

# 化学工程与工艺专业 2017 版本本科培养方案

## Undergraduate Education Plan for Specialty in Chemical Engineering and Technology (2017)

专业名称	化学工程与工艺	主干学科	化学、化学工程与工艺
Major	Chemical Engineering and Technology	Major Disciplines	Chemistry, Chemical Engineering and Technology
计划学制	四年	授予学位	工学学士
Duration	4 Years	Degree Granted	Bachelor of Engineering

### 最低毕业学分规定

#### Graduation Credit Criteria

课程分类 Course Classification 课程性质 Course Nature	通识教育课程 Public Basic Courses	专业教育课程 Specialized Courses	个性课程 Personalized Course	集中性实践教学环节 Practice Courses	课外学分 Study Credit after Class	总学分 Total Credits
必修课 Required Courses	29	72.5	\	24	\	170
选修课 Elective Courses	9	19.5	6	\	10	

### 一、培养目标与毕业要求

#### I Educational Objectives & Requirement

##### (一) 培养目标

本专业致力于培养德、智、体全面发展，适应国家化学工业及其相关领域经济建设需求，具有较好自然科学基础和人文社会科学基础，具备扎实的化工专业基础知识和工程实践能力，具有较强的社会责任感、良好的道德修养和心理素质，具备较强的创新精神、国际视野和管理能力，能够在化工及相关行业从事科学研究与技术开发；从事设计、工程开发和生产管理；从事以化工为专长的经济管理的高级工程技术人才。

本专业期待毕业生五年后能达成下列目标：

- (1) 身心健康，具备良好的敬业精神、社会责任感和工程职业道德，关注当代全球问题和社会可持续发展问题，具有质量意识、环境意识和安全意识；
- (2) 具有独立从事化工过程设计、化工新产品研发、化工系统优化、化工过程及设备操控等工作的能力，能运用自然科学、化学工程与工艺等基础理论解决工程实践中的基本问题；
- (3) 了解化学工程与工艺的发展前沿及趋势，具有化工新产品研发、工艺开发与改造、技术系统集成、生产过程管理的能力，可促进专业可持续发展；
- (4) 具有创新精神，具有终身学习的能力，能不断提升就业竞争力；
- (5) 具有良好的交流沟通能力、良好的团队意识和合作精神，能在团队中发挥协调和领导能力。

#### Educational Objectives

This program aims at training students who meet the requirements of the rapid growth of national economy and modernization as well as have a strong basis of natural science and humanistic and social science. With comprehensive knowledge and skills of chemical engineering and a strong sense of social responsibility, professional ethics, psychological quality, innovate consciousness, international perspective

and management ability, students can become competent senior engineering technicians not only in the aspects of academic research, design, development of novel technology and process, but also in the management works of operation and economic in chemical industry or related fields.

Students of this programs are expected to achieve the following objectives 5 years after graduation:

1. Have a strong sense of social responsibility, professional ethics and good quality of humanities and social sciences. Focus on contemporary global issues and social sustainability issues. Have quality awareness, environmental awareness and safety awareness.
2. Be competent to engage in chemical process design, development of novel chemical product, optimization of chemical process, development, reform and operation of chemical process and equipment production management. The basic problems of engineering practice can be solved by using basic theory of natural science、chemical engineering and technology.
3. Knowing the frontier and trend of chemical engineering and technology, be competitive in on the aspects of research and development of novel chemical product, development and reform of process, integration of technical system and management of production process and promotion of the sustainability of chemical engineering and technology.
4. Possess innovative spirit and life-long learning ability and constantly improve our employment competitiveness .
5. Promote team coordination and leadership with capacity in communication, negotiation, organization and executive.

## (二) 毕业要求

- (1) **工程知识**: 具有从事化学工程与工艺专业相关工作所需要的数学、自然科学、工程基础和专业 知识, 能够将其用于解决化学工程与工艺相关研发、设计、生产和应用过程中的复杂工程问题;
- (2) **问题分析**: 能够应用数学、自然科学和工程科学的基本原理, 识别、表达, 并通过文献研究、分析化学工程与工艺相关领域的工程问题, 以获得有效结论;
- (3) **设计/开发解决方案**: 能够设计针对化学工程与工艺领域复杂工程问题的解决方案, 设计满足 特定需求的系统、单元(部件)或工艺流程, 并能够在设计、开发环节中体现创新意识, 考虑 社会、健康、安全、法律、文化以及环境等因素;
- (4) **研究**: 能够基于化学工程与工艺基础理论并采用科学方法对复杂工程问题进行研究, 包括设计 实验、分析与解释数据、并通过信息综合得到合理有效的结论;
- (5) **使用现代工具**: 能够针对化学工程与工艺领域复杂工程问题, 开发、选择与使用恰当的技术、 资源、现代工程工具和信息技术工具, 包括对复杂工程问题的预测与模拟, 并能够理解其局 限性;
- (6) **工程与社会**: 能够基于专业基础理论和工程相关背景知识进行合理分析, 评价专业工程实践和 复杂工程问题解决方案对社会、健康、安全、法律以及文化的影响, 并理解应承担的责任;
- (7) **环境和可持续发展**: 能够理解和评价针对复杂工程问题的工程实践对环境、社会可持续发展的 影响;
- (8) **职业规范**: 具有人文社会科学素养、社会责任感, 能够在工程实践中理解并遵守工程职业道德 和规范, 履行责任;
- (9) **个人和团队**: 具有一定的组织管理能力、表达能力、人际交往能力和团队合作能力, 能够在多 学科背景下的团队中承担个体、团队成员以及负责人的角色;
- (10) **沟通**: 能够就化学工程与工艺相关领域复杂工程问题与业界同行及社会公众进行有效沟通和交 流, 包括撰写报告和设计文稿、陈述发言、清晰表达或回应指令。并具备一定的国际视野, 能 够在跨文化背景下进行沟通和交流;
- (11) **项目管理**: 理解并掌握工程管理原理与经济决策方法, 并能在多学科环境中应用;

(12) **终身学习**：具有自主学习和终身学习的意识，有不断学习和适应发展的能力。

## II Graduation Requirement

1. **Engineering knowledge**: Acquire mathematics, natural science, engineering principles and professional knowledge required for the work in the field of chemical engineering and technology, and be able to use them to solve complex engineering issues in research and development, design, production and application in chemical engineering and technology.
2. **Problem analysis**: Apply the fundamental principle of mathematics, natural science, engineering science and professional knowledge to identify, express and analyze the complex engineering problems related to chemical engineering and technology through literature review, and to finally reach effective conclusions.
3. **Design/development solution**: Be capable to provide solutions to complex engineering problems in the field of chemical engineering and technology, design operation system, unit (part) or process which meets the specialized requirement as well as to reflect innovation consciousness in the design and development processes, taking factors including society, health, safety, laws, culture, and environment into considerations.
4. **Research**: Be able to comprehensively apply fundamental theories and technical skills of chemical engineering and technology to investigate complex engineering problems in professional-related area, including experimental designs, analysis and interpretation of data, and acquiring reasonable and effective conclusion via discussing results.
5. **Usage of modern tools**: Be able to develop, select and use appropriate technology, resource, modern engineering development and information technology tools to solve complex engineering problems in the field of chemical engineering and technology. Also be capable to predict and simulate the problems as well as understand the limitations of the tools.
6. **Engineering and society**: Be able to analyze and estimate the influences of engineering practice and complex engineering problem solutions properly in the field of chemical engineering and technology on society, health, safety, laws, culture and environment, and understand the responsibilities that should be taken for.
7. **Environment and sustainable development**: Establish engineering thoughts of sustainable development, understand and estimate the influences of engineering practice of complex engineering problems in the field of chemical engineering and technology on sustainable development of environment and society.
8. **Professional standards**: Have quality of humanities and social sciences, social responsibilities, and moral sentiments to understand and comply with engineering professional ethics and norms, and to fulfill the responsibilities.
9. **Individual and team**: Acquire capabilities of organization management, expression, human communication and team work, and be able to play a role as an individual, team member or manager in a team with a multi-discipline background.
10. **Communication**: Be able to negotiate and exchange with industry peers and the public on complex engineering problems in the field of chemical engineering and technology, including writing, designing and presenting reports clearly, and have certain international perspectives to communicate under the cross-cultural background.
11. **Project management**: Understand and grasp engineering management principles and economic decision making methods, and be able to apply them in multi-discipline situations.
12. **Life-long learning**: Acquire consciousness of self-learning and life-long learning, and capabilities of continuous learning and adaptive development.

附：培养目标实现矩阵

	培养目标 1	培养目标 2	培养目标 3	培养目标 4	培养目标 5
毕业要求 1	✓				
毕业要求 2		✓	✓		
毕业要求 3		✓	✓	✓	
毕业要求 4		✓	✓	✓	
毕业要求 5	✓			✓	
毕业要求 6			✓	✓	
毕业要求 7			✓		✓
毕业要求 8					✓
毕业要求 9					✓

## 二、专业核心课程与专业特色课程

### II Core Courses and Characteristic Courses

#### (一) 专业核心课程：

物理化学、化工原理、化工热力学、化学反应工程、化工过程分析与综合、化工设计基础

Core Courses: Physical Chemistry, Principle of Chemical Engineering, Thermal Dynamics of Chemical Engineering, Reaction Engineering of Chemistry, Analysis and Synthesis of Chemical Processes, Basic Chemical Process Design

#### (二) 专业特色课程：

涂料与涂装工艺学、涂料结构与功能设计、精细有机合成技术、精细化工工艺学

Characteristic Courses: Paint and Coating Technology, Paint Structure & Function Design, Fine Organic Synthesis, Fine Chemical Technology

附：毕业要求实现矩阵：

专业 核心 课程	专业 特色 课程	课程名称	化学工程与工艺专业毕业要求								
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		中国近现代史纲要	✓								
		思想道德修养与法律基础	✓								
		毛泽东思想和中国特色社会主义理论体系概论	✓								
		马克思主义基本原理	✓								
		军事理论	✓								✓
		人文社科类课程	✓								
		创新创业类课程								✓	
		经济管理类课程					✓				
		心理健康教育	✓								✓
		体育	✓								✓

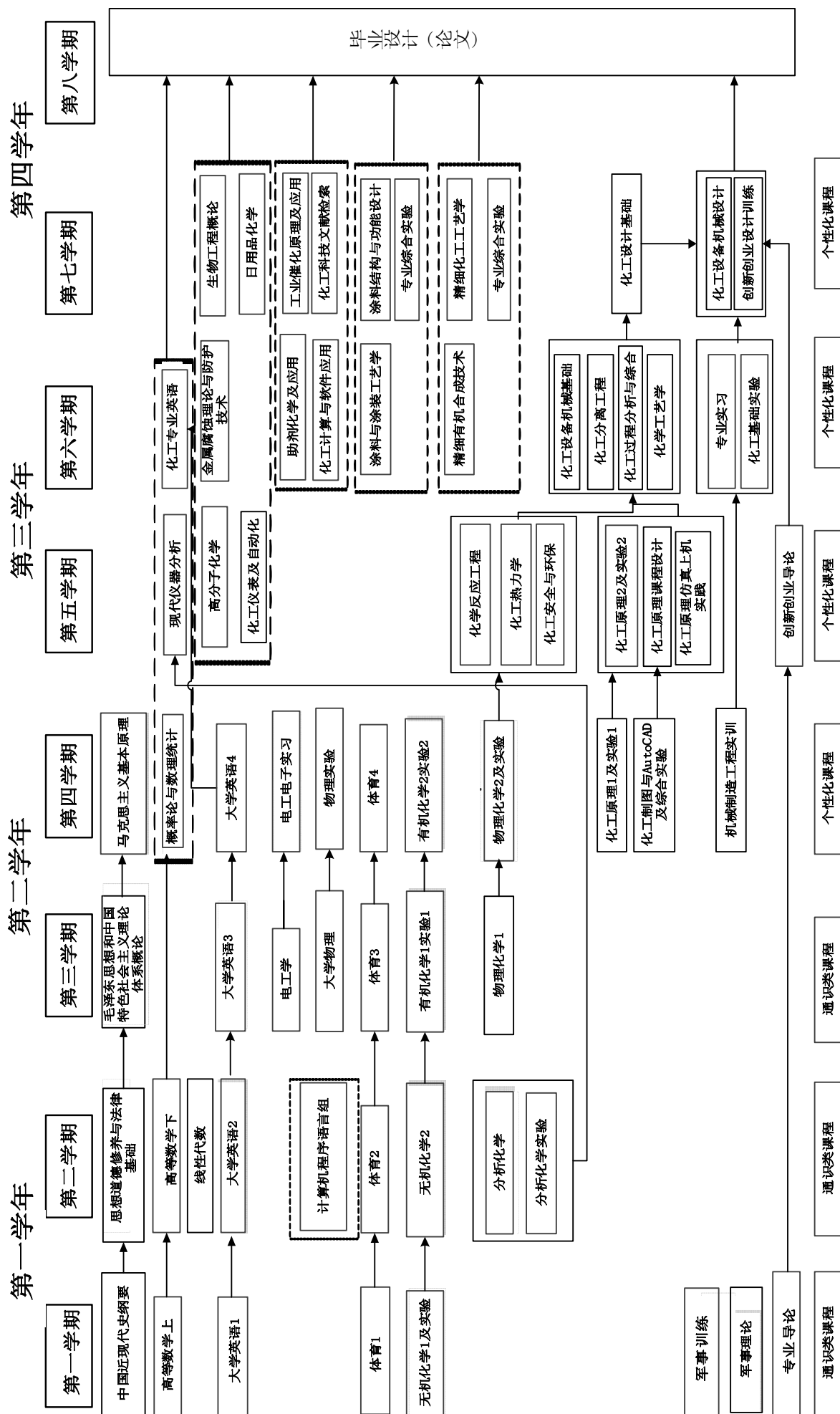
专业 核心 课程	专业 特色 课程	课程名称	化学工程与工艺专业毕业要求								
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		大学英语									√
		专业导论					√	√			
		高等数学		√							
		线性代数		√							
		概率论与数理统计		√							
		大学物理		√							
		物理实验		√							
		电工学		√							
		无机化学		√							
		无机化学实验		√							
		分析化学		√							
		分析化学实验		√							
		有机化学		√							
		有机化学实验		√							
√		物理化学		√							
√		物理化学实验		√							
√		化工原理		√	√	√					
		化工原理实验		√	√	√					
		化工制图与 Auto CAD		√	√						
		化工制图与 Auto CAD 综合实验		√	√						
		创新创业导论				√	√	√		√	
√		化工热力学		√	√	√					
√		化学反应工程		√	√	√					
		化工安全与环保					√	√			
		化工设备机械基础		√	√	√					
		化工分离工程		√	√	√					
√		化工过程分析与综合		√	√	√					
		化学工艺学		√	√	√		√			
√		化工设计基础		√	√	√	√				

专业 核心 课程	专业 特色 课程	课程名称	化学工程与工艺专业毕业要求								
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		概率论与数理统计		√							
		现代仪器分析		√		√					
		化工专业英语									√
		C 语言程序基础			√				√		
		计算机基础与 C 语言设计综合实验			√				√		
		VBA 程序设计基础			√				√		
		计算机基础与 VBA 程序设计综合实验			√				√		
		高分子化学				√					
		化工仪表及自动化			√						
		金属腐蚀理论与防护技术		√		√					
		生物工程概论						√			
		日用品化学		√		√					
		助剂化学及应用		√		√					
		化工计算与软件应用			√	√					
		工业催化原理及应用		√		√					
		化工科技文献检索						√	√		
	√	涂料与涂装工艺学		√		√					
	√	涂料结构与功能设计		√		√					
	√	精细有机合成技术		√		√					
	√	精细化工工艺学		√		√					
		专业综合实验				√			√		
		军事训练	√							√	
		机械制造工程实训			√	√					
		电工电子实习			√	√					
		化工原理仿真上机实践			√	√					
		化工原理课程设计			√	√	√			√	
		专业实习				√	√			√	
		化工基础实验		√	√						
		创新创业设计训练				√	√	√	√	√	

专业 核心 课程	专业 特色 课程	课程名称	化学工程与工艺专业毕业要求								
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		化工设备机械设计				√		√		√	
		毕业设计(论文)				√	√	√	√	√	√

### 三、课程教学进程图

### III Teaching Process Map





#### 四、 理论教学建议进程表

#### IV Theory Course Schedule

课程编号 Course Num ber	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
(一) 通识教育必修课程 General Education Required Courses									
4220002110	中国近现代史纲要 Outline of Contemporary and Modern Chinese History	2	32					1	
4220001110	思想道德修养与法律基础 Morals, Ethics and Fundamentals of Law	3	48			8		2	
4220003110	毛泽东思想和中国特色社会主义理论体系概论 Introduction to Mao Zedong Thought and Socialism with Chinese Characteristics	4	96			32		3	
4220005110	马克思主义基本原理 Marxism Philosophy	3	48			8		4	
1060003130	军事理论 Military Theory	1	32				16	1	
4210001170	体育 1 Physical Education I	1	26					1	
4210002170	体育 2 Physical Education II	1	34					2	
4210003170	体育 3 Physical Education III	1	34					3	
4210004170	体育 4 Physical Education IV	1	34					4	
4030002180	大学英语 1 College English I	3	60				12	1	
4030003180	大学英语 2 College English II	2	44				12	2	大学英语 1
4030004180	大学英语 3 College English III	2	44				12	3	大学英语 2
4030004180	大学英语 4 College English IV	2	44				12	4	大学英语 3
程序语言组（任选一组程序语言，3 学分）									
C 程序设计									
4120335170	C 程序设计基础 Foundation of C Language Design	2	32					2	
4120336170	计算机基础与 C 程序设计综合实验 Comprehensive Experiments of Foundation of Computer and C Language Programming	1	32	32				2	

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
VBA 程序设计									
4120341170	VBA 程序设计基础 Foundation of VBA Language Design	2	32					2	
4120342170	计算机基础与 VBA 程序设计综合实验 Comprehensive Experiments of Foundation of Computer and VBA Language Programming	1	32	32				2	
小 计 Subtotal		29	640	32	0	48	64		
(二) 通识教育选修课程 General Education Elective Courses									
创新创业类 Innovation and Entrepreneurship Courses		要求至少取得 9 个学分，且必须选修艺术体育类课程中的艺术类 相关课程并取得至少 2 个学分，在创新创业类课程中至少选修一 门课程，在人文社科类或经济管理类课程中至少选修一门。 Students are required to obtain at least 9 credits, which must cotain art courses of 2 credits from the category of Art and Physical Education Courses,at least one course from the category of Innovation and Entrepreneurship Courses, and at least one course from the category of Arts and Social Science Courses or the category of Economy and Management Courses.							
人文社科类 Arts and Social Science Courses									
经济管理类 Economy and Management Courses									
科学技术类 Science and Technology Courses									
艺术体育类 Art and Physical Education Courses									
(三) 专业教育必修课程 Basic Disciplinary RequiredCourses									
4200067110	专业导论 Introduction to Chemical Engineering & Technology	1	16					1	
4050063110	高等数学 A 上 Advanced Mathematics I	5	80					1	
4050064110	高等数学 A 下 Advanced Mathematics II	5	80					2	高等数学上
4050229110	线性代数 Linear Algebra	2.5	40					2	
4050463130	大学物理 B Physics	5	80					3	
4050224110	物理实验 B Physics Lab.	1	32	32				4	大学物理
4100008110	电工学 Electrical Engineering	3	48	8				3	
4200364170	无机化学 C1 Inorganic Chemistry I	2.5	40					1	
4200359170	无机化学实验 C Inorganic Chemistry Experiment	0.5	16	16				1	无机化学 1

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4200365170	无机化学 C2 Inorganic Chemistry II	1.5	24					2	
4200199120	分析化学 B Analytical Chemistry	2	32					2	
4200377170	分析化学实验 B Experiments of Analytical Chemistry	1.5	48	48				2	分析化学
4200385170	有机化学 B1 Organic Chemistry I	2.5	40					3	
4200387170	有机化学实验 B1 Organic Chemistry Experiment I	1	32	32				3	有机化学 1
4200386170	有机化学 B2 Organic Chemistry II	2.5	40					4	有机化学 1
4200388170	有机化学实验 B2 Organic Chemistry Experiment II	0.5	16	16				4	有机化学 2
4200389170	物理化学 B1 Physical Chemistry I	2.5	40					3	
4200390170	物理化学 B2 Physical Chemistry II	2.5	40					4	物理化学 1
4200367170	物理化学实验 B Physical Chemistry Experiment	1	32	32				4	
4200392170	化工制图与 Auto CAD Chemical Cartography and Auto CAD	2.5	40					4	
4200504170	化工制图与 Auto CAD 综合实验 Experiments of Chemical Cartography and Auto CAD	0.5	16		16			4	化工制图与 Auto CAD
4200021110	化工原理 1 Principles of Chemical Engineering I	3	48					4	
4200393170	化工原理实验 1 Experiments of Chemical Engineering Principle I	1	32	32				4	化工原理 1
4200022110	化工原理 2 Principles of Chemical Engineering II	3	48					5	化工原理 1
4200394170	化工原理实验 2 Experiments of Chemical Engineering Principle II	0.5	16	16				5	化工原理 2
4200395170	化工创新创业导论 Introduction to Innovation and Entrepreneurship	1	16					5	
4200396170	化工热力学 A Chemical Engineering Thermodynamics	3	48					5	

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4200025110	化学反应工程 A Chemical Reaction Engineering	3	48					5	
4200397170	化工安全与环保 Safety Engineering & Environmental Protection in Chemical Engineering	2	32					5	
4200350150	化工设备机械基础 Mechanical Base for Chemical Equipment	2	32					6	
4200113120	化工分离工程 B Chemical Separation Engineering	2	32					6	
4200112110	化工过程分析与综合 B Analysis and Synthesis for Process Engineering	2	32					6	
4200398170	化学工艺学 C Chemical Technology	2	32					6	化工原理
4200399170	化工设计基础 Chemical Process Design	2	32					7	化工制图与 Auto CAD
小 计 Subtotal		72.5	1280	232	16	0	0		
(四) 专业教育选修课程 Specialized Elective Courses									
限选课 (选 6.5 学分)									
4050598170	概率论与数理统计 C Probability and Mathematical Statistics	2.5	40					4	高等数学 线性代数
4200043110	现代仪器分析 Modern Instrumental Analysis	2	32					5	
4200024110	化工专业英语 Specialized English of Chemical Engineering and Technology	2	32					6	
专业拓展类 (至少选 4 学分)									
4200007110	高分子化学 C Polymer Chemistry	2	32					5	有机化学
4200020110	化工仪表及自动化 Chemical Instruments and Automation	2	32					5	
4200400170	金属腐蚀理论与防护技术 B Principles of Metallic Corrosion and protection Technology	2	32					6	
4200034110	生物工程概论 Basic Bioengineering	2	32					7	
4200033110	日用品化学 Applied Chemistry	2	32					7	

课程编号 Course Num ber	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
专业应用类（至少选 3 学分）									
4200066110	助剂化学及应用 Additive Chemistry and Application	2	32					6	
4200401170	化工计算与软件应用 B Chemical Engineering Calculation and Software Application	2	32					6	
4200402170	工业催化原理及应用 B Catalysis in Industrial Processes and Application of Catalyst	2	32					7	
4200015110	化工科技文献检索 Literature Searching for Chemical Engineering	1	16					7	
专业特色类（限选一个课程组，6 学分）									
涂料涂装特色方向课程组									
4200127120	涂料与涂装工艺学 B Paint and Coating Technology	2	32					6	
4200126120	涂料结构与功能设计 B Paint Structure & Function Design	2	32					7	
4200403170	涂料涂装综合实验 Comprehensive Experiments	2	64	64				7	
精细化工特色方向课程组									
4200124120	精细有机合成技术 B Fine Organic Synthesis	2	32					6	
4200123120	精细化工工艺学 B Fine Chemical Technology	2	32					7	
4200404170	精细化工综合实验 Comprehensive Experiments	2	64	64				7	
小 计 Subtotal		31	560	128	0	0	0		
修读说明：要求至少选修 19.5 学分。 NOTE：Minimum subtotal credits:19.5.									
（五）个性课程 Personalized Electice Courses									
4200405170	化学工程前沿 Frontier of Chemical Engineering	1	16					4	
4200406170	实验设计与数据处理方法 Methodology of Experiment Design and Data Processing	2	32					5	
4200407170	固体催化剂研究方法 Research Methodology of Solid Catalyst	2	32					6	
小 计 Subtotal		5	80	0	0	0	0		

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
修读说明：学生从以上个性课程中至少选修 2 门，学校发布的其它个性课程目录中选课，要求至少选修 6 学分。 NOTE: Students should select two courses from above and the other personalized courses in catalog, and are required to obtain at least 6 credits.									

