內容包括了探討奈米材料在奈米尺度下的量子侷限效應、各式的奈米材料合成發法原理、奈米材料鑑定、奈米材料的元件設計。
內容將會含括以下幾個主題：
1. 材料科學理論 2. 奈米材料導論 3. 奈米材料的量子侷限效應 4. 奈米材料合成方法與原理 5. 奈米材料鑑定技術 6. 奈米材料元件設計

This course combines the knowledge of the chemical, physical, chemical, and materials to introduce nanomaterial science. Materials are mainly based on inorganic nanomaterials. In the beginning, the course will review fundamental materials science related to nanomaterials, and then import nanomaterials content, including the quantum confinement effect of nano materials in the

nanoscale, a variety of nanomaterials synthesis, characterizatoin of nanomaterials, device design.

ChE 5550 膠體界面科學與科技特論 3 學分

Introduction to Colloid and Interface Science & Technology

The course is designed to provide basic understanding of colloid and interface science for students with interests of nanomaterial-manufactured products and their applications in the fields of chemical engineering. The objective is to understand the physical and chemical properties of nanomaterial dispersions, and then to bridge the knowledge of their synthesis and surface chemistry to the recent developments of nanotechnology and bionantechnology.

ChE 5700 陶瓷粉末處理 2 學分

Ceramic Powder Processing

introduction to the basic science and technology of ceramic powder processing; items include: powder characterization and analysis, various methods to synthesize powders, physical treatment of powders, powder agglomeration and dispersion; forming techniques, etc.

ChE 5750 材料相平衡 3 學分

Phase Equilibria of Materials

探討材料相平衡的基礎、表現方法及應用。介紹相平衡的原理、相平衡與自由能的關係、對相平衡圖的了解、計算相平衡的方法、及在材料製程上的應用。

The objective of this course is understanding the principles and applications of multi-component phase equilibria of materials. The topics include phase diagrams of one, two and three component systems, thermodynamic principles governing phase equilibria, liquidus projection and applications of phase equilibria.

能源與環境技術領域課程大綱

CHE 2540　化學工業安全概論　2 學分
Introduction to Chemical Process Safety

本課程以介紹各種可能遇到的化學災害為主，如火災、爆炸、洩漏或中毒等，並探討各種預防之道，及發生災害時緊急應變之道。唯有建立化學從業人員的正確安全觀念及預防性作法，避免化學災害的發生，才能使得化學技術及其產品充份發揮它改善人類生活品質的原來目的。

In this course, various kinds of possible chemical accidents, e.g. chemical fire, explosion, chemical leak and poison, will be discussed. The techniques used for prevention as well as emergency response will also be discussed. It is absolutely necessary to establish the correct concept about safety and methods of prevention before we can avoid the hazard of chemical accidents. Thus, we can achieve the original objective of improving the life of humankind by these chemicals and their processing techniques.

CHE 3010　能源科技與環境概論　2 學分
Introduction to Energy Technology and Environment

傳統能源之長期使用已造成許多環境災害，有限的化石燃料亦為將來世界的能源體系埋藏潛伏性的危機，發展綠色能源已成為各界關注的焦點。綠色能源可分為再生能源與儲能技術，其中太陽能是極重要的再生能源，在各國政府積極的投入下，致使全球太陽光電產業以平均30%成長幅度順勢而起，也帶動對太陽電池的高度需求，台灣包括聯電、奇美等大廠相繼規劃投入。能源與環境將會是未來數十年人類所將會遇到的重要問題，所以希望藉由此課程增進學生跨領域綠色科技能源之素養，推廣綠色能源科技之創意活動，結合全校資源與產業界培育具備綠色能源應用及創新能力人才，與推廣再生能源應用科技於各系所，進而提昇我國綠色能源科技產業人才競爭力。

The long-term use of traditional energy sources has caused many environmental disasters. Limited fossil fuel buried latent crisis for energy system in the world. The development of green energy has become a widespread focus. Green energy can be divided into renewable energy and energy storage technologies, in which solar energy is a very important renewable energy. Under involvement of the Governments, an average 30% increase growth of global solar industry has also led to high demand for solar cells. UMC and CMO and other companies in Taiwan have planned to invest the industry. Energy and environment will be important issues in the few decades. We hope by this course to enhance students' cross-cutting green Energy technology literacy, creative activities to promote green energy technologies combined with school resources. To nurture talented persons learn green energy applications and innovation capacity, and promote the application of renewable energy technology, thereby enhancing our green energy technology industry talent competition.

