ACCREDITATION AND OTHER PRESSURES ON REQUIREMENTS AND CURRICULUM DESIGN

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Curriculum Design

- Faculty governance
  - Faculty generally "own" the curriculum.
  - Approvals are required for course content changes, new courses, deleted courses, curricular changes, substitutions of courses, etc.
    - Significant changes and new courses/programs generally require approvals from the local faculty all the way up through university curriculum committees.
    - Depending on the funding model, curricula often include courses that are taught by faculty outside of the student's major department – which requires resource management and collegiality.
- Administration does not dictate or directly control the curriculum
  - Administration does control resources (e.g., $$$ and faculty).
  - Administration can provide incentives.

The US Undergraduate BS Curriculum

- Approximately 125 – 130 Credit Hours (roughly 40 courses – semester equivalents)
  - Average 15 to 16 credits per semester
  - Many students enter with significant AP/IP/Dual Enrollment Credit (but not necessarily helpful).
  - Completion in 8 semesters requires students to enter into Calculus I.
- Accreditation dictates the minimums
  - Regional accreditation (SACS COC) generally requires a minimum 120 semester credit hours, including General Education
    - Most General Education programs are 25% of the curriculum
  - ABET: Criteria establish minimum standards for programs consistent with regional accreditation

ABET Accreditation

- ABET
  - Was "Accreditation Board for Engineering and Technology" – now just ABET, Inc.
- Comprised of member societies like IEEE, ASME, ASCE, AICHE, etc.
- Assures quality of educational programs and continuous improvement.
- Generally, a normal review cycle is 6 years.
- Must demonstrate attainment of criteria, in part via assessment.

Importance of ABET Accreditation

- Industry looks for ABET accreditation as a quality threshold.
- Graduate school admission often requires a BS from ABET accredited program, or equivalent.
- Used to qualify for professional engineering licensure in US.
- Increasing number of international institutions (outside of US) seeking ABET accreditation.
- ABET accreditation or equivalent often used to qualify institutions for study-abroad credit transfer.

Global Accreditation Activities of ABET as of October 1, 2015

- Accredited **3,569** programs at **714** colleges and universities in **29** countries
  - Non-U.S. Programs Accredited **475** programs at **95** institutions in **28** countries
  - Uniform accreditation criteria, policies, and procedures used for all visits, regardless of location

Source: ABET presentation to NAE, Brackin and Sussman, February 2016.
https://www.nae.edu/File.aspx?id=150807

Global Accreditation Activities of ABET as of October 1, 2015

Bahrain
Chile
China
Colombia
Ecuador
Egypt
Germany
India
Indonesia
Jordan
Kazakhstan
Kuwait
Lebanon
Mexico
Philippines
Portugal
Morocco
Oman
Palestine
Peru
Qatar
Russian Federation
Saudi Arabia
Singapore
South Africa
Spain
Turkey
United Arab Emirates
Vietnam
USA

Source: ABET presentation to NAE, Brackin and Sussman, February 2016.

ABET requirements

- There are 8 General Criteria plus a Program Specific Criterion.
- A "Lead Society" (e.g., IEEE) oversees the accreditation process and dictates any program specific criteria.
- The current ABET Criteria were developed nearly 20 years ago, under "EC 2000".
- Two Criteria of Interest since they have proposed changes:
  - Criterion 3: Student Outcomes
  - Criterion 5: Curriculum
- Here's a link to the full criteria:
  - http://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2016-2017/

Current Criteria Preamble

These criteria are intended to assure quality and to foster the systematic pursuit of improvement in the quality of engineering education that satisfies the needs of constituencies in a dynamic and competitive environment.

It is the responsibility of the institution seeking accreditation of an engineering program to demonstrate clearly that the program meets the following criteria.

Proposed Criteria Preamble

These criteria are intended to provide a framework of education that prepares graduates to enter the professional practice of engineering who are:

(i) able to participate in diverse multicultural workplaces;

(ii) knowledgeable in topics relevant to their discipline, such as usability, constructability, manufacturability and sustainability; and

(iii) cognizant of the global dimensions, risks, uncertainties, and other implications of their engineering solutions.

Further, these criteria are intended to assure quality to foster the systematic pursuit of improvement in the quality of engineering education that satisfies the needs of constituencies in a dynamic and competitive environment. It is the responsibility of the institution seeking accreditation of an engineering program to demonstrate clearly that the program meets the following criteria.