## 五、 集中性实践教学环节

### V Practice Schedule

课程编号 Course Number	实践环节名称 Practice Courses Name	学分 Crs	周数 Weeks	建议修读学期 Suggested Term
1060002110	军事训练 Military Training	1.5	3	1
4080152110	机械制造工程实训 D Training on Mechanical Manufacturing Engineering D	1	1	4
4100069110	电工电子实习 B Practice of Electrical Engineering	1	1	4
4200408170	化工原理仿真上机实践 Simulated Practice of Principles of Chemical Industry	1	1	5
4200087110	化工原理课程设计 B Course Design of Principles of Chemical Industry	2	2	5
4200079110	专业实习 Practice of Specialty	4	4	6
4200409170	化工专业实验 Basic Experiments for Chemical Engineering	1.5	1.5	6
4200410170	化工创新创业设计训练 Innovation and Entrepreneurship Design Training	1	1	7
4200411170	化工设备机械设计 Mechanical Design of Chemical Equipment	2	2	7
4200412170	毕业设计（论文） Graduation Design (Thesis)	9	17	8
小 计 Subtotal		24	33.5	

## 六、其它要求

### VI Recommendations on Course Studies

1、《形势与政策》和《心理健康教育》课程为课外必修课程，分别计 2 个和 1 个课外学分。

2、学生选修的通识选修课程和从学校发布的个性课程目录中选修的个性课程，要求与本专业培养方案内设置的课程内容不重复。

1.Situation & Policy (2 credits) and Mental Health Education (1 credit) are the required extracurricular courses.

2.The selected General Education Elective Courses and Personalized Elective Courses from the courses program by university must be different from the major undergraduate education plan in content.

学院教学责任人：史 彬  
专业培养方案责任人：刘晓芳

# 制药工程专业 2017 版本本科培养方案

## Undergraduate Education Plan for Specialty in Pharmaceutical Engineering(2017)

专业名称	制药工程	主干学科	化学, 药学, 化学工程与技术
Major	Pharmaceutical Engineering	Major Disciplines	Chemistry, Pharmacy, Chemical Engineering and Technology
计划学制	四年	授予学位	工学学士
Duration	4 Years	Degree Granted	Bachelor of Engineering

### 最低毕业学分规定

#### Graduation Credit Criteria

课程分类 Course Classification 课程性质 Course Nature	通识教育课程 Public Basic Courses	专业教育课程 Specialized Courses	个性课程 Personalized Course	集中性实践教学环节 Practice Courses	课外学分 Study Credit after Class	总学分 Total Credits
必修课 Required Courses	29	72.5	\	26.5	\	170
选修课 Elective Courses	9	17	6	\	10	

### 一、培养目标与毕业要求

#### I Educational Objectives & Requirement

##### (一) 培养目标

本专业培养具备制药工程方面较宽的基础知识, 能在医药、农药、精细化工和生物化工等行业从事相关产品的生产管理、技术开发、工艺和设备设计、技术改造和经营管理等方面的工作, 适应市场经济发展的高层次、高素质、全面发展的科学研究与工程技术人才。

本专业期待毕业生五年后能达成下列目标:

- (1) 身心健康, 具备良好的敬业精神、社会责任感和工程职业道德, 关注社会问题, 具有质量意识、环境意识和安全意识;
- (2) 具有深厚的制药工程专业基础知识和理论, 具备系统化的专业技能和实践能力, 能胜任制药工程行业技术应用、管理、研究或开发工作;
- (3) 具有良好的交流沟通能力、良好的团队意识和合作精神, 能在团队中发挥协调和领导能力;
- (4) 具有创新精神, 具有终身学习的能力, 能不断提升就业竞争力;
- (5) 了解制药工程学科发展的前沿及趋势具备国际化视野, 能推动制药工程行业的创新发展。

##### Educational Objectives

This program cultivates high-level scientific researchers and engineers with broad basic knowledge of Pharmaceutical Engineering. Students can engage in product management, technological development, technique process and equipment design, technological transformation and business management in pharmaceuticals, pesticide, chemical, biochemical and other industries. They can also adapt to the development of social market economy and have the high-quality, comprehensive development of scientific research and engineering technology.



Graduates in this major are expected to achieve the following objectives in a few years:

1. Having good professionalism, social responsibility and engineering ethics, and paying close attention to the contemporary global problems and social sustainable development, with quality awareness, environmental awareness and safety awareness.
2. Having abundant basic knowledge and theory of Pharmaceutical Engineering, possessing systematic professional skills and practical ability, be competent in engineering application, management, research or development work in the pharmaceutical industry.
3. Having good communication skills and team work spirit, give full play to coordinating and leading role in the team.
4. With innovative spirit and lifelong learning ability, can continuously enhance employment competitiveness.
5. Knowing the frontier and trend of the development of pharmaceutical engineering disciplines, with an international perspective, be able to promote the innovation and development of the pharmaceutical engineering industry.

## (二) 毕业要求

- (1) 工程知识：具有从事制药工程专业相关工作所需要的数学、自然科学、工程基础和专业知识，能够将其用于解决制药工程相关研发、设计、生产和应用过程中的复杂工程问题；
- (2) 问题分析：能够应用数学、自然科学、工程科学和药学的基本原理，结合对科技文献研究的结果，识别、表达、分析制药工程领域的复杂工程问题，以获得有效结论；
- (3) 设计/开发解决方案：能够设计针对制药工程专业领域复杂工程问题的解决方案，设计满足特定需求的药物、生产装备及工艺流程，并能够在设计、开发环节中体现创新意识，考虑社会、健康、安全、法律、文化以及环境等因素；
- (4) 研究：能够基于制药工程基础理论并采用科学方法对复杂工程问题进行研究，包括设计实验、分析与解释数据、并通过信息综合得到合理有效的结论；
- (5) 使用现代工具：能够针对制药工程领域复杂工程问题，开发、选择与使用恰当的技术、资源、现代工程工具和信息技术工具，包括对复杂工程问题的预测与模拟，并能够理解其局限性；
- (6) 工程与社会：能够基于专业基础理论和工程相关背景知识进行合理分析，评价专业工程实践和复杂工程问题解决方案对社会、健康、安全、法律以及文化的影响，并理解应承担的责任；
- (7) 环境和可持续发展：能够理解和评价针对复杂工程问题的工程实践对环境、社会可持续发展的影响；
- (8) 职业规范：具有人文社会科学素养、社会责任感，能够在工程实践中理解并遵守工程职业道德和规范，履行责任；
- (9) 个人和团队：具有一定的组织管理能力、表达能力、人际交往能力和团队合作能力，能够在多学科背景下的团队中承担个体、团队成员以及负责人的角色；
- (10) 沟通：能够就制药工程相关领域复杂工程问题与业界同行及社会公众进行有效沟通和交流，包括撰写报告和设计文稿、陈述发言、清晰表达或回应指令。并具备一定的国际视野，能够在跨文化背景下进行沟通和交流；
- (11) 项目管理：理解并掌握工程管理原理与经济决策方法，并能在多学科环境中应用；
- (12) 终身学习：具有自主学习和终身学习的意识，有不断学习和适应发展的能力。

## Graduation requirements

1. Engineering knowledge: Having basic and professional knowledge of mathematics, science and engineering, with the ability to apply the knowledge to solve complex engineering issues in the fields of pharmaceutical engineering.
2. Problem analysis: Grasping the basic principles and methods of mathematics, science and professional

foundations; combining the results of scientific literature research, have the ability to identify, interpret and analyze complex engineering issues in the related fields of pharmaceutical engineering to obtain effective conclusions.

3. Design / development solutions: An ability to provide solutions for complex engineering problems in the field of pharmaceutical engineering, and design drugs, device parameters and process flow to meet desired needs within realistic constraints such as society, health, safety, law, culture, and the environment.
4. Research: Grasping the basic theory of pharmaceutical engineering; an ability to use scientific methods to study complex engineering problems including experiment design, data analysis and interpretation, and get valid conclusion synthetically.
5. Using modern tools: An ability to select and use proper technologies, resources, modern engineering tools, and information technology tools to predict and simulate complex engineering problems in the field of pharmaceutical engineering, and understand the applicability and limitations of the conclusions;
6. Engineering and society: Analyzing and evaluating impacts of solutions to professional practices and complex engineering issues on society, health, safety, law and culture based on professional basic theory and relevant engineering knowledge.
7. Environment and sustainable development: An ability to correctly recognize and evaluate the impact of engineering practices for complex engineering issues on environment and sustainable development of the society.
8. Professional norms: Having humanities sciences literacy and social responsibility, understanding and observing engineering professional ethics and norms in engineering practices.
9. Individuals and team: Having abilities of expression, interpersonal, teamwork, organization and management, and an ability to undertake the roles of individuals, team members and leaders in a multidisciplinary team.
10. Communication: Communicate and exchange ideas effectively with industry peers and the general public on complex engineering issues related to pharmaceutical engineering, including writing reports and design drafts, making presentations, expressing or responding to instructions. Have a certain international perspective to communicate and exchange ideas on cross-cultural background.
11. Project management: Understanding and grasping the principles of engineering management and methods of economic decision, which can be applied to multidisciplinary environment.
12. Life-long learning: Having awareness of self-study and life-long learning, and be able to keep learning and adapt to social development.

附：培养目标实现矩阵

	培养目标 1	培养目标 2	培养目标 3	培养目标 4	培养目标 5
毕业要求 1		√			√
毕业要求 2		√			√
毕业要求 3	√	√			√
毕业要求 4		√			√
毕业要求 5		√		√	√
毕业要求 6	√	√			
毕业要求 7	√				√
毕业要求 8	√	√	√	√	
毕业要求 9		√	√		√
毕业要求 10		√	√		

	培养目标 1	培养目标 2	培养目标 3	培养目标 4	培养目标 5
毕业要求 11		√	√		√
毕业要求 12				√	√

## 二、专业核心课程与专业特色课程

### II Core Courses and Characteristic Courses

#### (一) 专业核心课程:

化工原理、药物化学、药剂学、制药工艺学、制药工程、制药设备与车间设计

#### Core Courses:

The Principle of Chemical Engineering, Medicinal Chemistry, Pharmaceutics, Pharmaceutical Technology, Pharmaceutical Engineering, Pharmaceutical Equipment and Plant Design

#### (二) 专业特色课程:

药品生产质量管理工程、制药分离工程、药理学、天然药物化学、药物分析

#### Characteristic Courses:

Good Manufacturing Engineering, Pharmaceutical Separation Engineering, Pharmacology, Natural Medicinal Chemistry, Medicinal Analysis

附: 毕业要求实现矩阵:

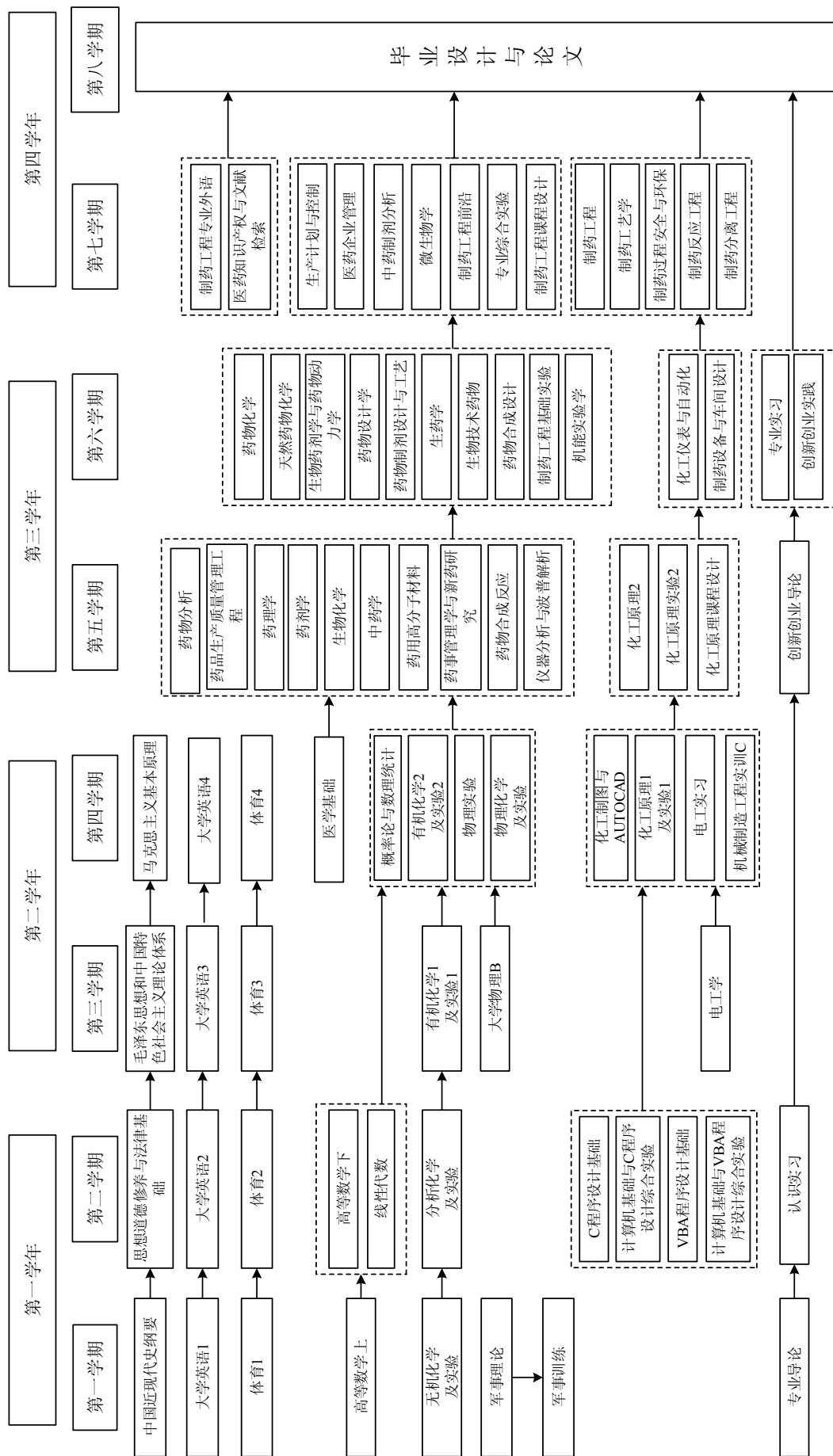
专业 核心 课程	专业 特色 课程	课程名称	制药工程专业毕业要求											
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
		思想道德修养与法律基础						√	√	√				
		中国近现代史纲要								√				
		毛泽东思想和中国特色社会主义理论体系概论								√				
		马克思主义基本原理								√				
		军事理论								√				
		体育									√			√
		大学英语					√					√		√
		C 程序设计基础					√							
		计算机基础与 C 程序设计综合实验					√							
		VBA 程序设计基础					√							
		计算机基础与 VBA 程序设计综合实验					√							
		通识选修类课程								√	√	√	√	
		专业导论						√		√				
		高等数学	√	√		√	√							
		线性代数	√	√		√	√							
		概率论与数理统计	√	√		√	√							
		大学物理	√	√		√								

专业 核心 课程	专业 特色 课程	课程名称	制药工程专业毕业要求											
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
		物理实验	√	√		√								
		电工学	√	√	√	√		√						
		无机化学	√	√		√								
		无机化学实验	√	√		√								
		分析化学	√	√		√								
		分析化学实验	√	√		√								
		有机化学	√	√		√								
		有机化学实验	√	√		√								
		物理化学	√	√		√								
		物理化学实验	√	√		√								
		化工制图与 AUTOCAD	√	√	√	√		√						
√		化工原理	√	√	√	√		√						
		化工原理实验	√	√	√	√		√						
		创新创业导论			√					√	√	√	√	
	√	药理学	√	√		√								
√		药剂学	√	√		√								
	√	药物分析	√	√		√	√							
√		药物化学	√	√		√								
	√	天然药物化学	√	√		√								
√		制药工程	√	√	√	√								
√		制药工艺学	√	√	√	√								
	√	药品生产质量管理工程						√		√	√		√	
	√	制药分离工程	√	√	√	√								
√		制药设备与车间设计			√		√							
		中药学	√	√		√								
		药用高分子材料	√	√		√								
		生物药剂学与药物动力学	√	√		√								
		医学基础	√	√		√								
		药事管理学与新药研究			√	√							√	
		药物合成反应	√	√		√								
		药物设计学	√	√		√								

专业 核心 课程	专业 特色 课程	课程名称	制药工程专业毕业要求											
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
		药物制剂设计与工艺	√	√	√	√								
		生药学	√	√		√								
		生物技术药物	√	√		√								
		化工仪表与自动化	√		√		√							
		生产计划与控制			√								√	
		机能实验学		√	√		√							
		中药制剂分析	√	√		√								
		微生物学	√	√		√								
		制药工程前沿						√	√					√
		制药工程专业外语					√					√		
		医药知识产权与文献检索			√		√	√						√
		制药过程安全与环保			√			√	√					
		医药企业管理		√	√			√		√	√	√	√	
		仪器分析与波谱解析 B		√		√	√							
		生物化学	√	√		√								
		药物合成设计	√	√	√	√								
		制药反应工程	√	√	√	√								
		军事训练									√			
		认识实习						√		√	√	√		
		机械制造工程实训	√		√							√		
		电工电子实习	√		√							√		
		化工原理课程设计	√		√	√						√		
		专业实习	√	√	√	√	√				√	√	√	
		创新创业实践			√		√			√	√	√	√	√
		制药工程基础实验	√	√		√					√	√		
		专业综合实验	√	√	√	√					√	√		
		制药工程课程设计	√	√	√		√							
		毕业论文	√	√	√	√	√				√	√		√

### 三、课程教学进程图

#### III Teaching Process Map



#### 四、 理论教学建议进程表

#### IV Theory Course Schedule

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 <b>Including</b>					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
(一) 通识教育必修课程 General Education Required Courses									
4220001110	思想道德修养与法律基础 Morals, Ethics and Fundamentals of Law	3	48			8		2	
4220002110	中国近现代史纲要 Outline of Contemporary and Modern Chinese History	2	32					1	
4220003110	毛泽东思想和中国特色社会主义理论体系概论 Introduction to Mao Zedong Thought and Socialism with Chinese Characteristics	4	96			32		3	
4220005110	马克思主义基本原理 Marxism Philosophy	3	48			8		4	
1060003130	军事理论 Military Theory	1	32			16		1	
4210001170	体育 1 Physical Education I	1	26					1	
4210002170	体育 2 Physical Education II	1	34					2	
4210003170	体育 3 Physical Education III	1	34					3	
4210004170	体育 4 Physical Education IV	1	34					4	
4030002180	大学英语 1 College English I	3	60				12	1	
4030003180	大学英语 2 College English II	2	44				12	2	大学英语 1
4030004180	大学英语 3 College English III	2	44				12	3	大学英语 2
4030004180	大学英语 4 College English IV	2	44				12	4	大学英语 3
程序设计语言课程组（二选一，3 学分） Courses of Computer Program Design (select one out of two, Credits: 3)									
4120335170	C 程序设计基础 Fundamentals of Computer Program Design(C)	2	32					2	
4120336170	计算机基础与 C 程序设计综合实验 Foundations of Computer and C Language Programming Experiments	1	32	32				2	
4120341170	VBA 程序设计基础 Fundamentals of Computer Program Design(VBA language)	2	32					2	

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4120342170	计算机基础与 VBA 程序设计综合实验 Foundations of Computer and VBA Language Programming Experiments	1	32	32				2	
小 计 Subtotal		29	640	32	0	64	48		
(二) 通识教育选修课程 General Education Elective Courses									
创新创业类 Innovation and Entrepreneurship Courses		要求至少取得 9 个学分，且必须选修艺术体育类课程中的艺术类 相关课程并取得至少 2 个学分，在创新创业类课程和经济管理类 课程中分别至少选修一门课程。  Students are required to obtain at least 9 credits, which must cotain art courses of 2 credits from the category of Art and Physical Education Courses,at least one course from the category of Innovation and Entrepreneurship Courses and the category of Economy and Management Courses respectively.							
人文社科类 Arts and Social Science Courses									
经济管理类 Economy and Management Courses									
科学技术类 Science and Technology Courses									
艺术体育类 Art and Physical Education Courses									
(三) 专业教育必修课程 Basic Disciplinary RequiredCourses									
4200068110	专业导论 Introduction to Materials Physics	1	16					1	
4050063110	高等数学 A 上 Advanced Mathematics I	5	80					1	
4050064110	高等数学 A 下 Advanced Mathematics II	5	80					2	高等数学 上
4050229110	线性代数 Linear Algebra	2.5	40					2	
4050463130	大学物理 B Physics II	5	80					3	
4050224110	物理实验 B Physics Lab. II	1	32	32				4	
4100008110	电工学 Electrical Engineering	3	48	8				3	
4200357170	无机化学 B Inorganic Chemistry	3	48					1	
4200359170	无机化学实验 C Inorganic Chemistry Experiment	0.5	16	16				1	
4200303120	分析化学 C Analysis Chemistry	1.5	24					2	
4200376170	分析化学实验 C Experiment of Analysis Chemistry	1	32	32				2	
4200385170	有机化学 B1 Organic Chemistry I	2.5	40					3	



课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 <b>Including</b>					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4200386170	有机化学 B2 Organic Chemistry II	2.5	40					4	
4200387170	有机化学实验 B1 Organic Chemistry Experiment I	1	32	32				3	
4200388170	有机化学实验 B2 Organic Chemistry Experiment II	0.5	16	16				4	
4200256120	物理化学 C Physical Chemistry	4	64					4	
4200382170	物理化学实验 C Physical Chemistry Experiment	0.5	16	16				4	
4200392170	化工制图与 Auto CAD Chemical Cartography and Auto CAD	2.5	40					4	
4200504170	化工制图与 Auto CAD 综合实验 Experiments of Chemical Cartography and Auto CAD	0.5	16		16			4	化 工 制 图 与 Auto CAD
4200419170	化工原理 B1 Principles of Chemical Engineering I	3	48					4	
42004393170	化工原理实验 1 Experiments of Chemical Engineering Principle I	1	32	32				4	化工原理 1
4200420170	化工原理 B2 Principles of Chemical Engineering II	2.5	40					5	化工原理 1
4200394170	化工原理实验 2 Experiments of Chemical Engineering Principle II	0.5	16	16				5	化工原理 2
4200423170	制药创新创业导论 Introduction to Innovation and Entrepreneurship	1	16					5	
4200045110	药理学 B Pharmacology	2.5	40					5	
4200128120	药剂学 B Industrial pharmaceuticals	2.5	40					5	
4200105110	药物分析 Pharmaceutical Analysis	2.5	40					5	
4200425170	药品生产质量管理工程 B Good Manufacturing Engineering	1.5	24					5	
4200424170	药物化学 B Medicinal Chemistry	2.5	40					6	
4200040110	天然药物化学 B Medicinal Chemistry of Natural Products	2.5	40					6	

