

**A COMPARISON OF ELECTRICAL ENGINEERING CURRICULA AT
TSINGHUA UNIVERSITY (BEIJING) AND AT THE UNIVERSITY OF
ILLINOIS (URBANA-CHAMPAIGN)**

Shi “Stan” Lan¹, and Gang Lee²

¹ DeVry University, Chicago, Illinois; Email: slan@chi.devry.edu

² Tsinghua University, Beijing, China; Email: ganglee-65@sohu.com

1. INTRODUCTION

For years, the electrical engineering programs at Tsinghua University (Tsinghua), Beijing, China, and at the University of Illinois at Urbana-Champaign (UIUC), Illinois, U.S.A., have been ranked one of the highest among all electrical engineering programs in their respective countries. This research compares the similarities and differences between the undergraduate electrical engineering curricula at both universities in regard to their basic mathematics and science requirements, engineering fundamentals and core requirements, social sciences/humanities components, and electives. The purpose of the research is not intended to imply which electrical engineering program is “stronger” than the other, but to objectively report the descriptive data and findings from the comparisons, in order for engineering educators to have better understanding of engineering programs in different cultural settings.

In recent years the increase in international students entering into U.S. higher education places greater demands for university administrators and admissions because of time-consuming evaluation of foreign transcripts and documents (Gray et al., 1996). Meanwhile, there are more and more American students who demonstrate interest in studying in China. According to a recent report, the American student group is the third largest foreign student group studying in China, following the Korean student group and the Japanese student group (Huang, 2004). The researchers try to use this study as a pilot investigation in order to systematically quantify the similarities and differences between Chinese and American universities in terms of their academic requirements.

2. DEFINITION OF TERMS

2.1 The Definition of Semester Credit Hour

Almost all sources in academia agree that the fundamental definition of a “credit hour” is based on the notion of a single hour of class time every week over a defined instructional period, such

as an academic term, or an academic semester (Ewell, 2004). Kellogg (2004) simply defines that one semester credit hour is “one hour a week for an academic semester.” Ewell (2004) further states that one hour of class is actually fifty clock minutes. Under laboratory settings, one credit hour may require two or more actual hours of lab-work per week. The credit hour measurement used in this study for both UIUC and Tsinghua follows the above definition.

2.2 The Length of Academic Semester

The length of an academic semester at the UIUC is approximately 16 calendar weeks, which includes 15 weeks of classes and 1 week for final examinations. The length of an academic semester at the Tsinghua is 22 calendar weeks, which includes 20 weeks of classes and 2 weeks for final examinations. This difference reflects the difference in the length of academic semester of universities and colleges between two countries in general.

3. FINDINGS

3.1 Similarities and Differences between the Two Curricula in regard to Mathematics and Science Requirements

The similarities and differences between the two electrical engineering curricula in regard to their mathematics and science requirements were analyzed using the curriculum descriptions (University of Illinois at Urbana-Champaign, 2004; Tsinghua University, 2004). A summary of the comparison is illustrated in Table 1.

Table 1 demonstrates that there is a difference between the two curricula in regard to the calculus and geometry requirements. At UIUC, students have the option to choose between the Calculus I/Calculus II sequence, or the Calculus + Geometry I/Calculus + Geometry II sequence. However, at Tsinghua, students are required to take Algebra/Geometry I and Algebra/Geometry II before they enter the calculus sequence. Table 1 shows that both universities require about the same credit hours for physics related topics. Table 1 illustrates that Tsinghua requires approximately 10 more credit hours for its mathematics and science courses than UIUC requires, mainly due to the fact that Tsinghua requires more credits for geometry/calculus sequence and mathematics laboratories.

3.2 Similarities and Differences between the Two Curricula in regard to Engineering Fundamentals and Electrical Engineering Core Courses

The similarities and differences between the two electrical engineering curricula in regard to their engineering fundamentals and electrical engineering core courses were analyzed and summarized in Table 2. Table 2 illustrates that there is a close similarity in terms of the number of required credit hours for engineering fundamental and core courses, although the specific course contents or course titles may be different. Meanwhile, at Tsinghua, students have a wide choice of short courses in the areas of computer fundamentals, Windows programming, microprocessors, communications and network, PLC, and applications software. As far as the technical electives are concerned, students at UIUC must choose 6 credit hours in science, and 9

credit hours engineering work outside the electrical engineering (15 credit hours total). However, students at Tsinghua only have to choose 4 credit hours of non-social science/humanity courses inside or outside the electrical engineering.