Criterion 3: Student Outcomes

The program must have documented student outcomes that prepare graduates to attain the program educational objectives. Student outcomes are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d) an ability to function on multidisciplinary teams

(e) an ability to identify, formulate, and solve engineering problems

Criterion 3: Student Outcomes

(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(i) a recognition of the need for, and an ability to engage in life-long learning

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Criterion 5: Curriculum

The curriculum requirements specify subject areas appropriate to engineering but do not prescribe specific courses. The faculty must ensure that the program curriculum devotes adequate attention and time to each component, consistent with the outcomes and objectives of the program and institution. The professional component must include:

(a) **one year (~32 credits or ~10 courses) of a combination of college level mathematics and basic sciences** (some with experimental experience) appropriate to the discipline. Basic sciences are defined as biological, chemical, and physical sciences.

Criterion 5: Curriculum

(b) **one and one-half years (~48 credits or ~16 courses) of engineering topics,** consisting of engineering sciences and engineering design appropriate to the student's field of study.

The engineering sciences have their roots in mathematics and basic sciences but carry knowledge further toward creative application. These studies provide a bridge between mathematics and basic sciences on the one hand and engineering practice on the other. Engineering design is the process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and the engineering sciences are applied to convert resources optimally to meet these stated needs.

Criterion 5: Curriculum

(c) **a general education component** that complements the technical content of the curriculum and is **consistent with the program and institution objectives.**

Students must be prepared for engineering practice **through a curriculum culminating in a major design experience** based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints.

Regional Accreditation – SACS Commission on Colleges (COC)

- SACS = **S**outhern **A**ssociation of **C**olleges and **S**chools

- Regional accrediting body in the eleven U.S. Southern states (AL, FL, GA, KY, LA, MS, NC, SC, TN, TX, and VA) and Latin America for institutions awarding associates, baccalaureate, master's or doctoral degrees

- Mission = the enhancement of educational quality throughout the region and the improvement of the effectiveness of institutions by ensuring that they meet standards established by the higher education community that address the needs of society and students

Accreditation - SACS

Accreditation by SACS signifies that the institution:

1. Has a mission appropriate to higher education,
2. has resources, programs, and services sufficient to accomplish and sustain that mission, and
3. maintains clearly specified educational objectives that are consistent with its mission and appropriate to the degrees it offers, and that indicate whether it is successful in achieving its stated objectives.

Accreditation - SACS

The Commission evaluates an institution and makes accreditation decisions based on compliance with:

- The Principle of Integrity
- Core Requirements
- Comprehensive Standards
- Federal Requirements (enable eligibility to participate in Federal Programs, such as Title IV)

Accreditation – SACS

Core requirements are basic, broad-based, foundational requirements that an institution must meet to be accredited with the Commission on Colleges.

- Baccalaureate Degree (BS or BA): minimum of 120 semester credit hours (eight 15-credit semesters)
- General Education minimum of 30 credit hours
  - Must include at least one course from each of the following areas: humanities/fine arts, social/behavioral sciences, and natural science/mathematics. The courses do not narrowly focus on those skills, techniques, and procedures specific to a particular occupation or profession.

General Education Requirements

GENERAL EDUCATION

An undergraduate student whose enrollment in a curriculum occurs after May 15, 2005, must fulfill the general education requirements in effect at that time. If a student withdraws from the University and subsequently returns or does not remain continuously enrolled (summers excluded), the requirements in effect at the time of return will normally prevail. Any variation in curricular or general education requirements shall be considered under the curriculum year change or the substitution procedure.

MISSION STATEMENT

Academic institutions exist for the transmission of knowledge, the pursuit of truth, the intellectual and ethical development of students, and the general well-being of society. Undergraduate students must be broadly educated and technically skilled to be informed and productive citizens. As citizens, they need to be able to think critically about significant issues. Students also need to be prepared to complete undergraduate work and a major course of study. The mission requires a high level of knowledge about and competence in the following areas:

General Education Competencies

A. Arts and Humanities
Demonstrate an ability to analyze and/or interpret the arts and humanities.

B. Mathematics
Demonstrate mathematical literacy through solving problems, communicating concepts, reasoning mathematically, and applying mathematical or statistical methods, using multiple representations where applicable.

C. Natural Sciences
Demonstrate the process of scientific reasoning by performing an experiment and thoroughly discussing the results with reference to the scientific literature, or by studying a question through critical analysis of the evidence in the scientific literature.

REQUIREMENTS—33 credit hours

To meet general education competencies, 33 total credit hours are required, distributed as follows: I. General Education Coursework—31 credit hours; II. Distributed Coursework—2 credit hours.

