

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

EP.10.40

Office of the Provost and Vice Chancellor
for Academic Affairs

Swanlund Administration Building
601 East John Street
Champaign, IL 61820



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MAR 10 2010

OFFICE OF THE SENATE

March 10, 2010

Abbas Aminmansour, Chair
Senate Committee on Educational Policy
Office of the Senate
228 English Building, MC-461

Dear Professor Aminmansour:

Enclosed is a copy of a proposal from the College of Engineering to revise the BS in Industrial Engineering in the Department of Industrial and Enterprise Systems Engineering (IESE).

This proposal has been approved by the College of Engineering Executive Committee. It now requires Senate review.

Sincerely,

Kristi A. Kuntz
Assistant Provost

KAK/dkk

Enclosures

c: I. Adesida
R. Dennis
S. Kamin
C. Livingstone
J. Pang
M. Rood
R. Srikant
C. Tucker

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

College of Engineering
Executive Committee
306 Engineering Hall, MC-266
1308 West Green Street
Urbana, IL 61801



RECEIVED
FEB 25 2010
OFFICE of the PROVOST

February 24, 2010

Andrea Golato
Associate Dean
Graduate College
204 Coble Hall
MC-322

Via: Ilesanmi Adesida, Engineering College

Dear Ms. Golato:

The College of Engineering Executive Committee has reviewed and approved the following:

Revised Programs: **Revision to the Undergraduate Curriculum in Industrial Engineering**
Revision to the Undergraduate Curriculum in General Engineering

Attached is a copy of the request.

Sincerely yours,

Samuel N. Kamin, Secretary
Executive Committee

Approval Recommended:

Ilesanmi Adesida, Dean
College of Engineering

2/24/10
Date

SNK/rd

Enclosure

c: Jong-shi Pang
R. Srikant
Mark Rood
Chuck Tucker
Michael Pleck
Robin Dennis

Proposal to the Senate Educational Policy Committee

PROPOSAL TITLE: Revision to the B.S. Degree in Industrial Engineering, Department of Industrial and Enterprise Systems Engineering (IESE), College of Engineering

SPONSOR: Jong-Shi Pang, Professor and Head, Department of Industrial and Enterprise Systems Engineering, 116 Transportation Bldg, 244-5703, jspang@illinois.edu

COLLEGE CONTACT: Charles Tucker III, Associate Dean, 206 Engineering Hall, 244-3822, ctucker@illinois.edu

BRIEF DESCRIPTION: It is proposed to change the requirements for the B.S. degree in Industrial Engineering (IE) as summarized below. The revised program will have 128 credit hours, a reduction of 4 hours from the existing curriculum.

1. Orientation and Professional Development (remains 0 credit hours)

Addition:

GE 100—Introduction to IESE (0 hr) – revised from current 1-hour version titled Intro to General Engineering

Replacement:

GE 390—Seminar (0 hr) – in place of IE 390—Seminar (0 hr)

2. Foundational Mathematics and Science (reduced from 37 to 31 credit hours)

Subtractions: (–6 hr)

CHEM 104—General Chemistry II (3 hr)

CHEM 105—General Chemistry Lab II (1 hr)

PHYS 214—Univ Physics: Quantum Physics (2 hr)

3. Industrial Engineering Technical Core (reduced from 51 to 45 credit hours)

Additions: (+8 hr)

GE 161—Business Side of Engineering (1 hr)

IE 311—Operations Research Lab (1 hr) – new course

IE 410—Stochastic Processes (3hr)

IE 413—Simulation (3 hr)

Subtractions: (–16 hr)

IE 330—Industrial Quality Control (3 hr)

IE 340—Human Factors (4hr)
IE 360—Facilities Planning and Design (3 hr)
IE 361—Production Planning & Control (3 hr)
ME 350—Design for Manufacturability (3 hr)

Replacements: (+3 hr net change)

ECE 110—Intro Elec & Computer Engrg (4 hr) – in place of ECE 205—Elec & Electronic Circuits (3 hr) + ECE 206—Elec & Electronic Circuits Lab (1 hr)
GE 494—Senior Engineering Project I (3 hr) + GE 495—Senior Engineering Project II (2 hr) – in place of IE 470—Senior Engineering Project (3 hr)
TAM 211—Statics (3 hr) – in place of TAM 210—Introduction to Statics (2 hr)

Revision: (–1 hr net change)

IE 310—Operations Research (3 hr) – revised with credit reduced from 4 to 3 hours and lab component broken off to new course IE 311

4. IE Track Options (new, 12 credit hours)

Addition:

Track Electives (12 hr) – *See Appendix A, Sec. 1*

Choose one track from an approved list. The current proposed list consists of the following track options:

- a. Industrial Engineering Fundamentals (IEF)
- b. Operations Research (OR)
- c. Quality Engineering (QE)
- d. Supply Chain, Manufacturing and Logistics (SC&L)
- e. Economics and Finance (E&F)
- f. Human Factors Engineering (HFE)

5. Technical Electives (reduced from 16 to 12 credit hours)

Additions: (+9 hr)

Computer Science Elective (choose one from list) (3 hr) – *See Appendix A, Sec. 2*

IE Technical Electives (choose two from list) (6 hr) – *See Appendix A, Sec. 3*

Subtractions: (–12 hr)

Human Factors elective (3 hr)

IE Elective (3 hr)

Manufacturing elective (3 hr)

Operations Research elective (3 hr)

Revision: (–1 hr net change)

Engineering Science elective* (choose one from list – *See Appendix A, Sec. 4*) – degree credit reduced from 4 to 3 hours.

* Note: In the current program, this category has the title “Technical electives,” which is being retitled to avoid potential confusion with “IE technical electives.”

6. Social Sciences & Humanities, Composition, and Free Electives. (no change, 28 credit hours)

Advanced Composition (ACP) certification will be sought for GE 494 to fulfill the General Education ACP requirement. Currently, it is met by IE 470.

JUSTIFICATION:

The Industrial and Enterprise Systems Engineering (IESE) Department has periodically revised its undergraduate curricula with the goal of delivering contemporary and relevant programs of study. The main impetus for this revision is the recommendation by the College of Engineering Executive Committee, Ad-hoc Subcommittee on Undergraduate Education (February 8, 2008) that all engineering undergraduate programs target 128 hours for graduation while ensuring strength in basic sciences as well as interdisciplinary concepts and engineering systems design. An equally important driving force is the goal of developing a common first two years in the IE and General Engineering (GE) undergraduate programs, which is also compatible with many other undergraduate programs in the College. This will facilitate transfers between programs in IESE and others in the College of Engineering. As a corollary to this is the development of maximum cohesiveness between IE and GE undergraduate programs in the 3rd and 4th years, while retaining the strongest and most successful characteristics of each. As such, we expect that the changes in the curriculum will attract more students to the IE program; this is aligned with a strategic goal of the IESE department to balance the diverse interest groups therein.

Industrial Engineering is the branch of engineering that engages in the study of how to describe, evaluate, design, modify, control and improve the performance of complex systems, viewed over time and within their relative context. The key notion is systems, including manufacturing, supply chains, financial, energy, service, and health care, among others.

When the B.S.I.E. program was previously offered under the Mechanical and Industrial Engineering (MIE) department, the main focus of the undergraduate program was on manufacturing. With the merger of the IE program in the newly formed IESE department, the focus on industrial engineering should be broadened and aligned with the other undergraduate program, GE) offered by IESE. Currently, industrial engineering tools are utilized heavily in the services sector, such as health care systems and supply chain systems. Consequently, it has become necessary that the B.S. in IE should also gain comprehensive training in those areas in addition to the manufacturing area. The proposed curriculum allows greater flexibility for students in terms of course selection, permitting students to not only complete a curriculum that is similar to the previous one but also to focus on other core and emergent areas of industrial engineering, such as operations research, supply chain management and other topics, viz. the IE Track options introduced as part of this proposal.

Within the context of these broad objectives, the rationale for the specific changes are as follows:

1. **Orientation and Professional Development** – GE 100 serves as the orientation to the IESE department and GE curriculum. Extending this to the IE curriculum is only natural. The reduction in credit is justified in a companion proposal for a revision of the B.S.G.E. curriculum. GE 331 and IE 300 serve the same purpose and since the IE program was absorbed into IESE, have been operated in “meets with” mode. Having a common course streamlines management and abides by the common sense rule of not having cross-listed or meets-with courses within the same department. Under the proposal, the IE version will prevail and GE 331 will be discontinued.

2. Foundational Mathematics and Science

Seeking to attain commonality in the first two years of the IE and GE curricula, disparate courses were examined and important conclusions were drawn. While in the former Mechanical and Industrial Engineering (MIE) department prior to the formation of the MechSE and IESE departments, the IE program had commonality in the requirements of CHEM 104, CHEM 105, and PHYS 214. The rationale for the second chemistry course set (which some GE students elect to take as a free elective to prepare for certain GE Secondary Fields) was that CHEM 104 was a prerequisite to ME 330. While ME 330 is still required in the proposed IE program revision, MechSE has eliminated its CHEM 104 prerequisite. PHYS 214 served primarily the program goals of ME students, and thus is considered nonessential to the IE program.