Table 1: Comparison of Mathematics and Science Requirements.*

Required Courses At UIUC	Credit Hours	Required Courses at Tsinghua	Credit Hours
Calculus I (or Calculus and Geometry I, (5)); Calculus II (or Calculus and Geometry II, (5 or 6)); Differential Equations (3); and Probability with Engineering Applications (3)	16 or 17	Geometry and Algebra I (4); Geometry and Algebra II (2); Calculus I (3), Calculus II (3); Calculus III (4); Complex Equations/Functions (2); and Probability and Random Number Analysis (3)	21
		Mathematics Laboratories	4
Electricity and Magnetism (4); Fluids and Thermal Physics (2); Waves and Quantum Physics (2); Mechanics (4); and General Chemistry (4)	16	University Physics I & II (8); University Physics Lab I & II (3); Engineering Mechanics (3); Engineering Graphics (2); and Biology or Chemistry (2)	18
<u>Total Credits</u>	<u>32 or 33</u>	<u>Total Credits</u>	<u>43</u>
<u>Total Courses</u>	<u>8</u>	<u>Total Courses</u>	<u>15</u>

* Credit hours are indicated in the parenthesis after the course title.

3.3 Similarities and Differences between the Two Curricula in regard to Social Science and Humanity Courses

The similarities and differences between the two electrical engineering curricula in regard to their social science and humanity course requirements were analyzed and summarized in Table 3. Table 3 shows a close similarity in the areas of course requirements in composition, history, cultures, foreign language, etc. Difference is found in terms of highly specialized political areas. Students at Tsinghua are required to take highly politically-oriented theoretical courses, such as Chairman Mao Thoughts, Marxism Political Economics, Deng Xiaoping Theory, Principle of Marxism Philosophy, etc. Meanwhile, at Tsinghua, students are required to take 31 credit hours in modern social science/humanity courses. However, students at UIUC are required to take 22 credit hours in social sciences/humanities.

3.4 Other Course Requirements

Table 4 summarizes other electives required at UIUC, and the practicum and other courses required at Tsinghua. Table 4 shows a difference between Tsinghua and UIUC in that students at Tsinghua are required to take 16 credit hours of hands-on practicum courses, such as computer skills trainings, metalworking skills trainings, electronics manufacturing training, and production trainings, etc. Traditionally, physical education is highly emphasized at Tsinghua. Students at

Tsinghua are required to take 4 credit hours of physical education courses during the first four semesters. As of the fifth semester, students at Tsinghua are still required to complete physical education courses, although these courses are not-for-credit. However, at UIUC, students have the choice to choose 11 to 12 credit hours as electives or minor concentrations such as bioengineering, technology, management, or research specialties. Another difference is that, at Tsinghua, students are required to take 15 credit hours in preparation of their graduation thesis for their Bachelor's degree.

Table 2: Electrical Engineering fundamentals and Core Courses.*

Required Courses At the UIUC	Credit Hours	Required Courses at Tsinghua	Credit Hours
Required EE Courses: Intro to Electrical and Computer Engineering (4); Analog Signal Processing (4); Intro to Electromagnetic Fields (3); Digital Labs (2); Intro to Computer Engineering (3); Solid State Electronic Devices (3); Senior Design Project (2); and Intro to Computer Science (4)	25	Required EE Courses: Electrical and Electronics Fundamentals (3); Signals and Systems (3); Electromagnetic Fields (3); Digital Electronics (4); Microprocessor (4); Analog Electronics and Lab (4); Computer Language Programming (2); Control Theories (3); Motor Theories and Labs (5); Circuit Principles I & II (6); Circuit Labs (2); and Data Structure and Apps (2)	41
Must choose 9-10 credits from: Digital Signal Processing (3); Power Circuits and Electromechanics (3); Lines, Fields, and Waves (3); Electronics Circuits and Labs (4); Data Structure (3)	9 or 10	Must choose 4 credits from: Computer Fundamentals (2); Windows Programming (2); Single Board uP and Lab (2); Communications and Network (3), Seminar on PLC (1); Digital Signal Processing Lab (2); Distributed Database (2); Applications Software Practice (1)	4
Choose a combination of electrical and computer engineering labs and 200-300 electrical engineering courses	12-13	Choose a combination of 13 credits from the following: Power Systems (3); High Voltage Power Engineering (3); Power Transmission and Control (2); Electronics Measurement (2); simulations and Design (2); Optimization (2); Power Systems Labs (1); etc.	13
Technical Electives: Two course must be science (6); 9 credits must be outside electrical engineering and at least 9 hours of engineering work	15	Any elective (non-social science of humanity) inside or outside the electrical engineering	4
<u>Total</u>	<u>62</u>	<u>Total</u>	<u>62</u>
<u>Total Courses</u>	<u>19</u>	<u>Total Courses</u>	<u>21</u>

* Credit hours are indicated in the parenthesis after the course title.