I. General Education Coursework—31 hours required

General education requirements in some curricula are more restrictive than those shown below. Science and Technology in Society and Cross-Cultural Awareness requirements may be satisfied by other General Education courses, as indicated in the footnotes below, as long as the student completes a total of 31 hours in area I. and satisfies requirements A-F below:

A. Communication: at least 6 credits

English Composition..... 3 credits
ENGL 1030 (ENGL 1020 for transfer students)

Oral Communication ..... 3 credits
COMM 1500, 2500, HON 2230, or an approved cluster of courses such as AS 3090, 3100, 4090, 4100; or ML 1010, 1020

*May be satisfied either by the courses above or by an approved departmental cluster of course, see II. Distributed Coursework. Students taking clusters must still earn at least 31 hours from the General Education Coursework list.

B. Mathematical, Scientific, and Technological Literacy: at least 10 credits

Mathematics ..... 3 credits
MATH 1010, 1020, 1060, 1070, 1080, 2070, STAT 2220[1], 2300, 3090, 3300. For Early Childhood Education, Elementary Education, and Special Education majors only, the approved cluster of MATH 1150, 1160 and 2160 satisfies the requirement.

Natural Science with Lab..... 4 credits
ASTR 1010/1030, 1020/1040, BIOL 1030/1050, 1040/1060, 1090, 1100, 1110, 1200/1220, 1200/1230, CH 1010, 1020, 1050[1], 1060[1], GEOL 1010/1030, 1120[1]/1140, 2020, PHSC 1070, 1080, 1170, 1180, PHYS 1220/1240, 2000, 2070/2090, 2080/2100, 2210/2230, 2220/2240

Rankings – U.S. News & World Report

- Graduation & Retention Rates (22.5%)
  - Six-year graduation rate (80%)
  - First-year retention rate (20%)
- Undergraduate Academic Reputation (22.5%)
  - Peer assessment survey allows top academics – presidents, provosts and deans of admissions
- Faculty Resources (20%)
  - Class size (40%)
  - Faculty salary (35%)
  - Faculty with terminal degrees (15%)
  - Student-faculty ratio (5%)
  - Proportion of faculty who are full-time (5%)

Rankings – U.S. News & World Report

- Student Selectivity (12.5%)
  - Admissions test scores (SAT and ACT) (65%)
  - Proportion of enrolled first-year students who graduated in the top 10% of their high school class (national universities) (25%)
  - Ratio of students admitted to applicants (10%)
- Financial Resources (10%)
  - Average spending per student on instruction, research, student services and related educational expenditures
- Graduation Rate Performance (7.5%)
  - U.S. News measures the difference between a school's actual six-year graduation rate and the rate U.S. News had predicted
- Alumni Giving Rate (5%)
  - The average percentage of living alumni with bachelor's degrees who gave to their school.

Financial Aid

Scholarships

- Generally, to receive a scholarship or other financial assistance, a student must be enrolled full-time (12 or more credit hours per semester).
- Many scholarships are awarded for a maximum of 4 years (8 semesters).
  - For example, state of SC scholarship programs (LIFE & Palmetto Fellows) allow students to receive funding for a total of 8 semesters from the date that the student first enters college.
- Significant financial burden if the student does not complete in 8 semesters (roughly $14k (in-state) or $24k (out-of-state) cost of attendance per semester).
  - Palmetto Fellows scholarship, STEM enhancement, and Clemson scholarships pay approximately $7000 per semester to in-state students. 50% of CU engineering students enter Clemson with these scholarships.

Professional Licensing

The Fundamentals of Engineering (FE) exam is generally the first step in the process to becoming a professional licensed engineer (P.E.). It is designed for recent graduates and students who are close to finishing an undergraduate engineering degree from an EAC/ABET accredited program.

6 hour exam / 110 multiple-choice questions

There is a 73% pass rate, nationally, for individuals taking the FE exam for Electrical & Computer Engineering.

Professional Licensing

EE FE Exam content includes:

- Mathematics
- Probability and statistics
- Ethics and professional practice
- Engineering economics
- Properties of electrical materials
- Engineering sciences
- Circuit analysis
- Linear systems
- Signal processing
- Electronics
- Power
- Electromagnetics
- Control systems
- Communications
- Computer networks
- Digital systems
- Computer systems
- Software development

Electrical Engineering
Bachelor of Science Degree
Curriculum Year 2016-2017

FRESHMAN YEAR

Fall semester	Cr	Term completed	Spring semester	Cr	Term completed
ENGR 1020/1021 Engr Discipl & Skills I*	2		ENGR 1410/1411 Engr Discipl & Skills II*	3	
CH 1010 & 1011 General Chemistry	4		CH 1020 & 1021 Gen Chemistry II	4	
ENGL 1030 Accelerated Composition	3		Humanities/Soc Sci req	3	
MATH 1060 Calculus I	4		MATH 1080 Calculus II	4	
Humanities/Soc Sci req	3		PHYS 1220 Physics with Calculus I	3	
	16			17	