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 <b>Including</b>					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4200131120	制药设备与车间设计 Pharmaceutical Apparatus and Workshop Design	2	32					6	
4200059110	制药工程 B Pharmaceutical Engineering	2	32					7	
4200062110	制药工艺学 A Pharmaceutical Technology	2	32					7	
4200104110	制药分离工程 Pharmaceutical Separation Engineering	2	32					7	
小 计 Subtotal		72.5	1264	200	16	0	0		
(四) 专业教育选修课程 Specialized Elective Courses									
模块一：药学专业限选课									
4050598170	概率论与数理统计 C Probability and Mathematical Statistics	2.5	40					4	
4200057110	仪器分析与波谱解析 B Instrument Analysis and Spectrum Analysis	2	32					5	
4200237120	生物化学 D Biochemistry	2	32					5	
4200426170	药物合成反应 A Drug Synthesis Reaction	2	32					5	
4200063110	制药过程安全与环保 Pharmaceutical Process Safety and Environment Protection	2	32					7 (企业)	
小 计 Subtotal		10.5	168	0	0	0	0		
模块二修读说明：从以上专业限选课中取得 10.5 个学分									
模块二：专业选修课									
4200055110	医学基础 Medicine Basis	2	32					4	
4200064110	中药学 Traditional Chinese Pharmacology	2	32					5	
4200054110	药用高分子材料 Medical Polymer Materials	2	32					5	
4200047110	药事管理学与新药研究 Pharmacy Administration & Drug Research	2	32					5	
4200037110	生物药剂学与药物动力学 Biopharmaceutics and pharmacokinetics	2	32					6	
4200052110	药物设计学 The Principle of Drug Design	2	32					6	
4200108110	药物制剂设计与工艺 Pharmaceutical Design and Technology	2	32					6	

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 <b>Including</b>					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4200038110	生药学 Raw Pharmacognosics	2	32					6	
4200036110	生物技术药物 Biotech Drugs	2	32					6	
4200168130	化工仪表与自动化 Chemical Instrumentation & Automation	2	32					6	
4200050110	药物合成设计 A Drug Synthesis Design	2	32					6	
4200288130	生产计划与控制 B Production Planning and Control	2	32					7	
4200065110	中药制剂分析 Traditional Chinese Medicine Analysis	2	32					7	
4200042110	微生物学 C Microbiology	2	32					7	
4200060110	制药工程前沿 Pharmaceutical Engineering Frontier	2	32					7	
4200061110	制药工程专业外语 Pharmaceutical Engineering Foreign Languages	2	32					7	
4200103110	医药知识产权与文献检索 Medicinal Knowledge Property and Literature Retrieval	2	32		12			7	
小 计 Subtotal		34	544	0	12	0	0		
修读说明：要求至少选修 17 学分。其中模块一取得 10.5 学分；模块二取得 6.5 学分。 NOTE: Minimum subtotal credits:17.									
(五) 个性课程 Personalized Elective Courses									
4200427170	机能实验学 Functional Experimentation	2	32					6	
4200289130	医药企业管理 Pharmaceutical Enterprise Management	2	32					7 (企业)	
4200428170	制药反应工程 A Engineering of pharmaceutical chemical reaction	2.5	40					7	
小 计 Subtotal		6.5	104	0	0	0	0		
修读说明：学生需要修读以上课程至少 4 学分，余下学分可自主选择修读学校发布的其它个性课程。要求至少选修 6 学分。 NOTE: Students need to choose the courses above at least 4 credits. For the remaining credits, students can choose from the other personalized courses in catalog, and are required to obtain at least 6 credits.									

## 五、集中性实践教学环节

### V Practice Schedule

课程编号 Course Number	实践环节名称 Practice Courses Name	学分 Crs	周数 Weeks	建议修读学期 Suggested Term
1060002110	军事训练 Military Training	1.5	3	1
4200370170	制药工程专业认识实习 Cognition Practice	2	2	2
4080152110	机械制造工程实训 D Machinery Manufacturing Engineering Practice	1	1	4
4100069110	电工电子实习 B Practice of Electrical Engineering	1	1	4
4200429170	化工原理课程设计 A Course Design of Principles of Chemical Industry	1	1	5
4200077110	制药工程基础实验 A Basic Experiment of Pharmaceutical Engineering	2	2	6 (分散)
4200080110	专业实习 Practice of Specialty	4	4	6
4200430170	制药创新创业实践 Innovation and Entrepreneurship Practice	1	1	6 (暑期)
4200081110	专业综合实验 B Specialized Integrated Experiment	3	3	7
4200431170	制药工程课程设计 A Course Design of Pharmaceutical Engineering	1	1	7
4200432170	毕业实习与毕业设计 (论文) Graduation Practice and Graduation Design(Thesis)	9	17	8
小 计 Subtotal		26.5	36	

## 六、其它要求

### VI Recommendations on Course Studies

- 1、《形势与政策》和《心理健康教育》课程为课外必修课程，分别计 2 个和 1 个课外学分。
- 2、学生选修的通识选修课程和从学校发布的个性课程目录中选修的个性课程，要求与本专业培养方案内设置的课程内容不重复。

1.Situation & Policy (2 credits) and Mental Health Education (1 credit) are the required extracurricular courses.

2.The selected General Education Elective Courses and Personalized Elective Courses from the courses program by university must be different from the major undergraduate education plan in content.

学院教学责任人：史 彬  
专业培养方案责任人：徐海星

# 应用化学专业 2017 版本本科培养方案

## Undergraduate Education Plan for Specialty in Applied Chemistry (2017)

专业名称	应用化学	主干学科	化学、应用化学
Major	Applied Chemistry	Major Disciplines	Chemistry, Applied Chemistry
计划学制	四年	授予学位	理学学士
Duration	4 Years	Degree Granted	Bachelor of Science

### 最低毕业学分规定 Graduation Credit Criteria

课程分类 Course Classification 课程性质 Course Nature	通识教育课程 Public Basic Courses	专业教育课程 Specialized Courses	个性课程 Personalized Course	集中性实践教学环节 Practice Courses	课外学分 Study Credit after Class	总学分 Total Credits
必修课 Required Courses	29	76	\	23	\	170
选修课 Elective Courses	9	17	6	\	10	

### 一、培养目标与毕业要求

#### I Educational Objectives & Requirement

##### (一) 培养目标

培养热爱祖国，了解国情社情民情，具有一定的人文底蕴、坚定的科学精神、较强的职业素养和社会责任感，践行社会主义核心价值观，具有一定的批判性思维和创新能力和解决复杂问题的能力和国际视野，具有良好的科学、文化素养，较系统地掌握化学基本理论、基础知识和基本技能，创新意识和实践能力强，能够在化学及相关学科、社会相关行业和企业从事科研、教学、管理和新产品开发的科技人才。本专业期待毕业生几年之后能达成下列目标：

- (1) 身心健康，具备良好的敬业精神、社会责任感和职业道德，关注社会问题，具有质量意识、环境意识和安全意识。
- (2) 具备较强的数理基础、系统扎实的化学基本理论、广博的化学基础知识和较强的实验技能。
- (3) 了解化学学科发展的前沿和科学发展的总体趋势，具有国际视野和国际理解能力。
- (4) 掌握英语和必要的计算机应用基础知识。
- (5) 受到良好的科学思维和科学实验的训练，具有良好的交流沟通能力、团队意识和创新精神，具有终身学习的能力。
- (6) 具备在科研机构、高等院校及企事业单位等从事科学研究、教学工作及管理工作的能力。

Aiming at preparing patriotic students with certain legacy of civilization, determined scientific spirits, good social responsibility, humanities and professional ethics. Students can practice the socialist core values, cultivate, act on core socialist, have critical consciousness, ability to innovate and solve complex problems, and international view. This plan will enable students to systematically grasp the basic chemistry theories and gain the basic knowledge and the application of chemical science. With initiative spirit and international view, students can be fit into jobs in the fields of chemistry and related areas. They can do the work of

chemical research, teaching, management and product development.

**Graduates in this major are expected to achieve the following objectives in a few years:**

1. Having physical and mental health; cultivating good professional dedication, social responsibility and professional ethics; paying close attention to social issues; establishing quality awareness, environmental awareness and safety awareness.
2. Having good mathematical knowledge, mastering comprehensive fundamental chemical theory and knowledge, having good experimental skills.
3. Familiar with the frontiers of chemical research and the overall trend of science, having an international perspective and international understanding abilities.
4. Mastering English and basic knowledge of computer applications.
5. Having good training of scientific thinking and experimental skills; Having good communication skills, good teamwork and innovation spirit, and the ability of lifelong learning.
6. Capable of engaging in scientific research, teaching, and administration in scientific research institutions, universities, colleges, and enterprises and public institutions.

**(二) 毕业要求**

**(II) Graduation Requirement**

**1. 化学学科相关的知识要求**

- ① 掌握数学、物理学等方面的基本理论和基本知识。
- ② 掌握有关化学的基本知识、基本理论、基本实验技能，培养独立分析和解决化学问题的能力，实际动手操作能力，为相关专业课程奠定基础。
- ③ 具备较丰富的管理、社会学、法律、环境等人文与社会学的知识。
- ④ 熟练掌握英语。
- ⑤ 具有较强的自学能力、综合应用各种手段查取资料、获取信息的基本能力；具有应用语言、文字、图表进行工程表达和交流的基本能力；掌握计算机的基本知识和应用，并掌握一门计算机高级语言，能进行一般化学工程应用程序开发设计。

**2. 具备运用适当的理论和实践方法解决应用化学实际问题的能力**

- ① 具有本专业必须的试验、测试、计算机应用等技能，熟悉合成化学、化工原理、化学反应工程与工艺、精细化学品化学、工业分析等专业知识和研究技能的基本理论和基本知识，具有从事化学合成、化学分析、精细化学品营销等领域的工作能力。
- ② 具有本专业所必需的运算、实验、测试、计算机应用、制图等基本科学技能，以及一定的基本工艺操作技能。
- ③ 具有独立获取知识、提出问题、分析问题和解决问题的科学思维、基本研究能力和创新精神，具有一定的组织管理能力和社会活动能力、从事本专业业务工作的能力和适应相邻专业业务工作的基本能力和素质，重视工程实践，具有工程经济观点，受到工程设计方法和科学研究方法的初步训练。
- ④ 具有较强的开拓创新精神和初步的科研开发能力，了解本学科国际前沿性的科学技术最新发展动态，具有一定的创新性思维和科技研究能力。

**3. 参与项目及工程、实践**

具有较强的安全防护、环境保护和法律意识，在法律法规规定的范畴内，按确定的相关标准和程序要求开展工作。

- ① 具有较强的安全防护意识和相关的安全知识，能在实验、实践活动和工程项目的实施中严格执行安全规范，有意识地进行防毒、防爆等安全工作，养成保证健康和安全的工作习惯。
- ② 具有较强的环境意识，能在实验、实践活动和项目的实施中自觉保护环境、执行环保标准。

- ③ 具有较强的法律意识，在法律法规规定的范畴内，按确定的相关标准和程序要求开展工作。
- ④ 了解体育运动基本知识，掌握科学锻炼身体的基本技能，养成锻炼身体的良好习惯，讲究卫生，培养吃苦耐劳精神。

#### 4. 有效的沟通与交流能力和较强的获取知识、终身学习的能力

- ① 具有较强的表达和沟通能力
  - A. 能够使用专业语言，在跨文化环境下进行沟通与表达；
  - B. 能够运用英语进行专业相关方面的表达、沟通和交流。
- ② 具有较强的交流能力
  - A. 具备较强的人际交往能力，能够控制自我并了解、理解他人需求和意愿；
  - B. 具备较强的适应能力，自信、灵活地处理新的和不断变化的人际环境和工作环境；
  - C. 具备团队合作精神，并具备一定的协调、管理、竞争与合作的初步能力。
- ③ 具有较强的获取知识、终身学习的能力
  - A. 能够跟踪应用化学领域最新研究和发展趋势，了解和学习应用化学领域的最新进展和研究成果，不断提升自己的专业水平；
  - B. 具备收集、分析、判断、归纳和选择国内外相关信息的能力，不断补充自己的专业知识。

#### 5. 具备良好道德和较强的责任感

- ① 具有良好的道德
  - A. 热爱国家，了解国情、社情、民情；
  - B. 具有良好的社会公德，自觉遵守社会行为规范；
  - C. 自觉遵守法律法规；
  - D. 为人正直、诚实守信；
  - E. 具有良好的职业道德规范，自觉遵守所属职业体系的职业行为准则。
- ② 较强的责任感
  - A. 具有较强的社会责任感，在环境保护、节约资源、公共安全、公共卫生、社会秩序等方面体现对社会的责任；
  - B. 具有较强的工作责任感，在工作质量、工作效率、工作纪律、职业健康安全、维护企业形象、关注企业发展等方面体现对工作、对企业的责任；
  - C. 为保持和增强职业能力，能不断检查自身的发展需求，制定并实施继续学习发展计划。

##### 1. Knowledge Requirement related to chemistry

- ① Mastery of basic theory and knowledge of mathematics and physics.
- ② Mastery of basic knowledge, theory and experimental skill related to chemistry. Ability to analyze and solve chemical problems independently and ability to carry out chemical experiment independently, which lays a firm foundation for major courses.
- ③ Mastery of abundant knowledge in the area of humanities and social science, such as management, sociology, jurisprudence and environmentology.
- ④ Mastery of English.
- ⑤ Ability of study independently and capability of acquiring data and information by different means; capability of carrying out presentation and communication with languages and graphs in chemical engineering; mastery of basic knowledge and applications of computer and a computer programming language; capability of developing application programs for chemical engineering.

##### 2. Ability to solve real problems in applied chemistry with proper theory and practical method

- ① Having skills in experiments, measurements and computer applications; familiar with basic theory and knowledge of synthetic chemistry, principle of chemical engineering, chemical reaction engineering and technology, chemistry of fine chemicals, industrial analysis; capability to work in the

- areas of chemical synthesis, chemical analysis, and marketing of fine chemicals.
- ② Having scientific skills such as calculational, experimental, measurement skills as well as computer and graphical plot skills; having basic process operation skills.
  - ③ Having scientific thinking, basic research ability and creative spirit to be able to obtain knowledge independently, and able to raise, analyze and solve problems; having organization management and social capability; having capabilities and qualities to work in the area of chemistry professionals and chemistry-related fields; paying great attention to engineering practice and having view of engineering economy, having training in project design and scientific research.
  - ④ Having pioneering and innovative spirit and scientific research and development ability; familiar with the frontier of the chemistry science; having innovative thinking and ability to carry out scientific research.
3. Participating in practice, and engineering project
- Having strong safety awareness, environmental protection and legal consciousness; working lawfully under the requirement of related standard and protocol.
- ① Having strong safety awareness and related safety knowledge and strictly obeying safety specification in experiment, practice and project; carrying out safety anti-toxin and anti-explosion work consciously and forming a good work habit of health and safety first.
  - ② Having strong environmental awareness, able to protect environment and obey environmental protection standard consciously when doing experiments, carrying out practices or projects.
  - ③ Having strong legal consciousness and able to work lawfully under the requirement of related standard and protocol.
  - ④ Knowing basic knowledge of athletic sports; mastering basic skills of physical training and forming the good habit of it; paying great attention to hygiene and developing perseverant and hard-working spirit.
4. Able to communicate effectively and capable of acquiring knowledge independently; having strong lifelong learning ability
- ① Having strong ability to express and communicate
    - A. Can express and communicate in a cross cultural environment using professional language;
    - B. Can express and communicate in English in chemistry related areas.
  - ② Having strong social ability
    - A. Having strong interpersonal communication skill, having the ability of self-control and able to understand, comprehend the demand and aspiration of other people;
    - B. Having strong adaptability, self-confident, able to handle new and changeable interpersonal environment and working environment;
    - C. Having team cooperation spirit and having ability of coordination, management, competition and cooperation.
  - ③ Having strong ability to acquire knowledge and having lifelong learning ability
    - A. Able to track the latest research and development trend in the field of applied chemistry; trying to understand and study recent advances and research results in the field of applied chemistry;
    - B. Ability to collect, analysis, judge, conclude and select relative domestic and foreign information; complementing professional knowledge without stop.
5. Possessing good moral and strong sense of responsibility
- ① Having good moral character
    - A. Loving our country, understanding the national, social and people's conditions



- B. Having good social morality, consciously abiding by the norms of social behavior;
  - C. Consciously abiding by the laws and regulations;
  - D. Upright, honest and trustworthy;
  - E. Having good work ethics, consciously abide by the professional code of conduct.
- ② Having strong sense of responsibility
- A. Having strong sense of social responsibility; paying close attention to the social responsibility in protecting environment and saving resources, public security, public health, social order, etc.;
  - B. Having strong sense of work responsibility; paying close attention to the responsibility in the work quality, work efficiency, work discipline, occupational health and safety, maintenance of corporate image, and development of enterprises;
  - C. Continuing to check the needs of their own development, formulating and implementing development plans for continuous study in order to maintain and enhance the professional ability.

附：培养目标实现矩阵

	目标 1	目标 2	目标 3	目标 4	目标 5	目标 6
毕业要求 1	✓	✓	✓	✓	✓	✓
毕业要求 2		✓	✓	✓	✓	✓
毕业要求 3	✓	✓	✓		✓	✓
毕业要求 4			✓	✓	✓	✓
毕业要求 5	✓				✓	✓

## 二、专业核心课程与专业特色课程

### II Core Courses and Characteristic Courses

#### (一) 专业核心课程:

无机化学及实验、分析化学及实验、有机化学及实验、物理化学及实验、仪器分析原理与波谱解析及实验、结构化学、精细有机合成及实验、精细无机合成及实验

Core Courses: Inorganic Chemistry & Inorganic Chemistry Lab, Analytical Chemistry & Analytical Chemistry Lab, Organic Chemistry & Organic Chemistry Lab, Physical Chemistry & Physical Chemistry Lab, Principles of Instrumental Analysis & Lab, Structural Chemistry, Fine Organic Syntheses & Lab, Fine Inorganic Syntheses & Lab

#### (二) 专业特色课程:

精细有机合成及实验、精细无机合成及实验、仪器分析原理与波谱解析及实验、计算机与应用化学、精细化学品化学

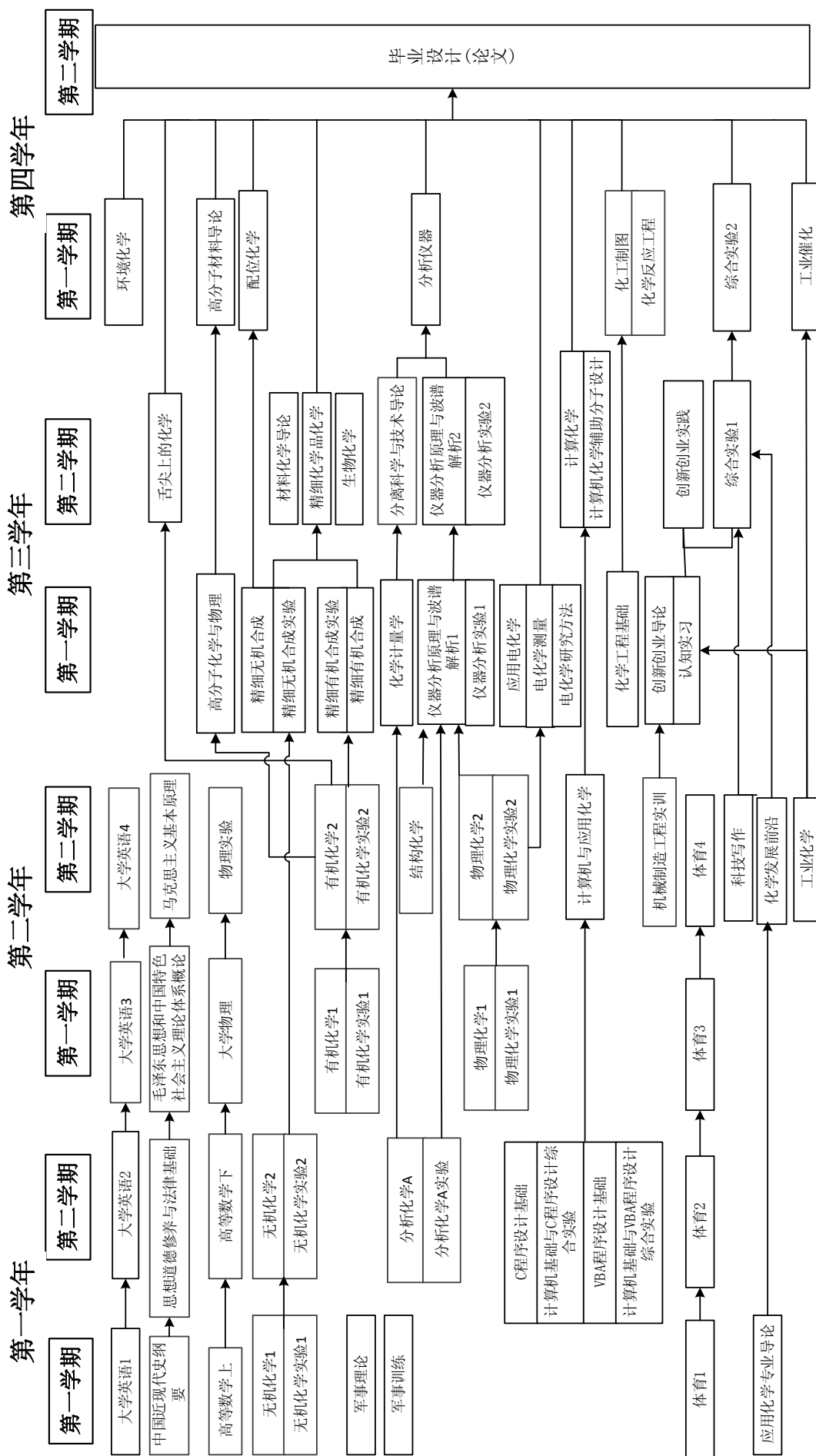
Characteristic Courses: Fine Organic Syntheses & Lab, Fine Inorganic Syntheses & Lab, Principles of Instrumental Analysis & Lab, Computer and Applied Chemistry, Fine Chemical Chemistry

附：毕业要求实现矩阵:

		应用化学专业毕业要求																		
专业 核心 课程	专业 特色 课程	课程名称	1- ①	1- ②	1- ③	1- ④	1- ⑤	2- ①	2- ②	2- ③	2- ④	3- ①	3- ②	3- ③	3- ④	4- ①	4- ②	4- ③	5- ①	5- ②
		思想道德修养与法律基础			√									√					√	√
		中国近现代史纲要			√														√	√
		马克思主义基本原理			√														√	√
		毛泽东思想和中国特色社会主义理论体系概论			√														√	√
		军事理论			√															
		体育													√					
		大学英语				√										√				
		C(或 VBA)程序设计基础					√	√												
		计算机基础与 C(或 VBA)程序设计综合实验					√	√												
		应用化学专业导论								√										
		高等数学	√						√											
		大学物理	√						√											
		物理实验	√						√											
√		无机化学		√				√	√	√	√		√							
√		无机化学实验		√				√	√	√	√		√							
√		分析化学		√				√	√	√	√		√							
√		分析化学实验		√				√	√	√	√		√							
√		有机化学		√				√	√	√	√		√							
√		有机化学实验		√				√	√	√	√		√							