CHE 5120　電化學分析技術與應用　3 學分
Electrochemical Analytical Techniques and Applications

1. Introduction to electrochemistry & electroanalytical chemistry

2. Fundamentals of electrochemistry
3. Potentiometry
4. Controlled-current methods
5. Controlled-potential methods
6. AC impedance analysis
7. Spectro-electrochemical methods
8. Final reports

本課程主要在介紹電化學與電化學分析方法, 首先藉由電化學基本觀念的說明，引導學生進入電化學與電化學分析相關之研究；其次介紹各種電化學分析方法與技巧，最後希望透過文獻導讀與報告，讓學生瞭解電化學分析方法與應用。

CHE 5121 石油化學工業 3 學分
Petroleum Chemistry

本課程宗旨在介紹石油化學之基本概念，以建立選修同學日後從事於石油化學工業之進一步研究或投入生產事業之基礎。內容涵蓋石油化學工業之主要製程、產品、品質與市場，天然氣生產與市場，國內石化工業近況。

The fundamental processes and chemistries in petroleum/petrochemical/LNG industries are discussed. It will cover the process/product/quality aspects of the related industries along with the global pricing, marketing and trading issues. The course provides a basis for students interested in further academic research and/or industrial practices.

CHE 5122 綠能發展與環境控制 3 學分
Green Energy Development and Environmental Control

隨著經濟發展，人類活動所需要的水、空氣、能源等，皆是從大量地球資源中所獲得。在這過程必定會造成一次能源的短缺和環境污染破壞。本課程介紹綠色能源的種類及應用原理與發展，並說明永續發展的環境科技，藉以培養學生對於綠色能源與永續環境科技之專業知識和開發創意，讓學生未來選擇於綠色能源產業就業時，能先有基本的概念。

Green energy deriving from solar, wind, and biomass sources has great potential for growth to meet our future energy needs. Upon completing the course the student should have a throughout understanding of green energy situation and the interactions between the human activities in the energy field and the environment. Furthermore the student should have a comprehensive knowledge of available production systems and tools as well as technical mitigation methods relevant to the energy field and applicable within the existing legal work.

CHE 5420 非均勻系催化動力學 2 學分
Heterogeneous Catalysis Kinetics

考慮金屬觸媒，介紹在其表面上所發生的化學反應受其催化的動力學。由基本反應步驟的吸附、表面反應及脫附的原理及影響，進而討論整個反應的動力學。由均勻至非均勻表面的動力學均介紹並予比較。並介紹金屬催化反應的結構敏感度的原理。

CHE 5740 汽車廢氣控制 2學分

Automotive emissions control

一、 汽車廢氣控制簡介

二、 三向觸媒轉化器 (three-way catalytic converter)

1. 三向觸媒 (three-way catalyst, TWC)
2. 反應機制

三、 選擇性觸媒還原 (selective catalytic reduction, SCR)

1. Urea (ammonia) based
2. Hydrocarbons based
3. Hydrogen & CO based

四、 電催化分解 (electro-catalytic decomposition)

1. Solid oxide fuel cell (SOFC) at open circuit
2. Electrochemical-catalytic cell: disk & tube (electro-catalytic tube)
3. Electro-catalytic honeycomb

CHE 5820 電化學能源 2學分

Electrochemical Energy Storage and Conversion

1 Introduction & scope of this class
2 Basic concepts
3 Electrochemical principles
4 Primary battery I
5 Primary battery II
6 Secondary battery I
7 Secondary battery II
8 Midterm Exam
9 Term paper topic assignment & guide
10 Capacitors & supercapacitor
11 Fuel cell
12 Dye sensitized solar cell I
13 Dye sensitized solar cell II
14 Term paper presentation I
15 Term paper presentation II
16 Term paper presentation III Term paper due