SOPHOMORE YEAR

Fall semester	Cr	Term completed	Spring semester	Cr	Term completed
CPSC 1110 & 1111 Intro to Prog in C	3		ECE 2120 Electrical Engr Lab II	1	
ECE 2010 Logic & Computing Devices	2		ECE 2620 Electric Circuits II	3	
ECE 2020 Electric Circuits I	3		ECE 2720 Computer Organization	3	
ECE 2090 Logic Lab	1		ECE 2730 Computer Org Lab	1	
ECE 2110 Electrical Engineering Lab I	1		MATH 2080 Differential Equations	4	
MATH 2060 Calculus III	4		Humanities/Social Science req **	3	
PHYS 2210 Physics with Calculus II	3				
	17			15	

JUNIOR YEAR

Fall semester	Cr	Term completed	Spring semester	Cr	Term completed
ECE 3110 Electrical Engr Lab III	1		ECE 3120 Electrical Engr Lab IV	1	
ECE 3200 Electronics I	3		ECE 3170 Random Signal Analysis	3	
ECE 3300 Signals, Sys, & Transforms	3		ECE 3210 Electronics II	3	
ECE 3600 Electric Power Engineering	3		ECE 3710 Microcntrllr Interfacing	3	
ECE 3800 Electromagnetics	3		ECE 3720 Microcontroller Interf Lab	1	
Adv. Mathematics Requirement [1]	3		ECE 3810 Fields, Waves & Circuits	3	
			ENGL 3140 Technical writing	3	
	16			17	

SENIOR YEAR

Fall semester	Cr	Term completed	Spring semester	Cr	Term completed
Communications Requirement***	3		ECE 4960 Systems Design II	2	
			EE Technical Elective OR	3	
ECE 4090 Intro Linear Control Systems	3		Humanities/Social Science req****		
ECE 4270 Communications Systems	3		EE Technical Elective	3	
ECE 4950 / 4951 Systems Design I	2		Humanities/Social Science req	3	
EE Technical Elective	3		Special Requirement [2]	3	
	14			14	

Total =126

Electrical Engineering (BS) (14EEBS)

FRESHMAN YEAR

Fall Semester	Credit	Spring Semester	Credit
CH 101 Chemistry, A Molecular Science[1]	3		
CH 102 General Chemistry Lab[1]	1	ECE 109 Intro to Computer Systems[2]	3
E 101 Intro to Engr & Prob Solving[2]	1	MA 241 Calculus II[1]	4
E 115 Intro to Computing Environ[2]	1	PY 205 Physics for Engineers & Scientists I[1]	3
ENG 101 Academic Writing & Research[2]	4	PY 206 Physics for Engineers & Scientists I Lab	1
MA 141 Calculus I[1]	4	Economics (EC 201/205, ARE 201)	3
GEP Requirement*	3	HESF 10* HES Fitness Elective*	1
	17		**15**

SOPHOMORE YEAR

Fall Semester	Credit	Spring Semester	Credit
ECE 200 Intro to ECE Laboratory[2]	4		
ECE 209 Computer Systems Programming[2]	3	COM 110 Public Speaking	3
MA 242 Calculus III	4	ECE 211 Electric Circuits[2]	4
PY 208 Physics for Engineers & Scientists II	3	ECE 212 Fund of Logic Des[2]	3
PY 209 Physics for Engineers & Scientists II Lab	1	ECE 220 Analytical Found of ECE[2]	3
	15	GEP Requirement*	3
			16

CLEMSON UNIVERSITY

NC STATE UNIVERSITY

JUNIOR YEAR

Fall Semester	Credit	Spring Semester	Credit
ECE 301 Linear Systems	3	ECE 303 Electromagnetic Fields	3
ECE 302 Intro to Microelectronics	4	ECE 380 or 381 or 383[4]	1
ECE 3xx ECE Foundation Elective[3]	3	ECE 3xx ECE Foundation Elective[3]	3
ST 371 Intro to Prob & Dist Theory	3	Open/Technical Elective[7]	3
HES_***Health & Exercise Studies Course	1	ENG 331 Comm for Engr & Tech	3
	14	GEP Requirement*	3
			16