应用化学专业毕业要求																				
专业 核心 课程	专业 特色 课程	课程名称	1- ①	1- ②	1- ③	1- ④	1- ⑤	2- ①	2- ②	2- ③	2- ④	3- ①	3- ②	3- ③	3- ④	4- ①	4- ②	4- ③	5- ①	5- ②
√		物理化学		√				√	√	√	√	√								
√		物理化学实验		√				√	√	√	√	√								
√	√	精细有机合成						√	√	√	√	√								
√	√	精细无机合成						√	√	√	√	√								
√	√	计算机与应用化学					√	√	√	√	√	√								
		创新创业导论					√			√	√	√	√	√				√		√
		化学工程基础					√	√	√											
√		结构化学						√	√	√										
√	√	仪器分析原理与波谱解析						√	√											
√	√	仪器分析实验						√	√											
	√	精细化学品化学						√												
		军事训练													√					
√		精细无机合成实验						√	√	√	√	√	√							
√		精细有机合成实验						√	√	√	√	√	√							
		机械制造工程实训						√							√		√			
		认识实习						√	√	√	√	√	√	√		√	√	√	√	√
		综合实验						√	√	√	√	√	√							
		创新创业实践						√	√	√	√	√	√			√	√	√		
		毕业设计（论文）						√	√	√	√	√	√	√		√	√	√	√	√

### 三、课程教学进程图 III Teaching Process Map



#### 四、 理论教学建议进程表

#### IV Theory Course Schedule

IV. Theory Course Schedule									
课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
(一) 通识教育必修课程 General Education Required Courses									
4220001110	思想道德修养与法律基础 Morals, Ethics and Fundamentals of Law	3	48			8		2	
4220002110	中国近现代史纲要 Outline of Contemporary and Modern Chinese History	2	32					1	
4220003110	毛泽东思想和中国特色社会主义理论体系概论 Introduction to Mao Zedong Thought and Socialism with Chinese Characteristics	4	96			32		3	
4220005110	马克思主义基本原理 Marxism Philosophy	3	48			8		4	
1060003130	军事理论 Military Theory	1	32			16		1	
4210001170	体育 1 Physical Education I	1	26					1	
4210002170	体育 2 Physical Education II	1	34					2	
4210003170	体育 3 Physical Education III	1	34					3	
4210004170	体育 4 Physical Education IV	1	34					4	
4030002180	大学英语 1 College English I	3	60				12	1	
4030003180	大学英语 2 College English II	2	44				12	2	大学英语 1
4030004180	大学英语 3 College English III	2	44				12	3	大学英语 2
4030004180	大学英语 4 College English IV	2	44				12	4	大学英语 3
以下计算机课程按照语言选修一组									
4120335170	C 程序设计基础 Fundamentals of Computer Program Design(C)	2	32					2	
4120336170	计算机基础与 C 程序设计综合实验 Foundations of Computer and C Language Programming Experiments	1	32	32				2	
4120341170	VBA 程序设计基础 Fundamentals of Computer Program Design(VBA language)	2	32					2	
4120342170	计算机基础与 VBA 程序设计综合实验 Foundations of Computer and VBA Language Programming Experiments	1	32	32				2	

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
小 计 Subtotal		29	640	32	0	64	48		
(二) 通识教育选修课程 General Education Elective Courses									
创新创业类 Innovation and Entrepreneurship Courses		要求至少取得 9 个学分，且必须选修艺术体育类课程中的艺术类相关课程并取得至少 2 个学分，在创新创业类课程和经济管理类课程中分别至少选修一门课程。 Students are required to obtain at least 9 credits, which must cotain art courses of 2 credits from the category of Art and Physical Education Courses,at least one course from the category of Innovation and Entrepreneurship Courses and the category of Economy and Management Courses respectively.							
人文社科类 Arts and Social Science Courses									
经济管理类 Economy and Management Courses									
科学技术类 Science and Technology Courses									
艺术体育类 Art and Physical Education Courses									
(三) 专业教育必修课程 Basic Disciplinary RequiredCourses									
4200278120	应用化学专业导论 Introduction to Applied Chemistry	1	16					1	
4050063110	高等数学 A 上 Advanced Mathematics I	5	80					1	
4050064110	高等数学 A 下 Advanced Mathematics II	5	80					2	高等数学上
4200355170	无机化学 A1 Inorganic Chemistry I	2.5	40					1	
4200378170	无机化学 A2 Inorganic Chemistry II	3	48					2	无机化学 1
4200356170	无机化学实验 A1 Inorganic Chemistry Lab. I	1	32	32				1	
4200379170	无机化学实验 A2 Inorganic Chemistry Lab. II	1.5	48	48				2	
4200380170	分析化学 A Analytical Chemistry	3.5	56					2	无机化学 2
4200381170	分析化学实验 A Analytic Chemistry Lab.	2	64	64				2	
4200478170	有机化学 A1 Organic Chemistry I	3	48					3	
4200479170	有机化学 A2 Organic Chemistry II	2.5	40					4	有机化学 1
4200480170	有机化学实验 A1 Organic Chemistry Lab. I	1.5	48	48				3	
4200481170	有机化学实验 A2 Organic Chemistry Lab. II	1	32	32				4	
4200482170	物理化学 A1 Physical Chemistry I	3	48					3	

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4200483170	物理化学 A2 Physical Chemistry II	2.5	40					4	物理化学 1
4200484170	物理化学实验 A1 Physical Chemistry Lab. I	1.5	48	48				3	分析化学实验
4200485170	物理化学实验 A2 Physical Chemistry Lab. II	1	32	32				4	
4050463130	大学物理 B Physics	5	80					3	高等数学下
4050224110	物理实验 B Physics Lab.	1	32	32				4	大学物理
4200486170	结构化学 B Structural Chemistry	3.5	56					4	无机化学 1
4200218120	计算机与应用化学 Computer and Applied Chemistry	2.5	40		20			4	
4200223120	精细有机合成 Fine Organic Syntheses	3.5	56					5	有机化学 2
4200487170	精细有机合成实验 Fine Organic Syntheses Lab.	2	64	64				5	
4200221120	精细无机合成 Fine Inorganic Syntheses	3.5	56					5	无机化学 2
4200488170	精细无机合成实验 Fine Inorganic Syntheses Lab.	2	64	64				5	
4200494170	应用化学创新创业导论 Innovation and Entrepreneurship	1	16					5	
4200210120	化学工程基础 Elementary Chemistry Engineering	2	32					5	物理化学 2
4200489170	仪器分析原理与波谱解析 1 Principles of Instrumental Analysis I	2.5	40					5	分析化学
4200490170	仪器分析原理与波谱解析 2 Principles of Instrumental Analysis II	3	48					6	有机化学 2
4200491170	仪器分析实验 1 Instrumental Analysis Lab I	1	32	32				5	物理化学 2
4200492170	仪器分析实验 2 Instrumental Analysis Lab II	0.5	16	16				6	
4200493170	精细化学品化学 C Fine Chemicals Chemistry	2.5	40					6	有机化学 2
小 计 Subtotal		76	1472	512	20	0	0		
(四) 专业教育选修课程 Specialized Elective Courses									
4200225120	科技写作 Writing on Science and Technology	1	16					4	

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4200208120	工业化学 Industrial Chemistry	2	32					4	
4200495170	应用电化学 Applied Electrochemistry	2	32					5	
4200211120	化学计量学 Chemometrics	2	32					5	分析化学
4200193120	电化学测量 Electrochemical Measurements	2	32					5	
4200496170	高分子化学及物理 Polymer Chemistry and Physics	4	64					5	有机化学 2
4200197120	分离科学与技术导论 Introduction to Separation Science	2	32					6	分析化学
4200192120	材料化学导论 A Introduction to Material Chemistry	2	32					6	
4200216120	计算化学 B Computational Chemistry	2	32					6	
4200237120	生物化学 D Biochemistry	2	32					6	
4200217120	计算机化学辅助分子设计 A Computer Chemistry and Molecular Design	2	32			16		6	
4200023110	化工制图 Chemical Engineering Cartography	2	32					7	
4070060110	高分子材料导论 Introduction to Polymer Materials	2	32					7	
4200008110	工业催化 Industrial Catalysis	2	32					7	物理化学 2
4200330120	分析仪器 Analytical Instrumentation	2	32					7	大学物理 2
4200026110	化学反应工程 B Chemical Reaction Engineering	2	32					7	
4200213120	环境化学 B Environmental Chemistry	2	32					7	
4200285120	配位化学 Coordination Chemistry	2	32					7	
小 计 Subtotal		37	592	0	0	16	0		
修读说明：要求至少选修 17 学分。 NOTE: Students are required to obtain at least 17 credits.									
(五) 个性课程 Personalized Elective Courses									
4200209120	化学发展前沿 Chemistry Frontier	1	16					4	



课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4200497170	电化学研究方法 Techniques and Methods in Electrochemical Research	1	32	32				5	
4200172120	舌尖上的化学 A bite of Chemistry	2	32					6	有机化学 1
小 计 Subtotal		4	80	32	0	0	0		
修读说明：要求至少选修 6 学分，其中包括本专业个性课程 3 学分以上。 NOTE: Minimum subtotal credits: 6. Students are required to select courses from above (at least 3 credits) and the other personalized courses in catalog.									

## 五、集中性实践教学环节

### V Practice Schedule

课程编号 Course Number	实践环节名称 Practice Courses Name	学分 Crs	周数 Weeks	建议修读学期 Suggested Term
1060002110	军事训练 Military Training	1.5	3	1
4080152110	机械制造工程实训 D Machinery Manufacturing Engineering Practice C	1	1	4
4200230120	应用化学专业认识实习 Cognition Practice	1	1	5
4200498170	应用化学创新创业实践 Innovation and Entrepreneurship Training	2.5	2.5	6
4200203120	综合实验 1 Comprehensive Experiment I	4	4	6
4200281120	综合实验 2 Comprehensive Experiment II	4	4	7
4200499170	毕业设计(论文) Graduation Design (Thesis)	9	17	8
小 计 Subtotal		23	32.5	

## 六、其它要求

### VI Recommendations on Course Studies

- 1、《形势与政策》和《心理健康教育》课程为课外必修课程，分别计 2 个和 1 个课外学分。
  - 2、学生选修的通识选修课程和从学校发布的个性课程目录中选修的个性课程，要求与本专业培养方案内设置的课程内容不重复。
1. Situation & Policy (2 credits) and Mental Health Education (1 credit) are the required extracurricular courses.
  2. The selected General Education Elective Courses and Personalized Elective Courses from the courses program by university must be different from the major undergraduate education plan in content.

学院教学责任人：史 彬  
专业培养方案责任人：林亚维

# 生物技术专业 2017 版本本科培养方案

## Undergraduate Education Plan for Specialty in Biotechnology (2017)

专业名称	生物技术	主干学科	生物技术
Major	Biotechnology	Major Disciplines	Biotechnology
计划学制	四年	授予学位	理学学士
Duration	4 Years	Degree Granted	Bachelor of Science

### 最低毕业学分规定

#### Graduation Credit Criteria

课程分类 Course Classification 课程性质 Course Nature	通识教育课程 Public Basic Courses	专业教育课程 Specialized Courses	个性课程 Personalized Course	集中性实践教学环节 Practice Courses	课外学分 Study Credit after Class	总学分 Total Credits
必修课 Required Courses	29	69	\	21.5	\	170
选修课 Elective Courses	9	25.5	6	\	10	

### 一、培养目标与毕业要求

#### I Educational Objectives & Requirement

##### (一) 培养目标

本专业培养具备生命科学的基本理论和较系统的生物技术的基本理论、基本知识、基本技能，能在科研机构或高等院校从事相关的科学研究或教学工作，能在医药、食品、环保等行业从事与生物技术相关的应用研究、技术开发、生产管理等工作的专门人才。

- (1) 具有扎实数、理、化基础和生物学宏观与微观领域的理论基础和实验技能。
- (2) 系统掌握生物科学及其重要分支学科的基本理论、基本知识和基本技能以及生物科学的研究方法和实验技术。
- (3) 掌握英语和必要的计算机应用基础知识。
- (4) 受到良好的科学思维科学实验和创新创业的训练，具备良好道德和较强的责任感。
- (5) 对生物科学的学科发展和生物技术新的进展也有相当深入的了解，并具有一定的从事基础研究及应用研究和科技开发的能力。具备在科研机构、高等院校及企事业单位等从事科学研究、教学工作及管理工作的能力。

##### (I) Educational Objectives

The program aims to provide advanced talents with fundamental theory, principle knowledge and basic techniques in life science and biotechnology. The graduates will have opportunities to develop their careers in

scientific research organization, higher education institution, pharmaceutical industry, food industry, environmental field as teacher, researcher, administrator, or manager.

1. Have solid knowledge in mathematics, physics, chemistry and theoretical basis and experimental skills in the field of macro and micro biology.
2. Master the basic theory, basic knowledge and basic skills systematically of bioscience and its important branches and its research methods and experimental techniques.
3. Master the English language and necessary basic knowledge of computer applications.
4. With a good training of scientific thinking, scientific experiments and innovative and businesses development, have good morals and strong sense of responsibility.
5. Have a deeply understanding of the discipline development of bioscience and new progress of biotechnology, and have the ability to engage in basic research and applied research and technology development. Have the ability to engage in scientific research, teaching and management in research institutions, universities and enterprises.

## （二）毕业要求

本专业学生主要学习生物技术方面的基本理论、基本知识，受到应用基础研究和技术开发方面的科学思维和科学实验训练，具有较好的科学素养及初步的教学、研究、开发与管理的基本能力。

毕业生应获得以下几方面的知识和能力：

1、掌握生命科学、生物学基础理论知识，掌握生物技术专业的基本理论知识、原理和方法，把握生物技术领域的新技术，了解新技术相关的新工艺以及技术发展趋势。

① 具有从事生物技术工作所需的生命科学、生物学理论知识以及一定的人文和社会科学知识，掌握本专业所需的数学、物理学、化学、信息学等学科的基本知识。

② 熟练掌握基因工程、细胞工程、蛋白质与酶工程、生化分离与分析等生物科学与技术实验的基本技能。

③熟悉生物相关产品生产领域的技术原理及方法，掌握一定的生物工程相关原理的基础知识，了解生物制品、药物、食品、环保的相关政策、法律和法规。

2、具备运用适当的理论和技术方法解决生命科学领域实际问题的能力，能依据生物相关产品的生产原理解决生产、运行、管理、设备维护等方面的实际问题。

① 初步掌握生物技术研究的方法和手段，初步具备发现、提出、分析和解决生物技术相关问题的能力。

②了解生物相关产品的生产原理、技术需求，加工原理、加工设备（系统）技术要求，了解通行设备的运行原理、模式、技术管理要求。

③具有一定的创新意识、批判性思维和可持续发展理念。

3、参与生物实验室运行及安全管理。

① 具有较强的规范、管理意识，知晓各项科学操作规范以及科学管理规章制度，对各项设备能够规范操作，遵守管理规定。

② 具有实验室安全意识，了解各项安全管理规章，自觉遵守并维护实验室安全。

③ 具备应对危机与突发事件的初步能力。

4、有效的沟通与交流能力和较强的获取知识、终身学习的能力。

① 具有较强的表达和沟通能力，如能够使用技术语言，在跨文化环境下进行沟通与表达：能够进行各种生物研究项目和生产项目相关文件的编纂，如：可行性分析报告、项目任务书、投标书等，并可进行说明、阐释。能够运用英语进行与生物技术方面的表达、沟通和交流。

② 具有较强的交流能力。具备较强的人际交往能力，能够控制自我并了解、理解他人需求和意愿；具备较强的适应能力，自信、灵活地处理新的和不断变化的人际环境和工作环境；具备团队合作精神，并具备一定的协调、管理、竞争与合作的初步能力。

③ 具备良好的自学习惯和能力、较好的表达交流能力、一定的计算机及信息技术应用能力，自主学习、自我发展能力。

5、具备良好道德和较强的责任感和创新创业意识。

① 具有良好的道德较强的责任感。

② 具有创新创业意识。

## （ II ） Educational Requirement

The program provides the students with fundamental theory and principle knowledge in biotechnology, with emphasis on the ability in practice and innovation. The students will develop their ability in teaching, scientific research and management.

Upon graduation, students can:

1.Master the basic theoretical knowledge, experimental skills and research methods of bioscience and biotechnology, as well as essential knowledge in mathematics, physics, chemistry, and informatics, understand new products, new technologies, new processes and development trends of biotechnology.

① Have required life science and technology knowledge of being engaged in biosciences and biotechnology working and some knowledge of the humanities and social sciences.

② Master the fundamental knowledge and experimental skills of biological science and biotechnology in genetic engineering, cell engineering, protein and enzyme engineering, biochemical separation and analysis.

③ Be familiar with the technology standards of related products production areas, master fundamental knowledge in bioengineering, understand related policies, laws and regulations of biological products, pharmaceutical, food, environmental protection.

2.Have the ability to apply appropriate theoretical and practical methods to solve practical problems in the field of life sciences, get the systematic training in the practical problems of biological-related products production process design, operation, management, production equipment maintenance and so on.

① Master basic methods for biotechnique research, have the ability in identifying, analyzing, and solving problems in biotechnology.

② Learn the performance, features and operation rules of bio-related products and the production, processing equipment (system), have basic ability of equipment (system) operation, management, improvement, maintenance.

③ Have ability in providing innovation ideas, critical thoughts, as well as ideas in sustainable development.

3.Participate in the biological laboratory safety management.

① Have strong safety and legal awareness of quality, environment, occupational health, within the context of laws and regulations, according to the relevant standards and procedures to carry out the work.

② Have lab safety awareness and know the safety administrative rules and comply with it..

③ Have the preliminary ability to deal with crises and emergencies.

4. Effective communication skills and strong ability of gaining knowledge and lifelong learning.

① Have strong expression and communication skills. Be able to use technical language to communicate and express in a cross-cultural environment. Be able to codify various files about biological research projects and production projects, for example, feasibility analysis report, project task document, tender books, etc., and be able to describe and explain. Be able to use English to express and communicate in biotechnology.

② Have strong communication skills. Have strong interpersonal skills, can control self, learn and understand the needs and intentions of others. Have strong ability to adapt, be confident and flexible to handle new and changeable interpersonal and working environment. Have team spirit, and have preliminary ability of coordination, management, competition and cooperation.

③ Have a strong ability to acquire knowledge and lifelong learning. Be able to take advantages of informatics skills in tracking the latest technology development trends of life science and biotechnology, learn and study latest technical knowledge and technological achievements of them, and improve own professional level constantly.

5. Have good morals, a strong sense of responsibility and strong sense of innovative and businesses development..

① Have good morals and a strong sense of responsibility.

② Have strong sense of innovative and businesses development.

附：培养目标实现矩阵

	培养目标 1	培养目标 2	培养目标 3	培养目标 4	培养目标 5
毕业要求 1	✓	✓			✓
毕业要求 2	✓	✓			✓
毕业要求 3	✓	✓		✓	✓
毕业要求 4		✓	✓	✓	✓
毕业要求 5		✓	✓	✓	✓

## 二、专业核心课程与专业特色课程

### II Core Courses and Characteristic Courses

#### (一) 专业核心课程:

基础生物学, 生物化学, 细胞生物学, 遗传学, 微生物学

#### (I) Core Courses:

General Biology, Biochemistry, Cell Biology, Genetics, Microbiology

#### (二) 专业特色课程:

基因工程、蛋白质与酶工程、细胞工程、生化分离与分析技术

( II ) Characteristic Courses:

Genetic Engineering, Protein and Enzyme Engineering, Cell Engineering, Biochemical Isolation and Analysis

附：毕业要求实现矩阵：

专业 核心 课程	专业 特色 课程	课程名称	生物技术专业毕业要求													
			1-①	1-②	1-③	2-①	2-②	2-③	3-①	3-②	3-③	4-①	4-②	4-③	5-①	5-②
		思想道德修养与法律基础													√	√
		中国近现代史纲要													√	√
		毛泽东思想和中国特色社会 主义理论体系概论													√	√
		马克思主义基本原理													√	√
		军事理论													√	√
		创新创业类						√	√							
		人文社科类	√												√	√
		经济管理类						√	√							
		科学技术类	√						√							
		艺术体育类							√						√	√
		体育							√						√	√
		大学英语	√									√	√	√		
		C 程序设计基础	√									√	√	√		
		计算机基础与 C 程序设计综 合实验	√									√	√	√	√	√
		高等数学	√													
		线性代数	√													
		概率论与数理统计	√													
		专业导论	√	√	√											
		大学物理	√													
		物理实验	√													
		无机化学	√													
		无机化学实验	√													
		分析化学	√													
		分析化学实验	√													
		有机化学	√													

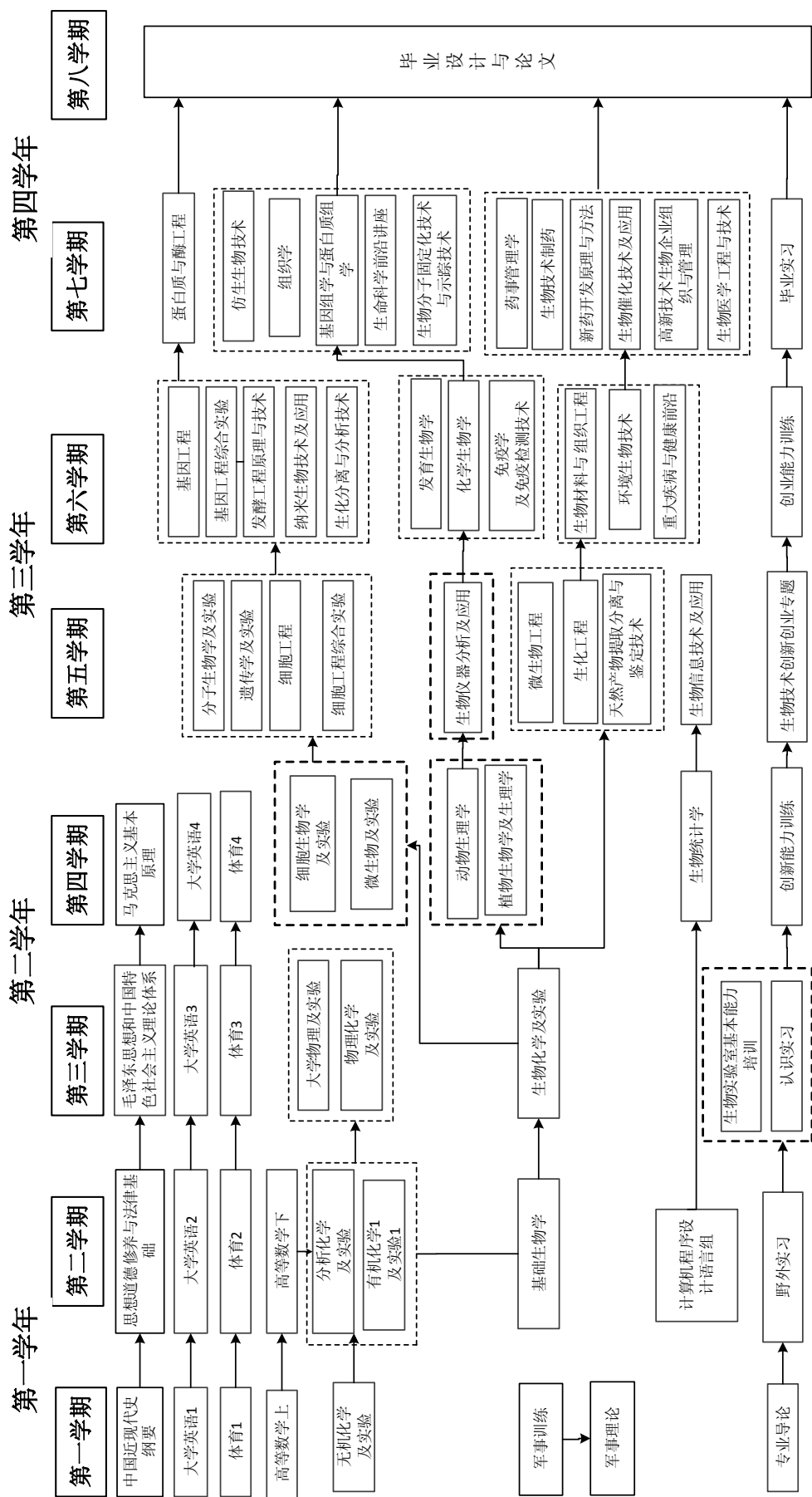
专业 核心 课程	专业 特色 课程	课程名称	生物技术专业毕业要求													
			1-①	1-②	1-③	2-①	2-②	2-③	3-①	3-②	3-③	4-①	4-②	4-③	5-①	5-②
		有机化学实验	√													
		物理化学	√													
		物理化学实验	√													
√		基础生物学及实验	√	√	√	√	√	√								
√		生物化学	√	√	√	√	√	√								
		生物化学实验	√	√	√	√	√	√								
		生物统计学	√	√	√											
		环境生物技术	√	√	√											
		生物信息技术及运用	√	√	√											
		动物生物学及生理学	√	√	√	√	√	√	√	√	√					
		生物技术创新创业专题	√	√	√	√	√	√	√	√	√	√	√	√	√	
√		细胞生物学	√	√	√	√	√	√								
		细胞生物学实验	√	√	√	√	√	√	√	√	√					
√		微生物学	√	√	√	√	√	√								
		微生物学实验				√	√	√	√	√	√					
		植物生物学及生理学				√	√	√	√	√	√					
		分子生物学				√	√	√	√	√	√					
√		遗传学				√	√	√	√	√	√					
		遗传学实验				√	√	√	√	√	√					
	√	细胞工程				√	√	√	√	√	√					
		生物材料与组织工程				√	√	√								
	√	基因工程				√	√	√	√	√	√					
		发酵工程原理与技术				√	√	√								
		免疫学及免疫检测技术				√	√	√								
		纳米生物技术与运用				√										
	√	生化分离与分析技术				√	√	√	√	√	√					
	√	蛋白质与酶工程				√	√	√	√	√	√					
		生化工程				√	√	√								