生物技術領域課程大綱

CHE 4400 製藥工程導論 3 學分
Introduction to Industrial Pharmacy

本課程由藥物的基本概念開始，逐步講授藥品從研發到上市的整體流程，包括配方及製程開發、生產、申報、及營銷等。並以錠劑及針劑的製作方法為例，介紹藥品製造的整體概念。本課程亦將對製藥產業作較為詳盡的介紹，包括產業的特性、全球及台灣醫藥市場的現況及未來趨勢等。

The course starts with an introduction of basic pharmacy background, followed by a series of topics on pharmaceutical commercial chain including drug research and development, manufacturing process, regulatory application, and sales and marketing. The manufacture of two selected pharmaceutical dosage forms (tablets and injectables) will be presented to illustrate the concepts of drug manufacturing process. The course will also provide an overview of the pharmaceutical industry. This includes the characteristics of the industry, current and future trend of global and domestic pharmaceutical markets, etc.

CHE 4552 生物技術概論 3 學分
Introduction to Biotechnology

此課程將會介紹基礎生物技術包括基本生物學,基因工程介紹, 反應器內質傳與設計,下游程序工程,生物技術在特用化學品、抗生素、環境、農業等之之應用。

The topics of this course cover basic cell biology, fundamental genetic engineering, cell culture, bioreactor design, downstream bioprocesses and applications of biotechnology.

CHE 4553 基礎細胞生物學 3 學分
Fundamentals of Cell Biology

This course is an introduction to the basic concepts of molecular cell biology in eukaryotic system including experimental strategies and methodology. This course will provide a foundation for engineering-major students who are interested in cell-related workings, such as cellular engineering and tissue engineering. Lecture topics will start from fundamentals of cellular components to cell cycle regulation, the cytoskeleton and cell motility, cellular membrane systems, and the interaction of cells with each other and the environment.

CHE 5126 代謝工程與生質化學品概論 3 學分

Metabolic engineering and renewable chemical production

此課程將會介紹代謝工程領域中所需的基礎分子生物技術，微生物之各式代謝途徑，及其在 生質燃料和化學品方面之應用 Selected topics in molecular biology that form the foundation of biotechnology and metabolic engineering will be discussed. Along with introduction of cell metabolism, this course will focus on the application of various techniques in the production of renewable chemical and fuel.

CHE 5040 生物產業特論 3 學分
Special Topics in Biotechnology Industries

課程涵蓋介紹現今生物技術產業發展概況。其內容包括各項相關技術，包括分子生物學、生物產品製造與純化，以及這些技術所衍生出來的產業；最後，我們會將學生分組，並試作一個生技產品的發展計劃。

This course will review molecular genetics, product synthesis and purification, and current trend in industrial development. Students will be working in teams, and present biotechnology product plan.

CHE 5153 生質燃料技術特論 2 學分
Biofuel Technology

應用於化學工程各項基礎概念，介紹生質燃料之概念及製造原理。

The course aims to provide an overview of the biofuels based on the concept of chemical engineering.

CHE 5412 人工器官與組織工程 3 學分
Artificial Organs and Tissue Engineering

To introduce currently available artificial organs and concepts of tissue engineering from the engineering disciplines' point of view.

CHE 5890 工業微生物學 3 學分
Industrial Microbiology

介紹關於微生物及生化學之基礎知識以利不熟悉生物科技領域的工程研究者可以深入淺出了解生物化學工程體系和應用，內容包括微生物之基本特性包括分類，細菌、酵母及黴菌之簡介，發酵生理及代謝、突變及育種。另外，簡介生物技術的傳統工業利用以及最新的發展概況。

Industrial Microbiology will introduce basic knowledge of microbiology and biochemistry to engineering students, so that they can grasp ideas and concepts of biochemical engineering and bioindustry quickly. The course content includes taxonomy, characteristics of bacteria, yeasts and fungi, microbial physiology, metabolism, strain improvement. Industrial applications of microbes in traditional and new bioindustry will be covered also.

CHE 5900 分子生物技術 3 學分
Molecular Biotechnology

此課程將會介紹基礎生物技術包括基本生物學, 分子生物, 基因工程, 動物細胞培養蛋白質表現系統等, 以及在製藥, 醫學, 農業, 環境等方面之應用。

This course provides introduction to basic cell biology, molecular biology, genetic engineering as well as applications in protein expression, vaccine design and gene therapy.