SENIOR YEAR

Fall Semester	Credit	Spring Semester	Credit
ECE 484 ECC Senior Design Project I	3	ECE 485 ECE Senior Design Project II	3
ECE 4xx EE Elective[5]	3	ECE 4xx Elective[6]	3
ECE 4xx EE Elective[5]	3	ECE 4xx Elective[6]	3
Open/Technical Elective[7]	3	GEP Requirement*	3
GEP Requirement*	3	GEP Requirement*	2-3
	15		**14-15**

Minimum Credit Hours Required for Graduation[*,I,J,K]:	122

CLEMSON UNIVERSITY

UNC CHARLOTTE

SUGGESTED PLAN OF STUDY – BSEE

Freshman Year					
Course Number	**Course Title**	**Credit Hours**	**General Education**	**W/O Course**	**Notes**
Fall Semester					
UWRT 1101	Writing and Inquiry in Academic Contexts I	3	X		
ENGR 1201	Introduction to Engineering Practices and Principles I	2			
CHEM 1251	Principles of Chemistry	3	X		
CHEM 1251L	Principles of Chemistry Lab	1	X		
ECGR 2103	Computer Utilization in C++	3			
MATH 1241	Calculus I	3	X		
Spring Semester					
UWRT 1102	Writing and Inquiry in Academic Contexts II	3	X		
ENGR 1202	Introduction to Engineering Practices and Principles II	2			
PHYS 2101	Physics for Science and Engineering I	3	X		
PHYS 2101L	Physics for Science and Engineering I Lab	1			
LBST 110X	LBST 1100 Series: Arts and Society	3	X		
MATH 1242	Calculus II	3	X		

30 Credit Hours for Year

Sophomore Year					
Course Number	**Course Title**	**Credit Hours**	**General Education**	**W/O Course**	**Notes**
Fall Semester					
ECGR 2111	Network Theory I	3			
ECGR 2155	Instrumentation and Networks Laboratory	1	X	W	
ECGR 2181	Logic Systems Design I	3			
MATH 2171	Differential Equations	3			
PHYS 2102	Physics for Science and Engineering II	3			
LBST 2101	Western Cultural and Historical Awareness	3	X		
Spring Semester					
ECGR 2112	Network Theory II	3			
ECGR 2156	Logic and Networks Laboratory	1	X	W	
ECGR 2252	Electrical Engineering Design I	2		O	
MATH 2241	Calculus III	3			
PHYS 3141	Introduction to Modern Physics	3			
MATH 2164	Matrices and Linear Algebra	3			

31 Credit Hours for Year

Junior Year					
Course Number	**Course Title**	**Credit Hours**	**General Education**	**W/O Course**	**Notes**
Fall Semester					
ECGR 3111	Signals and Systems	3			
ECGR 3121	Introduction to Electromagnetic Fields	3			
ECGR 3131	Fundamentals of Electronics and Semiconductors	3			
ECGR 3155	Systems and Electronics Lab	1	X	W	
STAT 3128	Probability & Statistics for Engineers	3			
LBST 221X	LBST 2200 Series: Ethical Issues and Cultural Critique	3	X		
Spring Semester					
ECGR 3122	Electromagnetic Waves	3			
ECGR 3132	Electronics	3			
ECGR 3142	Electromagnetic Devices or ECGR 3133 Solid State Microelectronics	3			3142 or 3133
ECGR 3156	Electromagnetic and Electronic Devices Laboratory	1		W	
ECGR 3112	System Analysis II or ECGR 3181 Logic System Design II	3			3112 or 3181
ECGR 3157	Electrical Engineering Design II	2		O	
ENGR 3295	Professional Development	1			

32 Credit Hours for Year

Senior Year					
Course Number	**Course Title**	**Credit Hours**	**General Education**	**W/O Course**	**Notes**
Fall Semester					
ECGR 4241	Electrical Engineering Senior Design I	2		W,O	
ECGR 4123	Analog and Digital Comm. or ECGR 4124 Digital Signal Processing	3			4123 or 4124
ECGR 4XXX	4000 Level ECGR Course	3			
ECGR 4XXX	4000 Level ECGR Course	3			
XXXX XXXX	Technical Elective	3			
LBST 2102	Global and Intercultural Connections	3	X		
Spring Semester					
ECGR 4242	Electrical Engineering Senior Design II	3	X	W,O	
ECGR 3159	Professional Practice	2			
MEGR 3111	Thermodynamics I	3			
ECGR 4XXX	4000 Level ECGR Course	3			
ECGR 4XXX	4000 Level ECGR Course	3			
ECON 2101	Principles of Econ. Macro or ECON 2102 Principles of Econ. Micro	3	X		

34 Credit Hours for Year

Total =127