专业 核心 课程	专业 特色 课程	课程名称	生物技术专业毕业要求													
			1-①	1-②	1-③	2-①	2-②	2-③	3-①	3-②	3-③	4-①	4-②	4-③	5-①	5-②
		仿生生物技术				√	√	√								
		天然产物提取分离与鉴定技术				√	√	√								
		重大疾病与健康前沿	√	√	√	√	√	√								
		生物催化技术及应用				√	√	√								
		生物医学工程与技术				√	√	√								
		生物仪器分析及应用				√	√	√								
		化学生物学				√	√	√								
		高新技术生物企业组织与管理							√	√	√				√	√
		新药开发原理与方法				√	√	√								
		发育生物学				√	√	√								
		生命科学前沿讲座	√	√	√											
		生物分子固定化技术与示踪技术	√	√	√	√	√	√								
		药事管理学				√	√	√							√	√
		生物技术制药				√	√	√								
		基因组学与蛋白质组学	√	√	√	√	√	√								
		组织学	√	√	√											
		野外实习				√	√	√	√	√	√	√	√	√		
		生物实验室基本能力培训				√	√	√	√	√	√	√	√	√		
		认识实习				√	√	√	√	√	√	√	√	√		
		创新能力训练				√	√	√	√	√	√					
		细胞工程综合实验				√	√	√	√	√	√					
		基因工程综合实验				√	√	√	√	√	√					
		创业能力训练				√	√	√	√	√	√	√	√	√		
		毕业实习及毕业设计	√	√	√	√	√	√	√	√	√	√	√	√		
		军事训练										√	√	√	√	√

### 三、课程教学进程图

#### III Teaching Process Map





#### 四、 理论教学建议进程表

#### IV Theory Course Schedule

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
(一) 通识教育必修课程 General Education Required Courses									
4220002110	中国近现代史纲要 Outline of Contemporary and Modern Chinese History	2	32					1	
4220001110	思想道德修养与法律基础 Morals, Ethics and Fundamentals of Law	3	48			8		2	
4220003110	毛泽东思想和中国特色社会主义理论体系概论 Introduction to Mao Zedong Thought and Socialism with Chinese Characteristics	4	96			32		3	
4220005110	马克思主义基本原理 Marxism Philosophy	3	48			8		4	
1060003130	军事理论 Military Theory	1	32				16	1	
4210001170	体育 1 Physical Education I	1	26					1	
4210002170	体育 2 Physical Education II	1	34					2	
4210003170	体育 3 Physical Education III	1	34					3	
4210004170	体育 4 Physical Education IV	1	34					4	
4030002180	大学英语 1 College English I	3	60				12	1	
4030003180	大学英语 2 College English II	2	44				12	2	大学英语 1
4030004180	大学英语 3 College English III	2	44				12	3	大学英语 2
4030004180	大学英语 4 College English IV	2	44				12	4	大学英语 3
以下两组课程按照语言选修一组									
4120335170	C 程序设计基础 Fundamentals of Computer Program Design(C)	2	32					2	
4120336170	计算机基础与 C 程序设计综合实验 Foundations of Computer and C Language Programming Experiments	1	32	32				2	
4120341170	VBA 程序设计基础 Fundamentals of Computer Program Design(VBA language)	2	32					2	
4120342170	计算机基础与 VBA 程序设计综合实验 Foundations of Computer and VBA Language Programming Experiments	1	32	32				2	

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
小 计 Subtotal		29	640	32	0	48	64		
(二) 通识教育选修课程 General Education Elective Courses									
创新创业类 Innovation and Entrepreneurship Courses		要求至少取得 9 个学分，且必须选修艺术体育类课程中的艺术类 相关课程并取得至少 2 个学分，在创新创业类课程和经济管理类 课程中分别至少选修一门课程。  Students are required to obtain at least 9 credits, which must cotain art courses of 2 credits from the category of Art and Physical Education Courses,at least one course from the category of Innovation and Entrepreneurship Courses and the category of Economy and Management Courses respectively.							
人文社科类 Arts and Social Science Courses									
经济管理类 Economy and Management Courses									
科学技术类 Science and Technology Courses									
艺术体育类 Art and Physical Education Courses									
(三) 专业教育必修课程 Specialized Courses Required Courses									
4200337120	生物技术专业导论 Introduction to Specialty	1	16					1	
4050063110	高等数学 A 上 Advanced Mathematics I	5	80					1	
4050064110	高等数学 A 下 Advanced Mathematics II	5	80					2	高等数学上
4200357170	无机化学 B Inorganic Chemistry	3	48					1	
4200359170	无机化学实验 C Inorganic Chemistry Experiment	0.5	16	16				1	
4200303120	分析化学 C Analytical Chemistry	1.5	24					2	
4200376170	分析化学实验 C Analytical Chemistry Experiment	1	32	32				2	
4200284120	基础生物学 General Biology	3	48					2	
4200299120	基础生物学实验 General Biology Experiment	1	32	32				2	
4200274120	有机化学 C Organic Chemistry	3	48					2	
4200275120	有机化学实验 C Organic Chemistry Experiment	0.5	16	16				2	
4200438170	生物化学 B Biochemistry	3.5	56					3	
4200238120	生物化学实验 Biochemistry Experiment	1.5	48	48				3	
4200256120	物理化学 C Physical Chemistry	4	64					3	

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4200382170	物理化学实验 C Physical Chemistry Experiment	0.5	16	16				3	
4050463130	大学物理 B Physics	5	80					3	
4050224110	物理实验 B Physics Experiment	1	32	32				4	
4200263120	细胞生物学 Cell Biology	3	48					4	生物化学
4200264120	细胞生物学实验 Cell Biology Experiment	1	32	32				4	
4200246120	微生物学 A Microbiology	3	48					4	基础生物学
4200247120	微生物学实验 Microbiology Experiment	1	32	32				4	
4200439170	分子生物学 B Molecular Biology	2	32					5	生物化学
4200329130	分子生物学实验 Molecular Biology Experiment	1	32	32				5	
4200270120	遗传学 Genetics	2	32					5	生物化学
4200184120	遗传学实验 Genetics Experiment	1	32	32				5	
4200261120	细胞工程 A Cell Engineering	2	32					5	细胞生物学
4200440170	生物技术创新创业专题 Innovative and Businesses Development in Biotechnology	1	16					5	
4200214120	基因工程 Gene Engineering	2	32					6	分子生物学
4200441170	发酵工程原理与技术 Ferment Engineering Equipment and Technology	2	32					6	
4200442170	发酵工程原理与技术实验 Ferment Engineering Equipment and Technology Exp.	0.5	16	16				6	
4200227120	纳米生物技术及应用 A Nano-Biotechnology and Applications	2	32					6	
4200443170	生化分离与分析技术 Biochemical Isolation and Analysis	2	32					6	
4200444170	生化分离与分析技术实验 Biochemical Isolation and Analysis Exp.	1	32	32				6	
4200445170	蛋白质与酶工程 Protein and Enzyme Engineering	2	32					7	基因工程

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4200446170	蛋白质与酶工程实验 Protein and Enzyme Engineering Exp.	0.5	16	16				7	基因工程
小 计 Subtotal		69	1296	384	0	0	0		
(四) 专业教育选修课程 Specialized Courses Elective Courses									
大类基础选修课程 Basic Deciplinary Elective Courses									
4200341140	生物统计学 Biostatistics	2	32					4	
4200447170	植物生物学及生理学 B Plant Biology and Physiology	2	32					4	
4200448170	植物生物学及生理学实验 Plant Biology and Physiology Exp.	0.5	16	16				4	
4200175120	生物信息技术及应用 Bioinformatics Technology and Applications	2	32		8			5	
4200169120	环境生物技术 Environmental Biotechnology	2	32					6	分子生物学、细胞工程
小 计 Subtotal		8.5	144	16	8	0	0		
修读说明：要求至少选修 6.5 学分。 NOTE: Minimum subtotal credits:6.5.									
专业应用选修课程--成组选修模块 (以下课程如果选修理论课程，必须同时选修对应的实验课程。)									
4200451170	动物生理学 B Animal Physiology	2	32					4	
4200452170	动物生理学实验 Animal Physiology Exp.	0.5	16	16				4	
4200244120	微生物工程 Microbial Engineering	2	32					5	微生物学
4200453170	微生物工程实验 B Microbial Engineering Exp.	0.5	16	16				5	微生物学
4200454170	生物仪器分析及应用 B Analytic Biological Instruments and Applications	2	32					5	
4200455170	生物仪器分析及应用实验 Analytic Biological Instruments and Applications Exp.	0.5	16	16				5	
4200456170	免疫学及免疫检测技术 B Immunology and Immune Assay Technology	2	32					6	
4200457170	免疫学及免疫检测技术实验 Immunology and Immune Assay Technology Exp.	0.5	16	16				6	
专业应用选修课程--任意选修模块 Applied Elective Courses									

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4200232120	生化工程 A Biochemical Engineering	2	32					5	
4200343130	生物材料与组织工程 Biomaterials and Tissue Engineering	2	32					6	
4200212120	化学生物学 Chemical Biology	2	32					6	
4200196120	发育生物学 Development Biology	2	32					6	
4200449170	生命科学前沿讲座 A Frontiers of Life Sciences	2	32					7	
4200235120	生物分子固定化技术与示踪技术 Immobilizing and Tracing Techniques of Biological Molecules	2	32					7	
4200171120	基因组学与蛋白质组学 Genomics and Proteomics	2	32					7	
4200283120	组织学 Histology	2	32					7	
4200162120	仿生生物技术 Biomimics Biotechnology	2	32					7	
4200450170	高新技术生物企业组织与管理 A Hi-tech Biological Industrial Organizations and Management.	2	32					7	
4200266120	药事管理学 Pharmacy Administration	2	32					7	
4200239120	生物技术制药 Biotechnological Pharmaceutics	2	32					7	
4200347140	生物催化技术及应用 B Biological Catalytic Technology and Applications	2	32					7	
4200265120	新药开发原理与方法 Research Principle and Method of New Medicine	2	32					7	
小 计 Subtotal		55	928	96	16	0	0		
修读说明：专业应用选修课程要求至少选修 19 学分。 Note: Minimum subtotal credits in Applied Elective Courses: 19.									
(五) 个性课程 Personalized Elective Courses									
4200458170	天然产物提取分离与鉴定技术 C Extraction, Preparation and Identification Technology Natural Products	2	32					5	
4200459170	天然产物提取分离与鉴定技术实验 Extraction, Preparation and Identification Technology Natural Products Exp.	0.5	16	16				5	
4200460170	重大疾病与健康前沿 Frontiers of Diseases and Health	2	32					6	

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4200176120	生物医学工程与技术 Biomedical Engineering and Technology	2	32					7	细胞工程、 发酵工程、 基因工程
4200351150	天然产物提取分离与鉴定技术 B Extraction, Preparation and Identification Technology	2.5	40					5	
小 计 Subtotal		9	152	16	0	0	0		

修读说明：要求至少选修 6 学分的个性课程,其中学生需要修读以上课程至少 2 学分（如果选修《天然产物提取分离与鉴定技术》，必须同时选修对应的实验课程），余下学分可跨专业自主选择修读全校其他专业的课程。  
NOTE: Minimum subtotal credits: 6. Specifically, students need to take the above courses to obtain at least 2 credits and take any courses from the other specialties to obtain the remaining credits.

## 五、 集中性实践教学环节

### V Practice Schedule

课程编号 Course Number	实践环节名称 Practice Courses Name	学分 Crs	周数 Weeks	建议修读学期 Suggested Term
1060002110	军事训练 Military Training	1.5	3	1
4200267120	野外实习 Field Practice in Biology	1	1	2（暑期）
4200240120	生物实验室基本能力培训 Basic Skills Training in Biological Laboratory	1	1	3（分散）
4200231120	生物技术专业认识实习 Cognition Practice	1	1	3
4200160120	创新能力训练 Innovative Skills Training	1	1	4（暑期）
4200262120	细胞工程综合实验 Cell Engineering Experiments	2	2	5
4200215120	基因工程综合实验 Gene Engineering Experiments	2	2	6
4200461170	生物技术创新能力训练 Business Development Training	1	1	6（暑期）
4200157120	毕业实习 Graduation Practice	2	2	7
4200462170	毕业设计 Graduation Thesis	9	17	8
小 计 Subtotal		21.5	31	

## 六、其它要求

### VI Recommendations on Course Studies

- 1、《形势与政策》和《心理健康教育》课程为课外必修课程，分别计 2 个和 1 个课外学分。
- 2、学生选修的通识选修课程和从学校发布的个性课程目录中选修的个性课程，要求与本专业培养方案内设置的课程内容不重复。

1.Situation & Policy (2 credits) and Mental Health Education (1 credit) are the required extracurricular courses.

2.The selected General Education Elective Courses and Personalized Elective Courses from the courses program by university must be different from the major undergraduate education plan in content.

学院教学责任人：史 彬

专业培养方案责任人：谢 浩



# 生物技术专业（生物制药方向）2017 版本本科培养方案

## Undergraduate Education Plan for Specialty in Biotechnology (Biopharmaceutics) (2017)

专业名称	生物技术	主干学科	生物技术
Major	Biotechnology	Major Disciplines	Biotechnology
计划学制	四年	授予学位	理学学士
Duration	4 Years	Degree Awarded	Bachelor of Science

### 最低毕业学分规定

#### Graduation Credit Criteria

课程分类 Course Classification 课程性质 Course Nature	通识教育课程 Public Basic Courses	专业教育课程 Specialized Courses	个性课程 Personalized Course	集中性实践教学环节 Practice Courses	课外学分 Study Credit after Class	总学分 Total Credits
必修课 Required Courses	29	71.5	\	21.5	\	170
选修课 Elective Courses	9	23	6	\	10	

### 一、培养目标与毕业要求

#### I Educational Objectives & Requirement

##### (一) 培养目标

本专业培养具备生命科学的基本理论和较系统的生物技术的基本理论、基本知识、基本技能，能在科研机构或高等院校从事生物技术制药相关的科学研究或教学工作，并能在生物医药行业从事相关的应用研究、技术开发、生产管理等工作的专门人才。

- (1) 具有扎实数、理、化基础和生物学宏观与微观领域的理论基础和实验技能。
- (2) 系统掌握生物科学及生物技术制药领域的基本理论、基本知识和基本技能以及生物科学的研究方法和实验技术。
- (3) 掌握英语和必要的计算机应用基础知识。
- (4) 受到良好的科学思维科学实验和创新创业能力的训练，具备良好道德和较强的责任感。
- (5) 对生物科学的学科发展和生物技术制药领域的进展有相当深入的了解，并具有一定的从事基础研究及应用研究和科技开发的能力。具备在科研机构、高等院校及企事业单位等从事科学研究、教学工作及管理工作的能力。

##### ( I ) Educational Objectives

The program aims to provide advanced talents with fundamental theory, principle knowledge and basic techniques in life science and biotechnology. The graduates will have opportunities to develop their careers in scientific research organization, higher education institution and pharmaceutical industry as teacher, researcher,

administrator, or manager.

1. Have solid knowledge in mathematics, physics, chemistry and theoretical basis and experimental skills in the field of macro and micro biology.
2. Master the basic theory, basic knowledge and basic skills of bioscience and biotechnological pharmaceuticals as well as research methods and experimental techniques.
3. Master the English language and necessary basic knowledge of computer applications.
4. Have a good training of scientific thinking, scientific experiments, innovative and businesses development, have good morals and strong sense of responsibility.
5. Have a deeply understanding of the discipline development of bioscience and new progress of biotechnological pharmaceuticals, and have the ability to engage in basic research and applied research and technology development. Have the ability to engage in scientific research, teaching and management in research institutions, universities and enterprises.

## （二）毕业要求

本专业学生主要学习生物技术方面的基本理论、基本知识，受到应用基础研究和技术开发方面的科学思维和科学实验训练，具有较好的科学素养及初步的教学、研究、开发与管理的的基本能力。

毕业生应获得以下几方面的知识和能力：

1、掌握生命科学、生物学基础理论知识，掌握生物技术专业的基本理论知识、原理和方法，把握生物技术制药领域的新技术、新工艺以及发展趋势。

①具有从事生物技术制药工作所需的生命科学、生物学理论知识以及一定的人文和社会科学知识，掌握本专业所需的数学、物理学、化学、信息学等学科的基本知识。

② 熟练掌握基因工程、细胞工程、蛋白质与酶工程、生化分离与分析等生物科学与技术实验的基本技能。

③熟悉生物相关产品生产领域的技术原理及方法，掌握一定的生物工程相关原理的基础知识，了解生物制品、生物医药的相关政策、法律和法规。

2、具备运用适当的理论和技术方法解决生命科学领域实际问题的能力，能依据生物相关产品的生产原理解决生产、运行、管理、设备维护等方面的实际问题。

① 初步掌握生物技术研究的方法和手段，初步具备发现、提出、分析和解决生物技术相关问题的能力。

② 了解生物相关产品的生产原理、技术需求，加工原理、加工设备（系统）技术要求，了解通行设备的运行原理、模式、技术管理要求。

③ 具有一定的创新意识、批判性思维和可持续发展理念。

3、参与生物实验室运行及安全管理。

① 具有较强的规范、管理意识，知晓各项科学操作规范以及科学管理规章制度，对各项设备能够规范操作，遵守管理规定。

② 具有实验室安全意识，了解各项安全管理规章，自觉遵守并维护实验室安全。

③ 具备应对危机与突发事件的初步能力。

4、有效的沟通与交流能力和较强的获取知识、终身学习的能力。

① 具有较强的表达和沟通能力，如能够使用技术语言，在跨文化环境下进行沟通与表达：能够进行各种生物研究项目和生产项目相关文件的编纂，如：可行性分析报告、项目任务书、投标书等，并可进行说明、阐释。能够运用英语进行与生物技术方面的表达、沟通和交流。

② 具有较强的交流能力。具备较强的人际交往能力，能够控制自我并了解、理解他人需求和意愿；具备较强的适应能力，自信、灵活地处理新的和不断变化的人际环境和工作环境；具备团队合作精神，并具备一定的协调、管理、竞争与合作的初步能力。

③ 具备良好的自学习惯和能力、较好的表达交流能力、一定的计算机及信息技术应用能力，自主学习、自我发展能力。

5、具备良好道德和较强的责任感和创新创业意识。

① 具有良好的道德和较强的责任感。

② 具有创新创业意识。

## （II）Educational Requirement

The program provides the students with fundamental theory and principle knowledge in biotechnology, with emphasis on the ability in practice and innovation. The students will develop their ability in teaching, scientific research, management.

Upon graduation, students can:

1. Master the basic theoretical knowledge, experimental skills and research methods of bioscience and biotechnology, as well as essential knowledge in mathematics, physics, chemistry, and informatics, understand new products, new technologies, new processes and development trends of biotechnological pharmaceuticals.

① Have required life science and technology knowledge of being engaged in biotechnological pharmaceuticals and some knowledge of the humanities and social sciences.

② Master the fundamental knowledge and experimental skills of biological science and biotechnology in genetic engineering, cell engineering, protein and enzyme engineering, biochemical separation and analysis.

③ Be familiar with the technology standards of related products production areas, master fundamental knowledge in bioengineering, understand related policies, laws and regulations of biological products, biological pharmaceuticals.

2. Have the ability to apply appropriate theoretical and practical methods to solve practical problems in the field of life sciences, get the systematic training in the practical problems of biological-related products production process design, operation, management, production equipment maintenance and so on.

① Master basic methods for biotechnology research, have the ability in identifying, analyzing, and solving problems in biotechnology.

② Learn the performance, features and operation rules of bio-related products and the production, processing equipment (system), have basic ability of equipment (system) operation, management, improvement, maintenance.

③ Have ability in providing innovation ideas, critical thoughts, as well as ideas in sustainable development.

3. Participate in the biological laboratory safety management.

① Have strong safety and legal awareness of quality, environment, occupational health, within the context of

laws and regulations, according to the relevant standards and procedures to carry out the work.

② Have the preliminary management ability of biological research projects and engineering.

③ Have the preliminary ability to deal with crises and emergencies.

4. Effective communication skills and strong ability of gaining knowledge and lifelong learning.

① Have strong expression and communication skills. Be able to use technical language to communicate and express in a cross-cultural environment. Be able to codify various files about biological research projects and production projects, for example, feasibility analysis report, project task document, tender books, etc., and be able to describe and explain. Be able to use English to express and communicate in biotechnology.

② Have strong exchange skills. Have strong interpersonal skills, can control self, learn and understand the needs and wishes of others. Have strong ability to adapt, be confident and flexible to handle new and changeable interpersonal and working environment. Have team spirit, and have preliminary ability of coordination, management, competition and cooperation.

③ Have a strong ability to acquire knowledge and lifelong learning. Be able to take advantages of informatic skills in tracking the latest technology development trends of life science and biotechnology, learn and study latest technical knowledge and technological achievements of them, and improve own professional level constantly. Have ability to collect, analyze, judge, conclude and select the domestic and foreign technical information, and replenish own expertise constantly.

5. Have good morals and a strong sense of responsibility。

① Have good morals and a strong sense of responsibility.

② Have strong sense of innovative and businesses development.

