



# **Reconstructing Undergraduate Education at USTC**

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# Outline

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**1 USTC's tradition and achievements**

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**2 Goals of curriculum system restructuring**

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**3 A curriculum system that fosters all-round development**

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# 1. USTC's tradition and achievements

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## v History - Beijing

Φ **Founded in Beijing in 1958 as the only university under CAS jurisdiction**

Φ **“A major event in Chinese history of education and science”**

Φ **Unique features**

**1. Programs to meet the needs of national strategy and frontiers of science**

**2. Integration of science & technology, science & education, and CAS research institutes & USTC schools and depts.**

› **Breaking away from the then dominating Soviet format**

› **Top scientists of CAS serving as heads of USTC depts.**

› **Famous scholars teaching undergraduate courses**

**(300 person-days/year)**

**3. Solid wide-ranging basic training for students**



# 1. USTC's tradition and achievements

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## v “Basic courses at USTC”

——Qian Xuesen, People's Daily, 26/5/1959

“USTC aims at training top-level scientists, researchers and engineers for China. Therefore, **its students are given solid research training in basic theories**—physics, chemistry and math, and **basic technologies** such as machine design. These basic courses play an important role in the university's teaching, with basic theoretical courses accounting for 1/3 and basic tech courses for over 10% of the entire course hours. **Thus, USTC offers more studies of fundamental theory than most engineering universities while providing more basic technical training than most schools of sciences ....”**



# 1. USTC's tradition and achievements

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## v History - early period of opening-up and reform

### Φ “Class of Gifted Young”

- | Individually tailored for talents
- | Broad and solid basic training in freshman and sophomore year
- | New and flexible majors: freedom in selecting courses university-wide and hands-on learning in laboratories from the junior year

“Class of Gifted Young”  
carries on fine traditions as  
well as makes innovations

### Φ International exchange and training

- | Teachers are sent to study abroad and incorporate new ideas into teaching on their return
- | Many students pursue advanced studies overseas \ high international prestige



# 1. USTC's tradition and achievements

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## v Achievements

- Φ Widely regarded as “an incubator of top scientists and engineers”
- Φ Deng Xiaoping: “USTC is a good university with a lot of young talents and should receive our support.”
- Φ More than 50,000 have received undergrad education at USTC in over 50 years
  - } 46 of them elected academicians of CAS and CAE
  - } Over 20 are generals and many top tech personnel in the armed forces
  - } 21 members of American Society of Physics, 20 IEEE fellows
  - } Over 600 professors at universities abroad
- Φ USTC style of training widely acknowledged



## 2. Goals of curriculum system restructuring

### v New era, new situation & new needs

#### Φ Strategy of “empowering the nation through science & education and talent

**“... (USTC) has creatively done a good job in teaching and research, in trying to become a world-class research university, and in fostering more and higher quality creative people...”**

——Hu Jintao

**Congrats on USTC’s 50<sup>th</sup> anniversary**

胡锦涛总书记致信祝贺中国科大建校50周年



- 中国科学技术大学是新中国成立后创办的一所新型理工科大学。
- 半个世纪以来，中国科学技术大学依托中国科学院，为党和国家培养了一大批科技人才，取得了一系列具有世界先进水平的原创性科技成果，为推动我国科教事业发展和社会主义现代化建设作出了重要贡献。
- 希望中国科学技术大学进一步增强使命感和责任感，瞄准世界科技前沿，服务国家发展战略，创造性地做好教学和科研工作，努力办成世界一流的研究型大学，培养造就更多更好的创新人才。





## 2. Goals of curriculum system restructuring

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### 1. Pooling resources of entire CAS and integrating strengths of CAS research institutes with USTC depts.

- Φ Over 50-plus years, USTC has continuously promoted and optimized the integration of CAS research institutes and USTC depts.
- Φ New routes, new approaches and new concepts

**USTC has collaborations with close to 100 national-level research institutes, forming powerful partnerships for science and education**





## 2. Goals of curriculum system restructuring

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### 2. Cultivation of high-caliber creative people

- Φ **Effective training to produce world-class scholars of fundamental disciplines**
  - } **National “training program for first-class scholars of fundamental disciplines”**
  - } **CAS “program for cultivation of top scientists and engineers”**
  - } **Class of Gifted Young’s 30 years of experience and accomplishments in teaching and reform**
  - } **Class of Gifted Young’s innovation in multidisciplinary studies**
  