Table 3: Comparison of Social Science and Humanities Requirements.*

Required Courses At the University of Illinois at Urbana-Champaign	Credit Hours	Required Courses at Tsinghua University, Beijing	Credit Hours
Required Course: Composition I	4	Required Courses: Ethics (2); Chairman Mao Thoughts (3); Marxism Political Economics (3); Deng Xiaoping Theory (3); Principle of Marxism Philosophy (3); and Foreign Language (4)	18
Courses in the areas of Composition II, Western and non-Western cultures, history, language, etc.	18	Six courses in the areas of history, literature, cultures, philosophy, arts, composition, environment, etc.	13
<u>Total Credits</u>	<u>22</u>	<u>Total Credits</u>	<u>31</u>
<u>Total Courses</u>	<u>7</u>	<u>Total Courses</u>	<u>10</u>

* Credit hours are indicated in the parenthesis after the course title.

Table 4: Other Course Requirements.*

Required Courses At the University of Illinois at Urbana-Champaign	Credit Hours	Required Courses at Tsinghua University, Beijing	Credit Hours
Other electives: Course including minor concentrations such as bioengineering, technology, management, or research specialties.	11 or 12	Required Practicum Courses: Military trainings (3); Computer skills trainings (2); Metalworking skills trainings (2); Electronics manufacturing training (3), Production trainings (3); etc.	16
		Physical Education	4
		Graduation Thesis	15

*Credit hours are indicated in the parenthesis after the course title.

4. CONCLUSIONS

This research objectively compares and reports the similarities and differences between the undergraduate electrical engineering curricula at Tsinghua University, Beijing, and the University at Illinois at Urbana-Champaign, in order for engineering educators to have better understanding of engineering programs in different cultural settings.

The study found that, in total, students at UIUC are required to complete 128 semester credit hours to graduate from the electrical engineering program with a Bachelor's degree. At Tsinghua, students are required to complete 171 semester credit hours to graduate with a Bachelor's degree.

The study found that there is a minor difference in the geometry and calculus course sequence. On the other hand, the study found that both universities require about the same credit hours for physics related topics. The study demonstrated that Tsinghua requires more credit hours than UIUC for geometry/calculus sequence and mathematics laboratories. The study found a close similarity in terms of the number of required credit hours for electrical engineering fundamental and core courses. In the social sciences/humanities, the study found a similarity in the areas of course requirements in composition, history, cultures, foreign language, etc. Difference is found in terms of highly specialized political areas.

Finally, the study found that there is a difference between Tsinghua and UIUC in that students at Tsinghua are required to take hands-on practicum courses and the physical education courses. However, at UIUC, students have the choice to choose other electives or minor concentrations. Students at Tsinghua are required to take 15 credit hours in preparation of graduation thesis for their Bachelor's degree.

The researchers of this study believe that this pilot study will build the groundwork for a much more in-depth comparative research on engineering programs in general between the United States and China. The following research will include detailed comparisons of curriculum goals/objectives, admissions requirements, accreditation history, technology used in learning and instruction, faculty credentials, graduation rates, post graduate career/academic path, and the graduates' job-related assessment data.

REFERENCES

- Ewell, P. (2004). *Some Notes on the Credit Hours*. National Center for Higher Education Management Systems (NCHEMS). Retrieved December 17, 2004, from <http://www.pewundergradforum.org/Credit%20Hour%20Notes.html>
- Gray, M.J., Rolph, E., & Melamid, E. (1996). *Immigration and higher education: Institutional responses to changing demographics*. Santa Monica, CA: RAND.
- Huang, H. L. (2004, November 25). Chicago conference on foreign students studying in China. World Journal Daily News, p. B1.
- Kellogg, M. (2004). WordReference.com Dictionary. Retrieved December 17, 2004, from <http://www.wordreference.com/definition/credit+hour>
- Tsinghua University. (2004). *Bachelor's Degree Curriculum in Electrical Engineering and Automation*. Department of Electrical Engineering and Applied Electronic Technology. Beijing, China: Tsinghua University.
- University of Illinois at Urbana-Champaign. (2004). *Curriculum in Electrical Engineering*. Department of Electrical and Computer Engineering. Urbana, IL: University of Illinois at Urbana Champaign. Retrieved November 15, 2004, from <http://www.ece.uiuc.edu/abet/ecurr.html>