附：培养目标实现矩阵

	培养目标 1	培养目标 2	培养目标 3	培养目标 4	培养目标 5
毕业要求 1	✓	✓			✓
毕业要求 2	✓	✓			✓
毕业要求 3	✓	✓		✓	✓
毕业要求 4		✓	✓	✓	✓
毕业要求 5		✓	✓	✓	✓

## 二、专业核心课程与专业特色课程

### (一) 专业核心课程:

基础生物学、生物化学、细胞生物学、微生物学、药物化学

#### (I) Core Courses:

General Biology, Biochemistry, Cell Biology, Microbiology, Pharmaceutical Chemistry

### (二) 专业特色课程:

基因工程、蛋白质与酶工程、细胞工程、生化分离与分析技术、发酵工程原理与技术

#### (II) Characteristic Courses:

Genetic Engineering, Protein and Enzyme Engineering, Cell Engineering, Biochemical Separation and Analysis, Ferment Engineering Equipment and Technology

附：毕业要求实现矩阵：

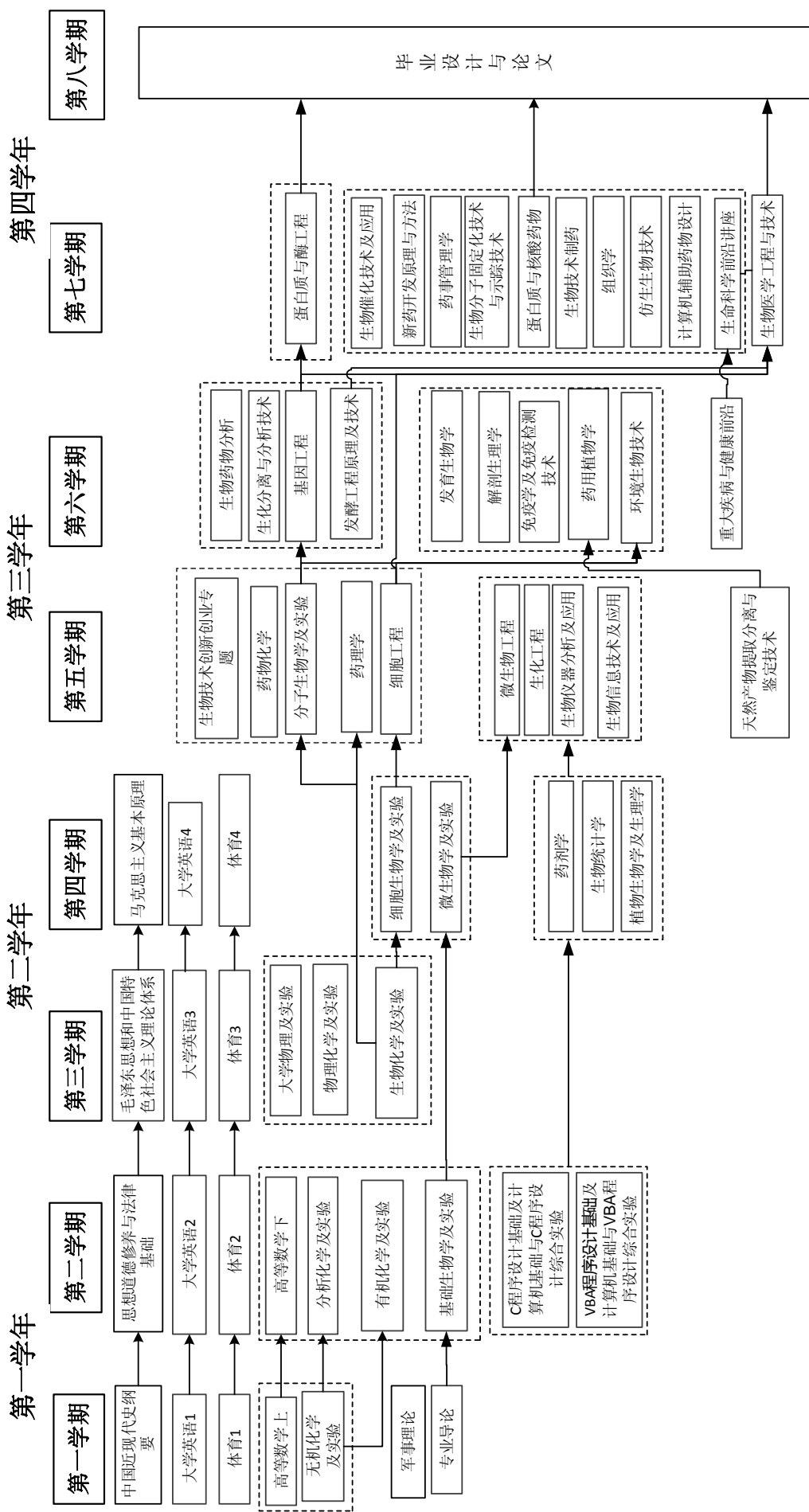
专业核 心课程	专业特 色课程	课程名称	生物技术专业（生物制药方向）毕业要求													
			1-①	1-②	1-③	2-①	2-②	2-③	3-①	3-②	3-③	4-①	4-②	4-③	5-①	5-②
		思想道德修养与法律基础													√	√
		中国近现代史纲要													√	√
		毛泽东思想和中国特色社会主义理论体系概论													√	√
		马克思主义基本原理													√	√
		军事理论													√	√
		创新创业类						√	√							
		人文社科类	√												√	√
		经济管理类						√								
		科学技术类	√						√							
		艺术体育类													√	√
		体育													√	√
		大学英语	√									√	√	√		
		C 程序设计基础	√									√	√	√		
		计算机基础与 C 程序设计综合实验	√									√	√	√	√	√
		高等数学上、下	√													
		专业导论	√	√	√											
		大学物理	√													
		物理实验	√													
		无机化学	√													
		无机化学实验	√													
		分析化学	√													
		分析化学实验	√													
		有机化学	√													
		有机化学实验	√													
		物理化学	√													
		物理化学实验	√													
√		基础生物学及实验	√	√	√	√	√	√								

专业核 心课程	专业特 色课程	课程名称	生物技术专业（生物制药方向）毕业要求													
			1-①	1-②	1-③	2-①	2-②	2-③	3-①	3-②	3-③	4-①	4-②	4-③	5-①	5-②
√		生物化学	√	√	√	√	√	√								
		生物化学实验	√	√	√	√	√	√								
		生物统计学	√	√	√											
		环境生物技术	√	√	√											
		生物信息技术及运用	√	√	√											
		生物技术创新创业专题	√	√	√	√	√	√	√	√	√	√	√	√	√	√
√		细胞生物学	√	√	√	√	√	√								
		细胞生物学实验	√	√	√	√	√	√	√	√	√					
√		微生物学	√	√	√	√	√	√								
		微生物学实验				√	√	√	√	√	√					
		植物生物学及生理学				√	√	√	√	√	√					
		分子生物学				√	√	√	√	√	√					
		分子生物学实验				√	√	√	√	√	√					
	√	细胞工程				√	√	√	√	√	√					
	√	基因工程				√	√	√	√	√	√					
	√	发酵工程原理与技术				√	√	√								
		免疫学及免疫检测技术				√	√	√								
	√	生化分离与分析技术				√	√	√	√	√	√					
	√	蛋白质与酶工程				√	√	√	√	√	√					
		生化工程				√	√	√								
		仿生生物技术				√	√	√								
		天然产物提取分离与鉴定技术				√	√	√								
		生物催化技术及应用				√	√	√								
		生物医学工程与技术				√	√	√								
		重大疾病与健康前沿	√	√	√	√	√	√								
		生物仪器分析及应用				√	√	√								
		新药开发原理与方法				√	√	√							√	√
		发育生物学				√	√	√								

专业核 心课程	专业特 色课程	课程名称	生物技术专业（生物制药方向）毕业要求													
			1-①	1-②	1-③	2-①	2-②	2-③	3-①	3-②	3-③	4-①	4-②	4-③	5-①	5-②
		生命科学前沿讲座	√	√	√											
		生物分子固定化技术与示踪技术	√	√	√	√	√	√								
		药事管理学				√	√	√							√	√
		生物技术制药				√	√	√								
		组织学	√	√	√											
		药理学	√	√	√	√	√	√								
√		药物化学	√	√	√	√	√	√								
		生物药物分析	√	√	√	√	√	√								
		药剂学	√	√	√	√	√	√								
		药用植物学	√	√	√	√	√	√								
		解剖生理学	√	√	√	√	√	√								
		蛋白质与核酸药物	√	√	√	√	√	√								
		计算机辅助药物设计				√	√	√								
		野外实习				√	√	√	√	√	√	√	√	√		
		生物实验室基本能力培训				√	√	√	√	√	√	√	√	√		
		认识实习				√	√	√	√	√	√	√	√	√		
		创新能力训练				√	√	√	√	√	√				√	√
		细胞工程综合实验				√	√	√	√	√	√					
		基因工程综合实验				√	√	√	√	√	√					
		创业能力训练				√	√	√	√	√	√	√	√	√		
		毕业实习及毕业设计	√	√	√	√	√	√	√	√	√	√	√	√		
		军事训练										√	√	√	√	√

### 三、课程教学进程图

#### III Teaching Process Map





#### 四、 理论教学建议进程表

#### IV Theory Course Schedule

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
(一) 通识教育必修课程 General Education Required Courses									
4220002110	中国近现代史纲要 Outline of Contemporary and Modern Chinese History	2	32					1	
4220001110	思想道德修养与法律基础 Morals, Ethics and Fundamentals of Law	3	48			8		2	
4220003110	毛泽东思想和中国特色社会主义理论体系概论 Introduction to Mao Zedong Thought and Socialism with Chinese Characteristics	4	96			32		3	
4220005110	马克思主义基本原理 Marxism Philosophy	3	48			8		4	
1060003130	军事理论 Military Theory	1	32				16	1	
4210001170	体育 1 Physical Education I	1	26					1	
4210002170	体育 2 Physical Education II	1	34					2	
4210003170	体育 3 Physical Education III	1	34					3	
4210004170	体育 4 Physical Education IV	1	34					4	
4030002180	大学英语 1 College English I	3	60				12	1	
4030003180	大学英语 2 College English II	2	44				12	2	大学英语 1
4030004180	大学英语 3 College English III	2	44				12	3	大学英语 2
4030004180	大学英语 4 College English IV	2	44				12	4	大学英语 3
以下两组课程按照语言选修一组									
4120335170	C 程序设计基础 Fundamentals of Computer Program Design(C)	2	32					2	
4120336170	计算机基础与 C 程序设计综合实验 Foundations of Computer and C Language Programming Experiments	1	32	32				2	
4120341170	VBA 程序设计基础 Fundamentals of Computer Program Design(VBA language)	2	32					2	

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4120342170	计算机基础与 VBA 程序设计综合实验 Foundations of Computer and VBA Language Programming Experiments	1	32	32				2	
小 计 Subtotal		29	640	32	0	48	64		
(二) 通识教育选修课程 General Education Elective Courses									
创新创业类 Innovation and Entrepreneurship Courses		要求至少取得 9 个学分，且必须选修艺术体育类课程中的艺术类 相关课程并取得至少 2 个学分，在创新创业类课程和经济管理类 课程中分别至少选修一门课程。 Students are required to obtain at least 9 credits, which must cotain art courses of 2 credits from the category of Art and Physical Education Courses,at least one course from the category of Innovation and Entrepreneurship Courses and the category of Economy and Management Courses respectively.							
人文社科类 Arts and Social Science Courses									
经济管理类 Economy and Management Courses									
科学技术类 Science and Technology Courses									
艺术体育类 Art and Physical Education Courses									
(三) 专业教育必修课程 Specialized Courses Required Courses									
4200337120	生物技术专业导论 Introduction to Specialty	1	16					1	
4050063110	高等数学 A 上 Advanced Mathematics I	5	80					1	
4050064110	高等数学 A 下 Advanced Mathematics II	5	80					2	高等数学上
4200357170	无机化学 B Inorganic Chemistry	3	48					1	
4200359170	无机化学实验 C Inorganic Chemistry Experiment	0.5	16	16				1	
4200303120	分析化学 C Analytical Chemistry	1.5	24					2	
4200368170	分析化学实验 C Analytical Chemistry Experiment	1	32	32				2	
4200284120	基础生物学 General Biology	3	48					2	
4200299120	基础生物学实验 General Biology Experiment	1	32	32				2	
4200274120	有机化学 C Organic Chemistry	3	48					2	
4200275120	有机化学实验 C Organic Chemistry Experiment	0.5	16	16				2	
4200438170	生物化学 B Biochemistry	3.5	56					3	
4200238120	生物化学实验 Biochemistry Experiment	1.5	48	48				3	

课程编号 Course Number	课 程 名 称 Course Title	学分 Cr	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4200256120	物理化学 C Physical Chemistry	4	64					3	
4200382170	物理化学实验 C Physical Chemistry Experiment	0.5	16	16				3	
4050463130	大学物理 B Physics B	5	80					3	
4050224110	物理实验 B Physics Experiment	1	32	32				4	
4200263120	细胞生物学 Cell Biology	3	48					4	生物化学
4200264120	细胞生物学实验 Cell Biology Experiment	1	32	32				4	
4200246120	微生物学 A Microbiology	3	48					4	基础生物学
4200247120	微生物学实验 Microbiology Experiment	1	32	32				4	
4200439170	分子生物学 B Molecular Biology	2	32					5	生物化学
4200329130	分子生物学实验 Molecular Biology Experiment	1	32	32				5	
4200463170	药理学 C Pharmacology	2	32					5	基础生物学
4200464170	药理学实验 Pharmacology Exp.	0.5	16	16				5	基础生物学
4200465170	药物化学 C pharmaceutical chemistry	2	32					5	生物化学
4200466170	药物化学实验 pharmaceutical chemistry Exp.	0.5	16	16				5	生物化学
4200261120	细胞工程 A Cell Engineering	2	32					5	细胞生物学
4200440170	生物技术创新创业专题 Innovative and Businesses Development in Biotechnology	1	16					5	
4200214120	基因工程 Gene Engineering	2	32					6	分子生物学
4200441170	发酵工程原理与技术 Ferment Engineering Equipment and Technology	2	32					6	
4200442170	发酵工程原理与技术实验 Ferment Engineering Equipment and Technology Exp.	0.5	16	16				6	
4200467170	生物药物分析 Bio-pharmaceutical Analysis	2	32					6	药物化学

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4200468170	生物药物分析实验 Bio-pharmaceutical Analysis Exp.	0.5	16	16				6	药物化学
4200443170	生化分离与分析技术 Biochemical Separation and Analysis	2	32					6	
4200444170	生化分离与分析技术实验 Biochemical Separation and Analysis Exp.	1	32	32				6	
4200445170	蛋白质与酶工程 Protein and Enzyme Engineering	2	32					7	基因工程
4200446170	蛋白质与酶工程实验 Protein and Enzyme Engineering Exp.	0.5	16	16				7	基因工程
小 计 Subtotal		71.5	1344	400	0	0	0		
(四) 专业教育选修课程 Specialized Courses Elective Courses									
大类基础选修课程 Basic Deciplinary Elective Courses									
4200341140	生物统计学 Biostatistics	2	32					4	
4200447170	植物生物学及生理学 B Plant Biology and Physiology	2	32					4	
4200448170	植物生物学及生理学实验 Plant Biology and Physiology Exp.	0.5	16	16				4	
4200175120	生物信息技术及应用 Bioinformatics Technology and Applications	2	32		8			5	
4200169120	环境生物技术 Environmental Biotechnology	2	32					6	分子生物学、细胞工程
小 计 Subtotal		8.5	144	16	8	0	0		
修读说明：要求至少选修 6 学分。 NOTE: Minimum subtotal credits: 6.									
专业应用选修课程--成组选修模块 (以下课程如果选理论课程, 必须同时选修对应的实验课程。)									
4200244120	微生物工程 Microbial Engineering	2	32					5	微生物学
4200453170	微生物工程实验 B Microbial Engineering Exp.	0.5	16	16				5	微生物学
4200454170	生物仪器分析及应用 B Analytic Biological Instruments and Applications	2	32					5	
4200455170	生物仪器分析及应用实验 Analytic Biological Instruments and Applications Exp.	0.5	16	16				5	
4200456170	免疫学及免疫检测技术 B Immunology and Immune Assay Technology	2	32					6	

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4200457170	免疫学及免疫检测技术实验 Immunology and Immune Assay Technology Exp.	0.5	16	16				6	
专业应用选修课程--任意选修模块									
4200469170	药剂学 C Pharmacy	2	32					4	
4200232120	生化工程 A Biochemical Engineering	2	32					5	
4200470170	药用植物学 Pharmaceutical botany	2	32					6	
4200471170	解剖生理学 Anatomical physiology	2	32					6	
4200196120	发育生物学 Development Biology	2	32					6	
4200449170	生命科学前沿讲座 A Frontiers of Life Sciences	2	32					7	
4200235120	生物分子固定化技术与示踪技术 Immobilizing and Tracing Techniques of Biological Molecules	2	32					7	
4200472170	蛋白质与核酸药物 Protein and nucleic acid Pharmaceutics	2	32					7	
4200283120	组织学 Histology	2	32					7	
4200162120	仿生生物技术 Biomimics Biotechnology	2	32					7	
4200473170	计算机辅助药物设计 Computer aided drug design	2	32					7	
4200266120	药事管理学 Pharmacy Administration	2	32					7	
4200239120	生物技术制药 Biotechnological Pharmaceutics	2	32					7	
4200347140	生物催化技术及应用 B Biological Catalytic Technology and Applications	2	32					7	
4200265120	新药开发原理与方法 Research Principle and Method of New Medicine	2	32					7	
小 计 Subtotal		232.5	4368	976	16	48	64		
修读说明：要求至少选修 17 学分。 Note: Minimum subtotal credits: 17.									
(七) 个性课程 Personalized Elective Courses									
4200458170	天然产物提取分离与鉴定技术 C Extraction, Preparation and Identification Technology Natural Products	2	32					5	

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议修读学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4200459170	天然产物提取分离与鉴定技术实验 Extraction, Preparation and Identification Technology Natural Products Exp.	0.5	16	16				5	
4200460170	重大疾病与健康前沿 Frontiers of Dieases and Health	2	32					6	
4200176120	生物医学工程与技术 Biomedical Engineering and Technology	2	32					7	
小 计 Subtotal		6.5	112	16	0	0	0		

修读说明：要求至少选修 6 学分的个性课程,其中学生需要修读以上课程至少 2 学分，余下学分可跨专业自主选择修读全校其他专业的课程。

NOTE: Minimum subtotal credits: 6. Specifically, students need to take the above courses to obtain at least 2 credits and take any courses from the other specialties to obtain the remaining credits.

## 五、 集中性实践教学环节

### V Practice Schedule

课程编号 Course Number	实践环节名称 Practice Courses Name	学分 Crs	周数 Weeks	建议修读学期 Suggested Term
1060002110	军事训练 Military Training	1.5	3	1
4200267120	野外实习 Field Practice in Biology	1	1	2（暑期）
4200240120	生物实验室基本能力培训 Basic Skills Training in Biological Laboratory	1	1	3（分散）
4200474170	生物制药认识实习 Cognition Practice	1	1	3
4200160120	创新能力训练 Innovative Skills Training	1	1	4（暑期）
4200262120	细胞工程综合实验 Cell Engineering Experiments	2	2	5
4200215120	基因工程综合实验 Gene Engineering Experiments	2	2	6
4200475170	生物制药创业能力训练 Business Development Training	1	1	6（暑期）
4200476170	生物制药毕业实习 Graduation Practice	2	2	7
4200477170	毕业设计 Graduation Thesis	9	17	8
小 计 Subtotal		21.5	31	

## 六、其它要求

### VI Recommendations on Course Studies

- 1、《形势与政策》和《心理健康教育》课程为课外必修课程，分别计 2 个和 1 个课外学分。
- 2、学生选修的通识选修课程和从学校发布的个性课程目录中选修的个性课程，要求与本专业培养方案内设置的课程内容不重复。

1.Situation & Policy (2 credits) and Mental Health Education (1 credit) are the required extracurricular courses.

2.The selected General Education Elective Courses and Personalized Elective Courses from the courses program by university must be different from the major undergraduate education plan in content.

学院教学责任人：史 彬  
专业培养方案责任人：谢 浩

# 化学工程与工艺专业（卓越工程师班）

## 2017 版本本科培养方案

### Undergraduate Education Plan for Specialty in Chemical Engineering and Technology(Excellent Engineer Class) (2017)

专业名称	化学工程与工艺	主干学科	化学、化学工程与工艺
Major	Chemical Engineering and Technology	Major	Chemistry, Chemical Engineering and Technology
计划学制	四年	授予学位	工学学士
Duration	4 Years	Degree Granted	Bachelor of Engineering

#### 最低毕业学分规定

#### Graduation Credit Criteria

课程分类 Course Classification 课程性质 Course Nature	通识教育课程 Public Basic Courses	专业教育课程 Specialized Courses	个性课程 Personalized Course	集中性实践教学环节 Practice Courses	课外学分 Study Credit after Class	总学分 Total Credits
必修课 Required Courses	29	72.5	\	26	\	170
选修课 Elective Courses	9	17.5	6	\	10	

#### 一、培养目标与毕业要求

#### I Educational Objectives & Requirement

##### （一）培养目标

本专业致力于培养德、智、体全面发展，适应国家化学工业及其相关领域经济建设需求，具有较好自然科学基础和人文社会科学基础，具备扎实的化工专业基础知识和工程实践能力，具有较强的社会责任感、良好的道德修养和心理素质，具备较强的创新精神、国际视野和管理能力，能够在化工及相关行业从事科学研究与技术开发；从事设计、工程开发和生产管理；从事以化工为专长的经济管理的高级工程技术人才。

本专业期待毕业生五年后能达成下列目标：

- （1）身心健康，具备良好的敬业精神、社会责任感和工程职业道德，关注当代全球问题和社会可持续发展问题，具有质量意识、环境意识和安全意识；
- （2）具有独立从事化工过程设计、化工新产品研发、化工系统优化、化工过程及设备操控等工作的能力，能运用自然科学、化学工程与工艺等基础理论解决工程实践中的基本问题；
- （3）了解化学工程与工艺的发展前沿及趋势，具有化工新产品研发、工艺开发与改造、技术系统集成、生产过程管理的能力，可促进专业可持续发展；
- （4）具有创新精神，具有终身学习的能力，能不断提升就业竞争力；
- （5）具有良好的交流沟通能力、良好的团队意识和合作精神，能在团队中发挥协调和领导能力。

#### Educational Objectives



This program aims at training students who meet the requirements of the rapid growth of national economy and modernization as well as have a strong basis of natural science and humanistic and social science. With comprehensive knowledge and skills of chemical engineering and a strong sense of social responsibility, professional ethics, psychological quality, innovate consciousness, international perspective and management ability, students can become competent senior engineering technicians not only in the aspects of academic research, design, development of novel technology and process, but also in the management works of operation and economic in chemical industry or related fields.

Students of this programs are expected to achieve the following objectives 5 years after graduation:

1. Have a strong sense of social responsibility, professional ethics and good quality of humanities and social sciences. Focus on contemporary global issues and social sustainability issues. Have quality awareness, environmental awareness and safety awareness.
2. Be competent to engage in chemical process design, development of novel chemical product, optimization of chemical process, development, reform and operation of chemical process and equipment production management. The basic problems of engineering practice can be solved by using basic theory of natural science、chemical engineering and technology.
3. Knowing the frontier and trend of chemical engineering and technology, be competitive in on the aspects of research and development of novel chemical product, development and reform of process, integration of technical system and management of production process and promotion of the sustainability of chemical engineering and technology.
4. Possess innovative spirit and life-long learning ability and constantly improve our employment competitiveness.
5. Promote team coordination and leadership with capacity in communication, negotiation, organization and executive.