- Φ **“2-stage” training**
  - } **1<sup>st</sup>-2<sup>nd</sup> year (period of basic study)**
    - › **Wide-ranging solid training, with emphasis on mathematics & physics**
  - } **3<sup>rd</sup>-4<sup>th</sup> year ( period of specialized study)**
    - › **Advisors appointed to provide guidance**
    - › **Students encouraged to work with top scholars in/outside of USTC**
    - › **Students given opportunities to work at research labs in/outside of USTC**



## **2. Goals of curriculum system restructuring**

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### **3. Summer school lectures/workshops by first-class scholars from home and abroad**

#### **Φ Summer term offerings**

- } Courses that enhance and broaden students' knowledge**
- } “College student research projects” for first-hand experience**
- } Condensed courses**

**Φ 41 courses in summer term this year with a total of 1781 students**



### 3. A curriculum system that fosters all-round development

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#### v Basic rationale for curriculum restructuring

**We will bring into full play USTC's strengths and CAS resources, establish a system that promotes the growth of talented and creative people, and help students fully tap their potential to become future leaders in various fields of study and world-class scientists.**

- Φ **Emphasis on basis, multidisciplinary studies & sci. frontiers**
- Φ **Optimally-tiered curriculum system**
- Φ **Core bodies of knowledge for different specialties**
- Φ **Curriculum design for smooth progress from specific undergrad majors to corresponding postgrad programs, commensurate with the concept of “extended training”**



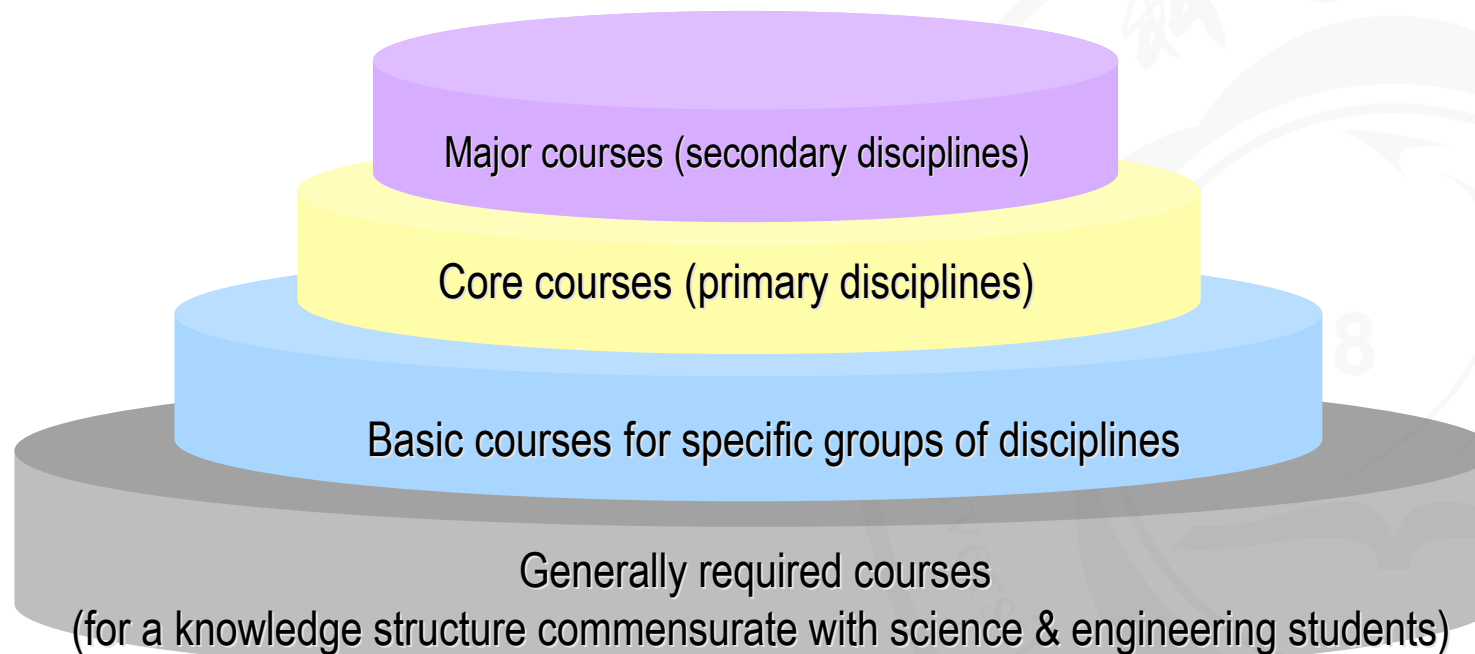
### 3. A curriculum system that fosters all-round development