## (二) 毕业要求

- (1) **工程知识**: 具有从事化学工程与工艺专业相关工作所需要的数学、自然科学、工程基础和专业 知识, 能够将其用于解决化学工程与工艺相关研发、设计、生产和应用过程中的复杂工程问题;
- (2) **问题分析**: 能够应用数学、自然科学和工程科学的基本原理, 识别、表达, 并通过文献研究、分析化学工程与工艺相关领域的工程问题, 以获得有效结论;
- (3) **设计/开发解决方案**: 能够设计针对化学工程与工艺领域复杂工程问题的解决方案, 设计满足特定需求的系统、单元(部件)或工艺流程, 并能够在设计、开发环节中体现创新意识, 考虑社会、健康、安全、法律、文化以及环境等因素;
- (4) **研究**: 能够基于化学工程与工艺基础理论并采用科学方法对复杂工程问题进行研究, 包括设计实验、分析与解释数据、并通过信息综合得到合理有效的结论;
- (5) **使用现代工具**: 能够针对化学工程与工艺领域复杂工程问题, 开发、选择与使用恰当的技术、资源、现代工程工具和信息技术工具, 包括对复杂工程问题的预测与模拟, 并能够理解其局限性;
- (6) **工程与社会**: 能够基于专业基础理论和工程相关背景知识进行合理分析, 评价专业工程实践和复杂工程问题解决方案对社会、健康、安全、法律以及文化的影响, 并理解应承担的责任;
- (7) **环境和可持续发展**: 能够理解和评价针对复杂工程问题的工程实践对环境、社会可持续发展的影响;
- (8) **职业规范**: 具有人文社会科学素养、社会责任感, 能够在工程实践中理解并遵守工程职业道德和规范, 履行责任;
- (9) **个人和团队**: 具有一定的组织管理能力、表达能力、人际交往能力和团队合作能力, 能够在多学科背景下的团队中承担个体、团队成员以及负责人的角色;

- (10) **沟通**: 能够就化学工程与工艺相关领域复杂工程问题与业界同行及社会公众进行有效沟通和交流, 包括撰写报告和设计文稿、陈述发言、清晰表达或回应指令。并具备一定的国际视野, 能够在跨文化背景下进行沟通和交流;
- (11) **项目管理**: 理解并掌握工程管理原理与经济决策方法, 并能在多学科环境中应用;
- (12) **终身学习**: 具有自主学习和终身学习的意识, 有不断学习和适应发展的能力。

### **Graduation Requirement**

1. **Engineering knowledge**: Acquire mathematics, natural science, engineering principles and professional knowledge required for the work in the field of chemical engineering and technology, and be able to use them to solve complex engineering issues in research and development, design, production and application in chemical engineering and technology.
2. **Problem analysis**: Apply the fundamental principle of mathematics, natural science, engineering science and professional knowledge to identify, express and analyze the complex engineering problems related to chemical engineering and technology through literature review, and to finally reach effective conclusions.
3. **Design/development solution**: Be capable to provide solutions to complex engineering problems in the field of chemical engineering and technology, design operation system, unit (part) or process which meets the specialized requirement as well as to reflect innovation consciousness in the design and development processes, taking factors including society, health, safety, laws, culture, and environment into considerations.
4. **Research**: Be able to comprehensively apply fundamental theories and technical skills of chemical engineering and technology to investigate complex engineering problems in professional-related area, including experimental designs, analysis and interpretation of data, and acquiring reasonable and effective conclusion via discussing results.
5. **Usage of modern tools**: Be able to develop, select and use appropriate technology, resource, modern engineering development and information technology tools to solve complex engineering problems in the field of chemical engineering and technology. Also be capable to predict and simulate the problems as well as understand the limitations of the tools.
6. **Engineering and society**: Be able to analyze and estimate the influences of engineering practice and complex engineering problem solutions properly in the field of chemical engineering and technology on society, health, safety, laws, culture and environment, and understand the responsibilities that should be taken for.
7. **Environment and sustainable development**: Establish engineering thoughts of sustainable development, understand and estimate the influences of engineering practice of complex engineering problems in the field of chemical engineering and technology on sustainable development of environment and society.
8. **Professional standards**: Have quality of humanities and social sciences, social responsibilities, and moral sentiments to understand and comply with engineering professional ethics and norms, and to fulfill the responsibilities.
9. **Individual and team**: Acquire capabilities of organization management, expression, human communication and team work, and be able to play a role as an individual, team member or manager in a team with a multi-discipline background.
10. **Communication**: Be able to negotiate and exchange with industry peers and the public on complex engineering problems in the field of chemical engineering and technology, including writing, designing and presenting reports clearly, and have certain international perspectives to communicate under the cross-cultural background.
11. **Project management**: Understand and grasp engineering management principles and economic decision

making methods, and be able to apply them in multi-discipline situations.

12. **Life-long learning:** Acquire consciousness of self-learning and life-long learning, and capabilities of continuous learning and adaptive development.

附：培养目标实现矩阵

	培养目标 1	培养目标 2	培养目标 3	培养目标 4	培养目标 5
毕业要求 1	✓				
毕业要求 2			✓		
毕业要求 3			✓		
毕业要求 4	✓			✓	
毕业要求 5		✓			
毕业要求 6					✓
毕业要求 7	✓			✓	✓
毕业要求 8	✓				✓
毕业要求 9		✓			✓
毕业要求 10		✓			✓

## 二、专业核心课程与专业特色课程

### II Core Courses and Characteristic Courses

#### (一) 专业核心课程:

物理化学、化学工艺学、化工原理、化工热力学、化学反应工程、化工过程分析与综合、化工设计基础

Core Courses: Physical Chemistry, Chemical Technology, Principle of Chemical Engineering, Thermal Dynamics of Chemical Engineering, Reaction Engineering of Chemistry, Analysis and Synthesis of Chemical Processes, Basic Chemical Process Design

#### (二) 专业特色课程:

企业自主选修课程、典型化学品生产工艺、企业能源管理、工程项目管理 B、化工计算与软件应用

Characteristic Courses: Self-elective Courses in Enterprises, Representative Chemical Production Processes, Plant Energy Management, Engineering Project Management B, Chemical Engineering Calculation and Software Application

附：毕业要求实现矩阵:

专业 核心 课程	专业 特色 课程	课程名称	化学工程与工艺专业（卓越工程师班）毕业要求									
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		中国近现代史纲要								✓		
		思想道德修养与法律基础								✓		
		毛泽东思想和中国特色社会主义理论体系概论								✓		
		马克思主义基本原理								✓		
		军事理论								✓		

专业 核心 课程	专业 特色 课程	课程名称	化学工程与工艺专业（卓越工程师班）毕业要求									
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		人文社科类课程								√		
		创新创业类课程						√				
		经济管理类课程							√			
		心理健康教育								√		
		体育								√		
		大学英语										√
		专业导论				√	√					
		高等数学	√									
		线性代数	√									
		大学物理	√									
		物理实验	√									
		电工学	√									
		无机化学	√									
		无机化学实验	√									
		分析化学	√									
		分析化学实验	√									
		有机化学	√									
		有机化学实验	√									
√		物理化学	√									
		物理化学实验	√									
√	√	化工原理	√	√	√							
		化工原理实验	√	√	√							
		化工制图与 AutoCAD	√	√								
		化工制图与 AutoCAD 综合实验	√	√								
		创新创业导论				√	√	√		√		
√		化工热力学	√	√	√							
√	√	化学反应工程	√	√	√							

专业 核心 课程	专业 特色 课程	课程名称	化学工程与工艺专业（卓越工程师班）毕业要求									
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		化工安全与环保				√	√					
		化工设备机械基础	√	√	√							
		化工分离工程	√	√	√							
√	√	化工过程分析与综合	√	√	√							
√		化学工艺学	√	√	√		√					
√	√	化工设计基础	√	√	√	√						
		概率论与数理统计	√									
		化工仪表及自动化		√								
		化工专业英语										√
		C 语言程序基础		√							√	
		计算机基础与 C 语言设计综合实验		√							√	
		VBA 程序设计基础		√							√	
		计算机基础与 VBA 程序设计综合实验		√							√	
		高分子化学			√							
		生物工程概论					√		√			
		反应器设计原理				√		√				
		化工传递过程原理	√		√							
		现代仪器分析	√		√							
	√	企业自主选修课程			√		√					
	√	工程项目管理							√			
	√	典型化学品生产工艺					√					
	√	企业能源管理				√			√			
		化工技术经济分析				√			√			
		金属腐蚀理论与防护技术	√		√							
	√	化工计算与软件应用		√	√							
		工业催化原理及应用	√		√							
		化工科技文献检索					√				√	√

专业 核心 课程	专业 特色 课程	课程名称	化学工程与工艺专业（卓越工程师班）毕业要求									
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		军事训练								√		
		机械制造工程实训		√	√							
		电工电子实习		√	√							
		专业实习				√	√			√		
		化工原理课程设计		√	√	√						
		工艺流程仿真训练		√	√							
		工程设计训练			√	√			√			
		化工设备机械设计		√	√							
		创新创业设计训练			√	√						
		专业综合实验	√		√							
		岗位实习				√	√			√		
		毕业设计（论文）			√	√	√	√	√		√	√

### III Teaching Process Map



#### 四、 理论教学建议进程表

#### IV Theory Course Schedule

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
(一) 通识教育必修课程									
General Education Required Courses									
4220002110	中国近现代史纲要 Outline of Contemporary and Modern Chinese History	2	32					1	
4220001110	思想道德修养与法律基础 Morals, Ethics and Fundamentals of Law	3	48			8		2	
4220003110	毛泽东思想和中国特色社会主义理论 体系概论 Introduction to Mao Zedong Thought and Socialism with Chinese Characteristics	4	96			32		3	
4220005110	马克思主义基本原理 Marxism Philosophy	3	48			8		4	
1060003130	军事理论 Military Theory	1	32				16	1	
4210001170	体育 1 Physical Education I	1	26					1	
4210002170	体育 2 Physical Education II	1	34					2	
4210003170	体育 3 Physical Education III	1	34					3	
4210004170	体育 4 Physical Education IV	1	34					4	
4030002180	大学英语 1 College English I	3	60				12	1	
4030003180	大学英语 2 College English II	2	44				12	2	大学英语 1
4030004180	大学英语 3 College English III	2	44				12	3	大学英语 2
4030004180	大学英语 4 College English IV	2	44				12	4	大学英语 3
程序语言组（任选一组程序语言，3 学分）									
C 程序设计									
4120335170	C 程序设计基础 Foundation of C Language Design	2	32					2	
4120336170	计算机基础与 C 程序设计综合实验 Comprehensive Experiments of Foundation of Computer and C Language Programming	1	32	32				2	
VBA 程序设计									



课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4120341170	VBA 程序设计基础 Foundation of VBA Language Design	2	32					2	
4120342170	计算机基础与 VBA 程序设计综合实验 Comprehensive Experiments of Foundation of Computer and VBA Language Programming	1	32	32				2	
小 计 Subtotal		29	640	32	0	48	64		
(二) 通识教育选修课程 General Education Elective Courses									
创新创业类 Innovation and Entrepreneurship Courses		要求至少取得 9 个学分，且必须选修艺术体育类课程中的艺术类 相关课程并取得至少 2 个学分，在创新创业类课程和经济管理类 课程中分别至少选修一门课程。  Students are required to obtain at least 9 credits, which must cotain art courses of 2 credits from the category of Art and Physical Education Courses,at least one course from the category of Innovation and Entrepreneurship Courses and the category of Economy and Management Courses respectively.							
人文社科类 Arts and Social Science Courses									
经济管理类 Economy and Management Courses									
科学技术类 Science and Technology Courses									
艺术体育类 Art and Physical Education Courses									
(三) 专业教育必修课程 Basic Disciplinary RequiredCourses									
4200067110	专业导论 Introduction to Chemical Engineering & Technology	1	16					1	
4050063110	高等数学 A 上 Advanced Mathematics I	5	80					1	
4050064110	高等数学 A 下 Advanced Mathematics II	5	80					2	高等数学上
4050229110	线性代数 Linear Algebra	2.5	40					2	
4050463130	大学物理 B Physics	5	80					3	
4050224110	物理实验 B Physics Lab.	1	32	32				4	大学物理
4100008110	电工学 Electrical Engineering	3	48	8				3	
4200364170	无机化学 C1 Inorganic Chemistry I	2.5	40					1	
4200359170	无机化学实验 C Inorganic Chemistry Experiment	0.5	16	16				1	无机化学 1
4200365170	无机化学 C2 Inorganic Chemistry II	1.5	24					2	
4200199120	分析化学 B Analytical Chemistry B	2	32					2	

课程编号 Course Number	课 程 名 称 Course Title	学分 CrS	学时分配 <b>Including</b>					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4200377170	分析化学实验 B Experiments of Analytical Chemistry	1.5	48	48				2	分析化学
4200385170	有机化学 B1 Organic Chemistry I	2.5	40					3	
4200387170	有机化学实验 B1 Organic Chemistry Experiment I	1	32	32				3	有机化学 1
4200386170	有机化学 B2 Organic Chemistry II	2.5	40					4	有机化学 1
4200388170	有机化学实验 B2 Organic Chemistry Experiment II	0.5	16	16				4	有机化学 2
4200389170	物理化学 B1 Physical Chemistry I	2.5	40					3	
4200390170	物理化学 B2 Physical Chemistry II	2.5	40					4	物理化学 1
4200367170	物理化学实验 B Physical Chemistry Experiment	1	32	32				4	物理化学
4200392170	化工制图与 Auto CAD Chemical Cartography and Auto CAD	2.5	40					4	
4200504170	化工制图与 Auto CAD 综合实验 Experiments of Chemical Cartography and Auto CAD	0.5	16		16			4	化工制图与 Auto CAD
4200021110	化工原理 1 Principles of Chemical Engineering I	3	48					4	
4200393170	化工原理实验 1 Experiments of Chemical Engineering Principle I	1	32	32				4	化工原理 1
4200022110	化工原理 2 Principles of Chemical Engineering II	3	48					5	化工原理 1
4200394170	化工原理实验 2 Experiments of Chemical Engineering Principle II	0.5	16	16				5	化工原理 2
4200395170	化工创新创业导论 Introduction to Innovation and Entrepreneurship	1	16					5	
4200396170	化工热力学 A Chemical Engineering Thermodynamics	3	48					5	
4200025110	化学反应工程 A Chemical Reaction Engineering	3	48					5	
4200397170	化工安全与环保 Safety Engineering & Environmental Protection in Chemical Engineering	2	32					5	

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 <b>Including</b>					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4200350150	化工设备机械基础 Mechanical Base for Chemical Equipment	2	32					6	
4200113120	化工分离工程 B Chemical Separation Engineering	2	32					6	
4200112110	化工过程分析与综合 B Analysis and Synthesis for Process Engineering	2	32					6	
4200398170	化学工艺学 C Chemical Technology	2	32					6	化工原理
4200399170	化工设计基础 Chemical Process Design	2	32					7	化工制图与 Auto CAD
小 计 Subtotal		72.5	1280	232	16	0	0		
(四) 专业教育选修课程 Specialized Elective Courses									
限选课 (选 6.5 学分)									
4050598170	概率论与数理统计 C Probability and Mathematical Statistics	2.5	40					4	高等数学、线性代数
4200043110	现代仪器分析 Modern Instrumental Analysis	2	32					5	
4200024110	化工专业英语 Specialized English of Chemical Engineering and Technology	2	32					6	
专业拓展类 (至少选 4 学分)									
4200007110	高分子化学 C Polymer Chemistry	2	32					5	有机化学
4200020110	化工仪表及自动化 Chemical Instruments and Automation	2	32					5	
4200004110	反应器设计原理 B Principle of the Reactor Design	2	32					6	
4200011110	化工传递过程原理 B Theory of Transport Process in Chemical Engineering	2	32					6	
4200034110	生物工程概论 Basic Bioengineering	2	32					7	
企业课程类 (至少选 4 学分)									
4200093110	企业自主选修课程 Self-elective Courses in Enterprises	2	32					6(企业)	
4080043110	工程项目管理 B Engineering Project Management	2	32					6(企业)	

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 <b>Including</b>					建议修读学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Operation	实践 Prac-tice	课外 Extra-cur		
4200091110	典型化学品生产工艺 Representative Chemical Production Processes	2	32					7(企业)	
4200032110	企业能源管理 Plant Energy Management	2	32					7(企业)	
专业应用类（至少选 3 学分）									
4200413170	化工技术经济分析 Analysis of Chemical Technology Economics	2	32					5	
4200400170	金属腐蚀理论与防护技术 B Principles of Metallic Corrosion and protection Technology	2	32					5	
4200401170	化工计算与软件应用 B Chemical Engineering Calculation and Software Application	2	32					6	
4200402170	工业催化原理及应用 B Catalysis in Industrial Processes and Application of Catalyst	2	32					7	
4200015110	化工科技文献检索 Literature Searching for Chemical Engineering	1	16					7	
小 计 Subtotal		213.5	3864	560	32	48	64		
修读说明：要求至少选修 17.5 学分。 NOTE: Minimum subtotal credits:17.5.									
(五) 个性课程 Personalized Elective Courses									
4200405170	化学工程前沿 Frontier of Chemical Engineering	1	16					4	
4200406170	实验设计与数据处理方法 Methodology of Experiment Design and Data Processing	2	32					5	
4200407170	固体催化剂研究方法 Research Methodology of Solid Catalyst	2	32					6	
小 计 Subtotal		5	80	0	0	0	0		
修读说明：学生从以上个性课程中至少选修 2 门，学校发布的其它个性课程目录中选课，要求至少选修 6 学分。 NOTE: Students should select two courses from above and the other personalized courses in catalog, and are required to obtain at least 6 credits.									

## 五、集中性实践教学环节

### V Practice Schedule

课程编号 Course Number	实践环节名称 Practice Courses Name	学分 Crs	周数 Weeks	建议修读学期 Suggested Term
1060002110	军事训练 Military Training	1.5	3	1

课程编号 Course Number	实践环节名称 Practice Courses Name	学分 Crs	周数 Weeks	建议修读学期 Suggested Term
4080152110	机械制造工程实训 D Training on Mechanical Manufacturing Engineering	1	1	4
4100069110	电工电子实习 B Practice of Electrical Engineering	1	1	4
4200414170	化工专业实习 Simulated Practice of Principles of Chemical Industry	1.5	3	4（暑期）（企业）
4200087110	化工原理课程设计 B Course Design of Principles of Chemical Industry	2	2	5
4200415170	工艺流程仿真训练 Simulated Practice of Technological Process	1	2	6（企业）
4200416170	工程设计训练 Engineering Design Training	1.5	3	6（企业）
4200411170	化工设备机械设计 Mechanical Design of Chemical Equipment	2	2	7
4200410170	化工创新创业设计训练 Innovation and Entrepreneurship Design Training	1	1	7（企业）
4200417170	化工专业综合实验 Comprehensive Experiments	2	2	7
4200418170	岗位实习 Job Training	2.5	5	7（企业）
4200412170	毕业设计（论文） Graduation Design (Thesis)	9	17	8（企业）
小 计 Subtotal		26	42	

## 六、其它要求

### VI Recommendations on Course Studies

- 1、《形势与政策》和《心理健康教育》课程为课外必修课程，分别计 2 个和 1 个课外学分。
  - 2、学生选修的通识选修课程和从学校发布的个性课程目录中选修的个性课程，要求与本专业培养方案内设置的课程内容不重复。
- 1.Situation & Policy (2 credits) and Mental Health Education (1 credit) are the required extracurricular courses.
- 2.The selected General Education Elective Courses and Personalized Elective Courses from the courses program by university must be different from the major undergraduate education plan in content.

学院教学责任人：史 彬  
专业培养方案责任人：刘晓芳

# 制药工程专业（卓越工程师班）2017 版本本科培养方案

## Undergraduate Education Plan for Specialty in Pharmaceutical Engineering(Excellent Engineer Class)(2017)

专业名称	制药工程	主干学科	化学, 药学, 化学工程与技术
Major	Pharmaceutical Engineering	Major Disciplines	Chemistry, Pharmacy, Chemical Engineering and Technology
计划学制	四年	授予学位	工学学士
Duration	4 Years	Degree Granted	Bachelor of Engineering

### 最低毕业学分规定

#### Graduation Credit Criteria

课程性质 Course Nature	课程分类 Course Classification	通识教育课程 Public Basic Courses	专业教育课程 Specialized Courses	个性课程 Personalized Course	集中性实践教学环节 Practice Courses	课外学分 Study Credit after Class	总学分 Total Credits
必修课 Required Courses		29	72.5	\	26.5	\	170
选修课 Elective Courses		9	17	6	\	10	

### 一、培养目标与毕业要求

#### I Educational Objectives & Requirement

##### (一) 培养目标

培养能够适应国家经济科技、社会发展对高素质工程技术人才的要求，满足制药工程领域，特别是医药、农药、精细化工等行业的生产实践需求，具有扎实的专业基础知识，较强的工程能力和创新意识，良好的团队合作精神，能从事制药工程领域内的生产管理、技术开发、工艺和设备设计、技术改造、经营管理等方面工作的应用型和设计型工程师。

#### I Educational Objectives

The aim is to train application-oriented engineers who can adapt to the requirements of high-quality engineering and technical personnel due to the development of the national economy, science technology, and society, to satisfy the production practice demands in pharmaceutical engineering, especially in the medicine, pesticides, fine chemical engineering and other industries and have solid professional knowledge, strong engineering ability and innovative consciousness, and good teamwork spirit, and can engage in production management, technology development, process and equipment design, technological innovation and operating management, etc. in the field of pharmaceutical engineering.

本专业期待毕业生五年后能达成下列目标：

- (1) 身心健康，具备良好的敬业精神、社会责任感和工程职业道德，关注社会问题，具有质量意识、环境意识和安全意识；
- (2) 具有深厚的制药工程专业基础知识和理论，具备系统化的专业技能和实践能力，能胜任制药工程行业技术应用、管理、研究或开发工作；
- (3) 具有良好的交流沟通能力、良好的团队意识和合作精神，能在团队中发挥协调和领导能力；

- (4) 具有创新精神，具有终身学习的能力，能不断提升就业竞争力；
- (5) 了解制药工程学科发展的前沿及趋势具备国际化视野，能推动制药工程行业的创新发展。

Graduates in this major are expected to achieve the following objectives in a few years:

1. Having good professionalism, social responsibility and engineering ethics, and paying close attention to the contemporary global problems and social sustainable development, with quality awareness, environmental awareness and safety awareness.
2. Having abundant basic knowledge and theory of Pharmaceutical Engineering, possessing systematic professional skills and practical ability, be competent in engineering application, management, research or development work in the pharmaceutical industry.
3. Having good communication skills and team work spirit, give full play to coordinating and leading role in the team.
4. With innovative spirit and lifelong learning ability, can continuously enhance employment competitiveness.
5. Knowing the frontier and trend of the development of pharmaceutical engineering disciplines, with an international perspective, be able to promote the innovation and development of the pharmaceutical engineering industry.

## (二) 毕业要求

- (1) 工程知识：具有从事制药工程专业相关工作所需要的数学、自然科学、工程基础和专业知识，能够将其用于解决制药工程相关研发、设计、生产和应用过程中的复杂工程问题；
- (2) 问题分析：能够应用数学、自然科学、工程科学和药学的基本原理，结合对科技文献研究的结果，识别、表达、分析制药工程领域的复杂工程问题，以获得有效结论；
- (3) 设计/开发解决方案：能够设计针对制药工程专业领域复杂工程问题的解决方案，设计满足特定需求的药物、生产装备及工艺流程，并能够在设计、开发环节中体现创新意识，考虑社会、健康、安全、法律、文化以及环境等因素；
- (4) 研究：能够基于制药工程基础理论并采用科学方法对复杂工程问题进行研究，包括设计实验、分析与解释数据、并通过信息综合得到合理有效的结论；
- (5) 使用现代工具：能够针对制药工程领域复杂工程问题，开发、选择与使用恰当的技术、资源、现代工程工具和信息技术工具，包括对复杂工程问题的预测与模拟，并能够理解其局限性；
- (6) 工程与社会：能够基于专业基础理论和工程相关背景知识进行合理分析，评价专业工程实践和复杂工程问题解决方案对社会、健康、安全、法律以及文化的影响，并理解应承担的责任；
- (7) 环境和可持续发展：能够理解和评价针对复杂工程问题的工程实践对环境、社会可持续发展的影响；
- (8) 职业规范：具有人文社会科学素养、社会责任感，能够在工程实践中理解并遵守工程职业道德和规范，履行责任；
- (9) 个人和团队：具有一定的组织管理能力、表达能力、人际交往能力和团队合作能力，能够在多学科背景下的团队中承担个体、团队成员以及负责人的角色；
- (10) 沟通：能够就制药工程相关领域复杂工程问题与业界同行及社会公众进行有效沟通和交流，包括撰写报告和设计文稿、陈述发言、清晰表达或回应指令。并具备一定的国际视野，能够在跨文化背景下进行沟通和交流；
- (11) 项目管理：理解并掌握工程管理原理与经济决策方法，并能在多学科环境中应用；
- (12) 终身学习：具有自主学习和终身学习的意识，有不断学习和适应发展的能力。

## II Graduation Requirement

1. Engineering knowledge: Having basic and professional knowledge of mathematics, science and engineering, with the ability to apply the knowledge to solve complex engineering issues in the fields of pharmaceutical engineering.
2. Problem analysis: Grasping the basic principles and methods of mathematics, science and professional foundations; combining the results of scientific literature research, have the ability to identify, interpret and analyze complex engineering issues in the related fields of pharmaceutical engineering to obtain effective conclusions.
3. Design / development solutions: An ability to provide solutions for complex engineering problems in the field of pharmaceutical engineering, and design drugs, device parameters and process flow to meet desired needs within realistic constraints such as society, health, safety, law, culture, and the environment.
4. Research: Grasping the basic theory of pharmaceutical engineering; an ability to use scientific methods to study complex engineering problems including experiment design, data analysis and interpretation, and get valid conclusion synthetically.
5. Using modern tools: An ability to select and use proper technologies, resources, modern engineering tools, and information technology tools to predict and simulate complex engineering problems in the field of pharmaceutical engineering, and understand the applicability and limitations of the conclusions;
6. Engineering and society: Analyzing and evaluating impacts of solutions to professional practices and complex engineering issues on society, health, safety, law and culture based on professional basic theory and relevant engineering knowledge.
7. Environment and sustainable development: An ability to correctly recognize and evaluate the impact of engineering practices for complex engineering issues on environment and sustainable development of the society.
8. Professional norms: Having humanities sciences literacy and social responsibility, understanding and observing engineering professional ethics and norms in engineering practices.
9. Individuals and team: Having abilities of expression, interpersonal, teamwork, organization and management, and an ability to undertake the roles of individuals, team members and leaders in a multidisciplinary team.
10. Communication: Communicate and exchange ideas effectively with industry peers and the general public on complex engineering issues related to pharmaceutical engineering, including writing reports and design drafts, making presentations, expressing or responding to instructions. Have a certain international perspective to communicate and exchange ideas on cross-cultural background.
11. Project management: Understanding and grasping the principles of engineering management and methods of economic decision, which can be applied to multidisciplinary environment.
12. Life-long learning: Having awareness of self-study and life-long learning, and be able to keep learning and adapt to social development.

附：培养目标实现矩阵

	培养目标 1	培养目标 2	培养目标 3	培养目标 4	培养目标 5
毕业要求 1		√			√
毕业要求 2		√			√
毕业要求 3	√	√			√
毕业要求 4		√			√



	培养目标 1	培养目标 2	培养目标 3	培养目标 4	培养目标 5
毕业要求 5		√		√	√
毕业要求 6	√	√			
毕业要求 7	√				√
毕业要求 8	√	√	√	√	
毕业要求 9		√	√		√
毕业要求 10		√	√		
毕业要求 11		√	√		√
毕业要求 12				√	√

## 二、专业核心课程与专业特色课程

### II Core Courses and Characteristic Courses

#### (一) 专业核心课程:

化工原理、药物化学、药剂学、制药工艺学、制药工程、制药设备与车间设计

##### Core Courses:

The Principle of Chemical Engineering, Medicinal Chemistry, Pharmaceutics, Pharmaceutical Technology, Pharmaceutical Engineering, Pharmaceutical Equipment and Plant Design

#### (二) 专业特色课程:

药品生产质量管理工程、制药分离工程、药理学、天然药物化学、药物分析

##### Characteristic Courses:

Good Manufacturing Engineering, Pharmaceutical Separation Engineering, Pharmacology, Natural Medicinal Chemistry, Medicinal Analysis

附：毕业要求实现矩阵：

专业 核心 课程	专业 特色 课程	课程名称	制药工程专业（卓越工程师班）毕业要求											
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
		思想道德修养与法律基础						√	√	√				
		中国近现代史纲要								√				
		毛泽东思想和中国特色社会 主义理论体系概论								√				
		马克思主义基本原理								√				
		军事理论								√				
		体育									√			√
		大学英语					√					√		√
		C 程序设计基础					√							
		计算机基础与 C 程序设计综 合实验					√							
		VBA 程序设计基础					√							
		计算机基础与 VBA 程序设计 综合实验					√							
		通识选修类课程								√	√	√	√	

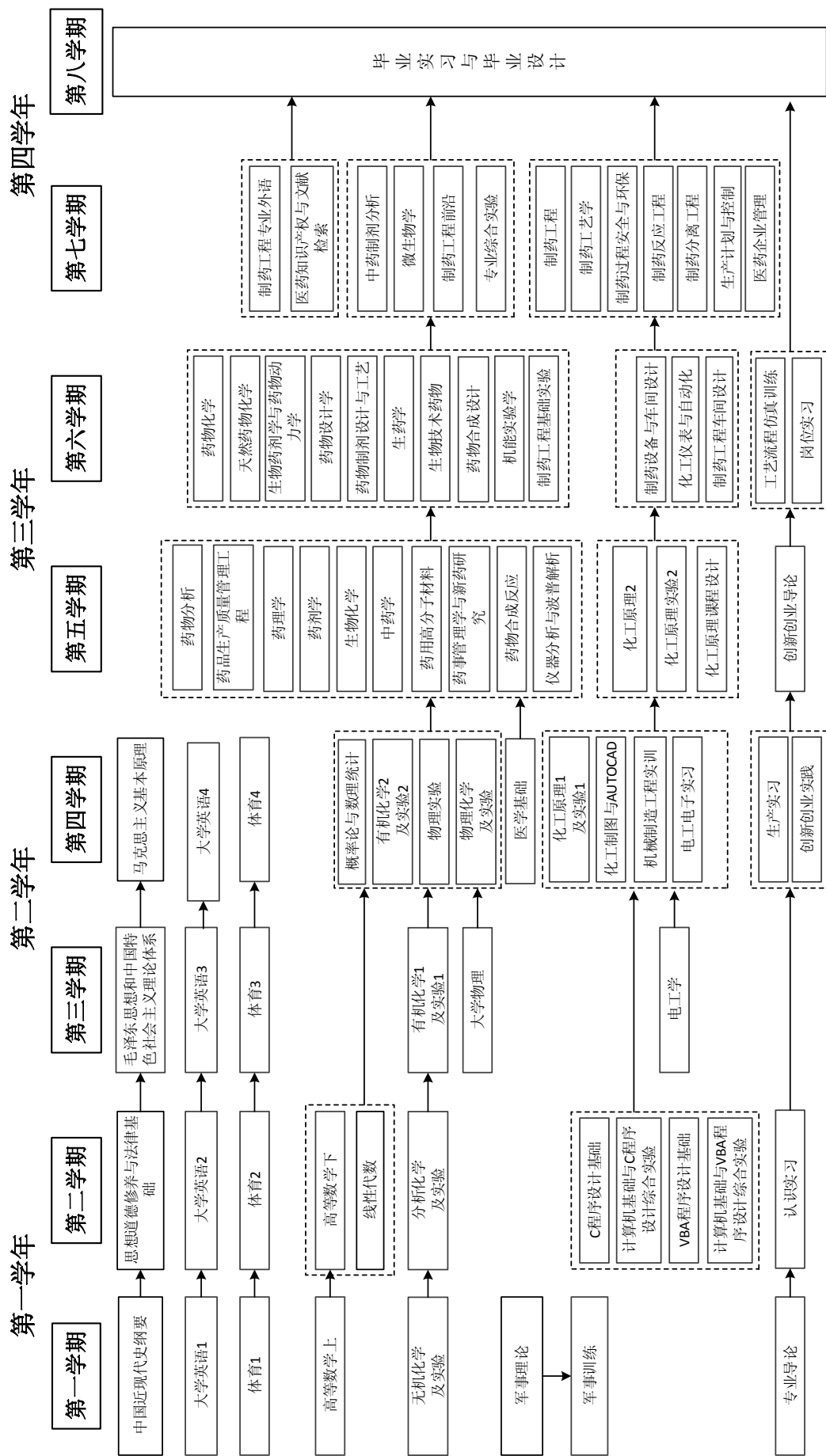
专业 核心 课程	专业 特色 课程	课程名称	制药工程专业（卓越工程师班）毕业要求											
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
		专业导论						√		√				
		高等数学	√	√		√	√							
		线性代数	√	√		√	√							
		概率论与数理统计	√	√		√	√							
		大学物理	√	√		√								
		物理实验	√	√		√								
		电工学	√	√	√	√		√						
		无机化学	√	√		√								
		无机化学实验	√	√		√								
		分析化学	√	√		√								
		分析化学实验	√	√		√								
		有机化学	√	√		√								
		有机化学实验	√	√		√								
		物理化学	√	√		√								
		物理化学实验	√	√		√								
		化工制图 AUTOCAD	√	√	√	√		√						
√		化工原理	√	√	√	√		√						
		化工原理实验	√	√	√	√		√						
		创新创业导论			√					√	√	√	√	
	√	药理学	√	√		√								
√		药剂学	√	√		√								
	√	药物分析	√	√		√	√							
√		药物化学	√	√		√								
	√	天然药物化学	√	√		√								
√		制药工程	√	√	√	√								
√		制药工艺学	√	√	√	√								
	√	药品生产质量管理工程						√		√	√		√	
	√	制药分离工程	√	√	√	√								
		制药设备与车间设计			√		√							

专业 核心 课程	专业 特色 课程	课程名称	制药工程专业（卓越工程师班）毕业要求											
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
		中药学	√	√		√								
		药用高分子材料	√	√		√								
		医学基础	√	√		√								
		药事管理学与新药研究			√	√							√	
		药物合成反应	√	√		√								
		生物药剂学与药物动力学	√	√		√								
		药物设计学	√	√		√								
		药物制剂设计与工艺	√	√	√	√								
		生药学	√	√		√								
		生物技术药物	√	√		√								
		化工仪表与自动化	√		√		√							
		生产控制与计划			√								√	
		机能实验学		√	√		√							
		中药制剂分析	√	√		√								
		微生物学	√	√		√								
		制药工程前沿						√	√					√
		制药工程专业外语					√					√		
		医药知识产权与文献检索			√		√	√						√
		制药过程安全与环保			√			√	√					
		医药企业管理		√	√			√		√	√	√	√	
		仪器分析与波谱解析		√		√	√							
		生物化学	√	√		√								
		药物合成设计	√	√	√	√								
		制药反应工程	√	√	√	√								
		军事训练									√			
		认识实习						√		√	√	√		
		机械制造工程实训	√		√							√		
		生产实习	√		√			√		√	√	√	√	
		创新创业实践			√		√			√	√	√	√	√

专业 核心 课程	专业 特色 课程	课程名称	制药工程专业（卓越工程师班）毕业要求											
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
		电工电子实习	√		√							√		
		化工原理课程设计	√		√	√						√		
		工艺流程仿真训练	√		√		√							
		制药工程车间设计	√		√								√	
		岗位实习								√	√	√	√	
		制药工程基础实验	√	√		√					√	√		
		专业综合实验	√	√	√	√					√	√		
		毕业实习与毕业设计（毕业论文）	√	√	√	√	√				√	√		√

### 三、课程教学进程图

#### III Teaching Process Map



#### 四、 理论教学建议进程表

#### IV Theory Course Schedule

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
(一) 通识教育必修课程 General Education Required Courses									
4220001110	思想道德修养与法律基础 Morals, Ethics and Fundamentals of Law	3	48			8		2	
4220002110	中国近现代史纲要 Outline of Contemporary and Modern Chinese History	2	32					1	
4220003110	毛泽东思想和中国特色社会主义理论体系概论 Introduction to Mao Zedong Thought and Socialism with Chinese Characteristics	4	96			32		3	
4220005110	马克思主义基本原理 Marxism Philosophy	3	48			8		4	
1060003130	军事理论 Military Theory	1	32			16		1	
4210001170	体育 1 Physical Education I	1	26					1	
4210002170	体育 2 Physical Education II	1	34					2	
4210003170	体育 3 Physical Education III	1	34					3	
4210004170	体育 4 Physical Education IV	1	34					4	
4030002180	大学英语 1 College English I	3	60				12	1	
4030003180	大学英语 2 College English II	2	44				12	2	大学英语 1
4030004180	大学英语 3 College English III	2	44				12	3	大学英语 2
4030004180	大学英语 4 College English IV	2	44				12	4	大学英语 3
程序设计语言课程组，要求按照语言选修一组，取得 3 学分									
4120335170	C 程序设计基础 Fundamentals of Computer Program Design(C)	2	32					2	
4120336170	计算机基础与 C 程序设计综合实验 Foundations of Computer and C Language Programming Experiments	1	32	32				2	
4120341170	VBA 程序设计基础 Fundamentals of Computer Program Design(VBA language)	2	32					2	

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4120342170	计算机基础与 VBA 程序设计综合实验 Foundations of Computer and VBA Language Programming Experiments	1	32	32				2	
小 计 Subtotal		29	640	32	0	64	48		
(二) 通识教育选修课程 General Education Elective Courses									
创新创业类 Innovation and Entrepreneurship Courses		要求至少取得 9 个学分，且必须选修艺术体育类课程中的艺术类相关课程并取得至少 2 个学分，在创新创业类课程和经济管理类课程中分别至少选修一门课程。 Students are required to abtain at least 9 credits, which must cotain art courses of 2 credits from the category of Art and Physical Education Courses,at least one course from the category of Innovation and Entrepreneurship Courses and the category of Economy and Management Courses respectively.							
人文社科类 Arts and Social Science Courses									
经济管理类 Economy and Management Courses									
科学技术类 Science and Technology Courses									
艺术体育类 Art and Physical Education Courses									
(三) 专业教育必修课程 Basic Disciplinary RequiredCourses									
4200068110	专业导论 Introduction to Materials Physics	1	16					1	
4050063110	高等数学 A 上 Advanced Mathematics I	5	80					1	
4050064110	高等数学 A 下 Advanced Mathematics II	5	80					2	高等数学上
4050229110	线性代数 Linear Algebra	2.5	40					2	
4050463130	大学物理 B Physics II	5	80					3	
4050224110	物理实验 B Physics Lab. II	1	32	32				4	
4100008110	电工学 Electrical Engineering	3	48	8				3	
4200357170	无机化学 B Inorganic Chemistry	3	48					1	
4200359170	无机化学实验 C Inorganic Chemistry Experiment	0.5	16	16				1	
4200303120	分析化学 C Analysis Chemistry	1.5	24					2	
4200376170	分析化学实验 C Experiment of Analysis Chemistry	1	32	32				2	
4200385170	有机化学 B1 Organic Chemistry I	2.5	40					3	
4200386170	有机化学 B2 Organic Chemistry II	2.5	40					4	

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4200387170	有机化学实验 B1 Organic Chemistry Experiment I	1	32	32				3	
4200388170	有机化学实验 B2 Organic Chemistry Experiment II	0.5	16	16				4	
4200256120	物理化学 C Physical Chemistry	4	64					4	
4200382170	物理化学实验 C Physical Chemistry Experiment	0.5	16	16				4	
4200392170	化工制图与 Auto CAD Chemical Cartography and Auto CAD	2.5	40					4	
4200504170	化工制图与 Auto CAD 综合实验 Experiments of Chemical Cartography and Auto CAD	0.5	16		16			4	化工制图与 Auto CAD
4200419170	化工原理 B1 Principles of Chemical Engineering I	3	48					4	
4200393170	化工原理实验 1 Experiments of Chemical Engineering Principle I	1	32	32				4	化工原理 1
4200420170	化工原理 B2 Principles of Chemical Engineering II	2.5	40					5	化工原理 1
4200394170	化工原理实验 2 Experiments of Chemical Engineering Principle II	0.5	16	16				5	化工原理 2
4200423170	制药创新创业导论 Introduction to Innovation and Entrepreneurship	1	16					5	
4200045110	药理学 B Pharmacology	2.5	40					5	
4200128120	药剂学 B Industrial pharmaceutics	2.5	40					5	
4200105110	药物分析 Pharmaceutical Analysis	2.5	40					5	
4200425170	药品生产质量管理工程 B Good Manufacturing Engineering	1.5	24					5(企业)	
4200424170	药物化学 B Medicinal Chemistry	2.5	40					6	
4200040110	天然药物化学 B Medicinal Chemistry of Natural Products	2.5	40					6	
4200131120	制药设备与车间设计 Pharmaceutical Apparatus and Workshop Design	2	32					6	



课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Ope- ration	实践 Prac- tice	课外 Extra- cur		
4200059110	制药工程 B Pharmaceutical Engineering	2	32					7	
4200062110	制药工艺学 A Pharmaceutical Technology	2	32					7	
4200104110	制药分离工程 Pharmaceutical Separation Engineering	2	32					7	
小 计 Subtotal		72.5	1264	200	16	0	0		
(四) 专业教育选修课程 Specialized Elective Courses									
模块一：药学专业限选课									
4050598170	概率论与数理统计 C Probability and Mathematical Statistics	2.5	40					4	
4200057110	仪器分析与波谱解析 B Instrument Analysis and Spectrum Analysis	2	32					5	
4200237120	生物化学 D Biochemistry	2	32					5	
4200426170	药物合成反应 A Drug Synthesis Reaction	2	32					5	
4200063110	制药过程安全与环保 Pharmaceutical Process Safety and Environment Protection	2	32					7 (企业)	
小 计 Subtotal		10.5	168	0	0	0	0		
模块二修读说明：从以上专业限选课中取得 10.5 个学分									
模块二：专业选修课									
4200055110	医学基础 Medicine Basis	2	32					4	
4200064110	中药学 Traditional Chinese Pharmacology	2	32					5	
4200054110	药用高分子材料 Medical Polymer Materials	2	32					5	
4200047110	药事管理学与新药研究 Pharmacy Administration & Drug Research	2	32					5	
4200037110	生物药剂学与药物动力学 Biopharmaceutics and pharmacokinetics	2	32					6	
4200052110	药物设计学 The Principle of Drug Design	2	32					6	
4200108110	药物制剂设计与工艺 Pharmaceutical Design and Technology	2	32					6	
4200038110	生药学 Raw Pharmacognosics	2	32					6	

课程编号 Course Number	课 程 名 称 Course Title	学分 Crs	学时分配 Including					建议 修读 学期 Suggested Term	先修课程 Prerequisite Course
			总学时 Tot hrs.	实验 Exp.	上机 Operation	实践 Practice	课外 Extra-cur		
4200036110	生物技术药物 Biotech Drugs	2	32					6	
4200050110	药物合成设计 A Drug Synthesis Design	2	32					6	
4200168130	化工仪表与自动化 Chemical Instrumentation & Automation	2	32					6 (企业)	
4200288130	生产计划与控制 B Production Planning and Control	2	32					7 (企业)	
4200065110	中药制剂分析 Traditional Chinese Medicine Analysis	2	32					7	
4200042110	微生物学 C Microbiology	2	32					7	
4200060110	制药工程前沿 Pharmaceutical Engineering Frontier	2	32					7	
4200061110	制药工程专业外语 Pharmaceutical Engineering Foreign Languages	2	32					7	
4200103110	医药知识产权与文献检索 Medicinal Knowledge Property and Literature Retrieval	2	32		12			7	
小 计 Subtotal		34	544	0	12	0	0		
修读说明：要求至少选修 17 学分。模块一取得 10.5 学分；模块二取得 6.5 学分。 NOTE: Minimum subtotal credits:17.									
(五) 个性课程 Personalized Elective Courses									
4200427170	机能实验学 Functional Experimentation	2	32					6	
4200289130	医药企业管理 Pharmaceutical Enterprise Management	2	32					7 (企业)	
4200428170	制药反应工程 A Engineering of pharmaceutical chemical reaction	2.5	40					7	
小 计 Subtotal		6.5	104	0	0	0	0		
修读说明：学生需要修读以上课程至少 2 学分，余下学分可自主选择修读学校发布的其它个性课程。要求至少选修 6 学分。 NOTE: Students need to choose the courses above at least 4 credits. For the remaining credits, students can choose from the other personalized courses in catalog, and are required to obtain at least 6 credits.									

## 五、集中性实践教学环节

### V Practice Schedule

课程编号 Course Number	实践环节名称 Practice Courses Name	学分 Crs	周数 Weeks	建议修读学期 Suggested Term
1060002110	军事训练 Military Training	1.5	3	1
4200370170	制药工程专业认识实习 Cognition Practice	2	2	2
4080152110	机械制造工程实训 D Machinery Manufacturing Engineering Practice	1	1	4
4200433170	制药工程专业生产实习 Productive Practice	2	4	4 暑期（企业）
4200430170	制药创新创业实践 Innovation and Entrepreneurship Practice	1	1	4（企业）
4100069110	电工电子实习 B Practice of Electrical Engineering	1	1	4
4200429170	化工原理课程设计 A Chemical Principles of Curriculum Design	1	1	5
4200415170	工艺流程仿真训练 Simulated Practice of Technological Process	1	2	6（企业）
4200434170	制药工程车间设计 Pharmaceutical Engineering Workshop Design	1	2	6（企业）
4200435170	制药工程基础实验 Basic Experiment of Pharmaceutical Engineering	1	2	6
4200436170	制药工程专业岗位实习 Job Training	3.5	7	6 暑期（3 周）+7（4 周）（企业）
4200437170	制药专业综合实验 Specialized Integrated Experiment	1.5	3	7
4200432170	毕业实习与毕业设计（论文） Graduation Practice and Graduation Project (thesis)	9	17	8（企业）
小 计 Subtotal		26.5	46	

## 六、其它要求

### VI Recommendations on Course Studies

- 1、《形势与政策》和《心理健康教育》课程为课外必修课程，分别计 2 个和 1 个课外学分。
  - 2、学生选修的通识选修课程和从学校发布的个性课程目录中选修的个性课程，要求与本专业培养方案内设置的课程内容不重复。
- 1.Situation & Policy (2 credits) and Mental Health Education (1 credit) are the required extracurricular courses.
  - 2.The selected General Education Elective Courses and Personalized Elective Courses from the courses program by university must be different from the major undergraduate education plan in content.

学院教学责任人：史 彬  
专业培养方案责任人：徐海星