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- ✓ **Minimum graduation criterion: 160 credit points (~3200 course hours)**

**Fewer required courses and more electives available**

- ✓ **Tiered curriculum system**





### 3. A curriculum system that fosters all-round development

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#### √ Examples of new scheme and curriculum system

Φ Class of chemistry training base

Φ Talent class of materials science

Φ Dept. of pharmaceutical & biomedical engineering

- Fully utilizing CAS resources for the benefit of USTC
- Solid wide-ranging basic training, new & flexible majors
- “2-stage” training
- Individually-tailored teaching to meet specific needs & abilities



### 3. A curriculum system that fosters all-round development

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#### 1. Class of chemistry training base

- Φ **As a national training base for scientists**
- Φ **To meet academic and industrial needs for high-quality personnel of physical sciences (chemistry, physics, and materials science);**
- Φ **To emphasize math & physics, and research-based training;**
- Φ **To emphasize multidisciplinary studies of physics, chemistry, and materials science;**
- Φ **2+2 stage teaching**



### 3. A curriculum system that fosters all-round development

#### Period of basic study

	math (23 credits)	physics (19 credits)	chem (25 credits)	lab (10 credits)
1 (Term 1)	Single variable calculus	Mechanics (type A)	Inorganic chem (1)	Basic experiments of inorganic chem (T1)
1 (Term 2)	Multi-variable calculus Linear algebra	Electromagnetics	Inorganic chem (2) Physical chem (1) Analytic chem	Basic experiments of college physics Basic exp. of analytic chem (T1)
2 (T1)	Complex functions Math equations	Quantum physics Optics	Physical chem (2)	Comprehensive experiments of college physics
2 (T2)	Probability & statistics	theoretical mechanics, Electrodynamics	Organic chem (1) Basic quantum chem	Basic exp. of organic chem (T1) Modern tech exp. of college physics
3 (T1)	experiments of computation methods, solid state physics, organic chem (2), physical chem, etc.			

1. Emphasis on basic math, physics (type A) & chemistry (type A)
2. Integration of physics & chem: quantum mechanics+atomic physics \ q. physics; q. mechanics+structural chem \ q. chem; thermology incorporated into phys. chem



### 3. A curriculum system that fosters all-round development

## Period of specialized study

### Year 2006 distribution of student majors

source of students selected major	Chemical physics dept. (17 students)	Chem dept. (16 students)	Mat'l science dept. (9 students)	Polymer science dept. (9 students)
Chemical physics (17 students)	10	4	0	3
Chem (15)	5	9	0	1
Mat'l science (9)	0	1	8	
Polymer sci. (6)	1	0	0	5
Biochem (4)	1	2	1	

#### 1. Majors embodying multidisciplinary studies

- Chem physics, mat'l chem & biochemistry

#### 2. Students move across depts. & disciplines freely

#### 3. Advisors provide guidance with better customized training





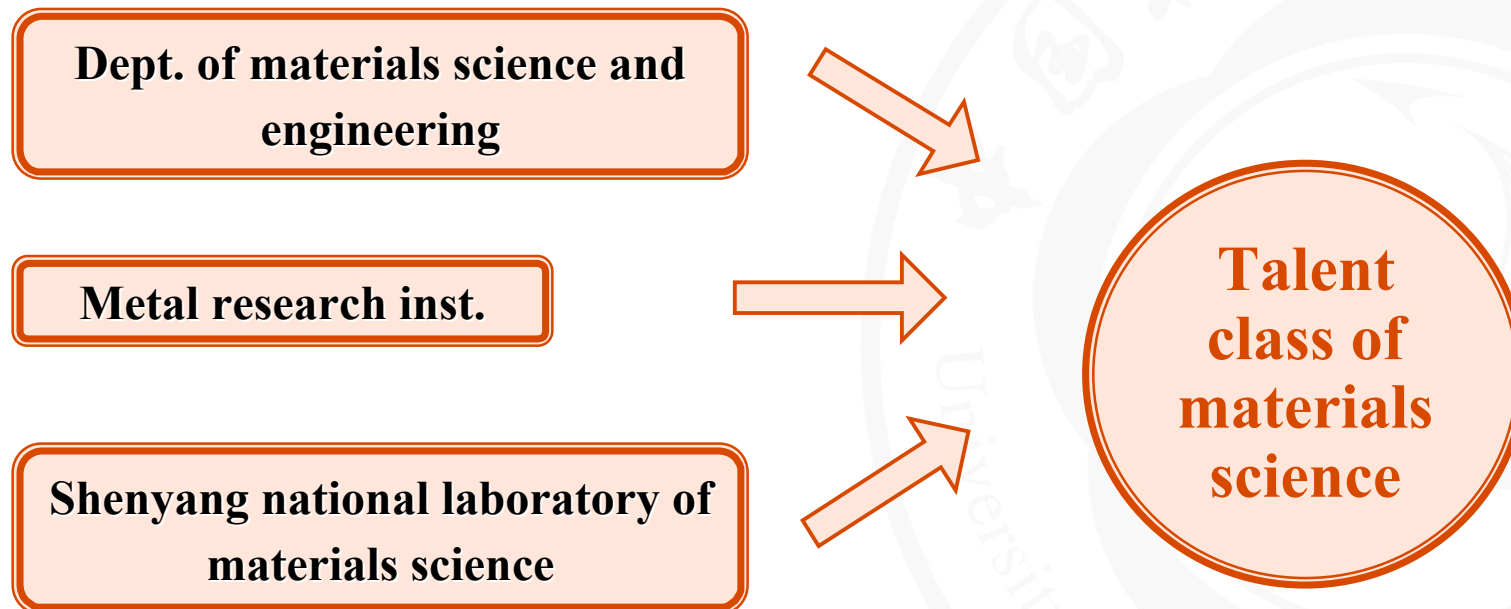
### 3. A curriculum system that fosters all-round development

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## 2. Talent class of materials science

Φ Train top-level personnel to meet national demands:

    | High-temp alloys, advanced carbon materials, fine ceramics,  
    nano materials





### 3. A curriculum system that fosters all-round development

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#### **Φ Form of training**

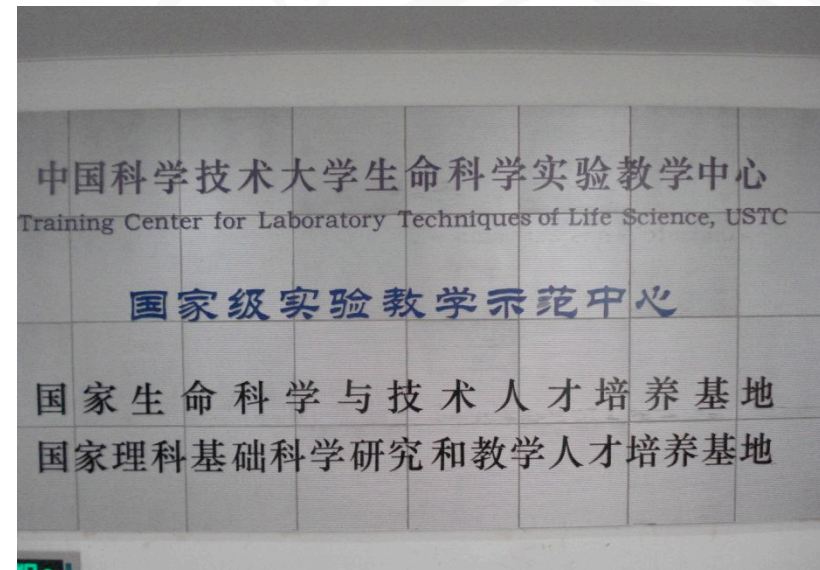
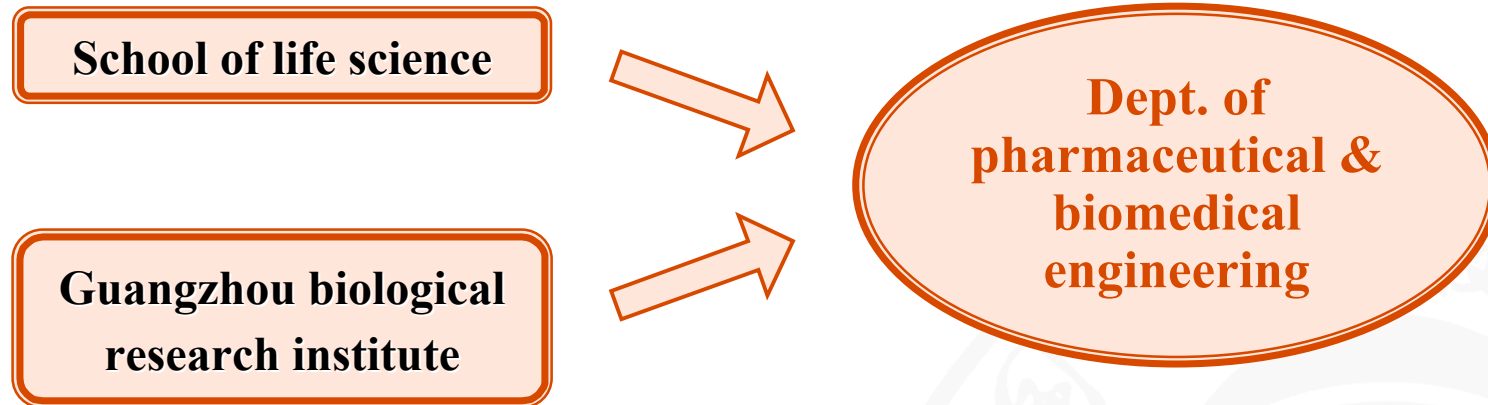
- } USTC provides basic courses**
- } Students take courses in their original depts. in years 1-2**
- } Specific courses in Talent Class start in year 3**
- } Experts of the Metal Inst. give lectures/workshops at USTC**
- } Students attend seminars or do research at Metal Inst. during vacations**
- } Students take specialized courses, do research and prepare graduation thesis at Metal Inst. during year 4**

**This approach is similar to the system employed in France for training high-level engineers, i.e., basic education in years 1-2 (preliminary), and specialized training in engineers college in years 3-5.**



### 3. A curriculum system that fosters all-round development

### 3. Dept. of pharmaceutical & biomedical engineering





### 3. A curriculum system that fosters all-round development

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#### **Φ Form of partnership**

- ] Head of Guangzhou biological research institute serves as chair of Dept. of pharmaceutical & biomedical engineering**
- ] Each partner provided 1.5 million RMB as inception funding for setting up the Dept.**
- ] USTC oversees enrollment for both under- and post-grad programs to train high-level pharmaceutical & biomedical specialists in a phased format**
  - › Students study at USTC in the first three years, with some courses taught at weekends by researchers from Guangzhou biological research institute**
  - › Students take specialized courses and prepare graduation thesis at Guangzhou Inst. in year 4, and may also prepare for more advanced studies in the future**



### 3. A curriculum system that fosters all-round development

#### Curriculum

	math (18 credits)	physics (12 credits)	chemistry (12 credits)	biology (>33 credits)	lab (>19 credits)
I (Term 1)	Single variable calculus		Inorganic & analytic chem	Intro to life science	Biodiversity & experiments I
1 (T2)	Multi-variable calculus Linear algebra	Mechanics, thermology	organic chem		Basic exp. of col. physics Basic exp. of inorganic & analytic chem Biodiversity & exp. II
2 (T1)		Electromagnetics	Physical chem	Ecology biochem (I) Histological processes & techs Neuroanatomy	Comprehensive exp. of college physics Basic exp. organic chem Genetic exp.
2 (T2)	Probability & statistics	Optics, atomic physics	Principles of chemical engineering	microbiology biochem (II) Microbe ferment eng. Plant physiology	Physical chem exp. Microorganism exp. Basic biochem exp. Biological electronic microscopic tech
3 (T1)	Cell biology, physiology, basic neurology, plant chem, bio-pharm eng., bioinformatics, <b>chem biology (Guangzhou Inst.), etc</b>				
3 (T2)	Cellular eng., molecular bio., immunology, str. bio. III (bio spectroscopy), system bio., pharmacology, cognitive neurology, bioelectronics, <b>intro to modern bio tech (Guangzhou Inst.), etc.</b>				
4	Graduation thesis				



# Reflections

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- ✓ **Many universities are needed to train top-level scholars, specialists and professionals for the nation as higher education has been popularized;**
- ✓ **USTC is set to cultivate first-class scientists and engineers and encourages its students to serve their country through science and technology in a down-to-earth, sustainable manner;**
- ✓ **USTC brings into full play the advantages from utilizing resources of entire CAS and integrating research institutes with its relevant depts.;**
- ✓ **We emphasize basic and multidisciplinary training and follow frontier developments closely;**
- ✓ **We have an optimally-tiered curriculum system;**
- ✓ **We strengthen the dissemination of core bodies of knowledge necessary for various fields of specialization; and**
- ✓ **USTC under- and post-grad curriculums are designed in a unified fashion, promoting “extended training”.**



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# Many Thanks!