3. Industrial Engineering Technical Core – Underlying the core of industrial engineering are operations research tools. Applications of these tools in different areas have widened the scope of industrial engineering continuously in the past. The main objective of the proposed changes to the Technical Core is to provide students with a strengthened and comprehensive education in the basic operations research tools. That's reflected in the additions of IE 410 and 413. GE 161 is central to the education of all IESE students. Of note, the course subtractions are now included in IE Track Options or the IE Technical Electives list.

Adjunct to the course additions and subtractions are replacements of certain required courses in the Technical Core for which excellent equivalents are existing requirements in the GE curriculum. Adopting them will promote commonality, and there is good reason beyond that to do so: ECE 110 and TAM 211 are more robust courses with ECE 110 replacing two service courses and TAM 211 providing a stronger base, which IE students often opt to take as an alternate prerequisite to TAM 212 and 251.

Finally, the separation of the current IE 310 (4 hrs) into IE 310 (3 hrs) + IE 311 (1 hr) is strictly administrative: in a companion proposal, a component of a GE undergraduate curriculum revision is to replace GE 330 (3 hrs) with the revised IE 310 (3 hrs)

4. IE Track Options – By allowing the flexibility of tracks of study in various IE fields, students may select areas of their interest and learn about the applications of the operations research tools in those areas, as well as gain more information about a particular field of interest. That is expected to not only increase the motivation of the students working towards an IE degree, but also allow a student to shape his/her education according to a career he/she would like to pursue.

5. Technical Electives –The IE Technical Electives are courses in industrial engineering and allied fields that permit the student to strengthen and broaden his/her program beyond the core technical courses and track option. The proposed Computer Science Elective enables the student to strengthen his or her computer science and programming skills by selecting one of three courses approved for that purpose. This is desirable because programming and software are important and practical components of many IE solution procedures. The Engineering Science Elective is similar in purpose to the IE Technical Electives, but it is chosen from an even broader selection of courses inside and outside the industrial engineering field. It was created by renaming the former 4-hour Technical Elective and revising the credit to 3 hours. The subtractions proposed in this category are available, for the most part, in the Track Options or the proposed new technical elective categories. The proposed approved lists for all of these technical electives are given in Appendix A. The lists will be revised as courses are offered or dropped by their home departments.

6. **Composition** – Currently IE 470—Senior Engineering Project is ACP-certified and GE 494+495—Senior Engineering Project I+II is not. In the GE program, GE 400—Engineering Law meets the ACP requirement. Since the IE program came under IESE’s wing, IE 470 has been taught in ‘meets-with’ mode with GE 494+495. In adopting the GE-rubric pair as the IE curriculum requirement, it makes sense to seek ACP certification for it. Moreover, having only one rubric avoids management problems and abides by the common sense guideline of not having cross-listed or meets-with courses within the same department.

In addition to updating the IE undergraduate curriculum to be competitive with our peer institutions, and serve the needs of modern industrial engineering education, research and practice, as outlined above, the proposed changes will also produce an IE undergraduate curriculum with the following additional desirable features:

- Preparation for advanced study and research at leading engineering institutions
- Preparation for professional employment in industry in a wide variety of industrial engineering fields
- Continued compliance with accreditation requirements by the appropriate accreditation board (ABET)
- Streamlined management of courses in the IE and GE programs, both controlled by IESE, resulting in economies of scale.

BUDGETARY AND STAFF IMPLICATIONS:

a. Additional staff and dollars needed

Since the proposed curriculum results in a reduction in credit hours (from 132 to 128) and utilizes existing IE courses for tracks and electives, no additional staff or dollars will be needed. Everything required to implement the revised program is already in place.

b. Internal reallocations

The proposed IE curriculum will help alleviate internal reallocation pressures in staffing of the two undergraduate programs in the IESE department. Over the past three years the IESE Department has hired highly qualified young faculty to strengthen the Department in needed areas of IE and operations research, which are also essential to enable a top Industrial Engineering undergraduate program to be offered. The proposed IE curriculum will capitalize on the talents and teaching interests of these new faculty members. It will also help meet the needs of the general engineering undergraduate program through the teaching of several courses in common, which is important because most IESE undergraduates take the GE program. Overall, the proposed IE curriculum will better match the IE program to faculty strengths, will have a direct positive impact on the IE undergraduate program, and will also have a positive impact on the GE undergraduate program.

c. Effect on course enrollment in other units and explanations of discussions with representatives of those departments

Since the revised program requires fewer courses in other units except for Computer Science, and since the number of students involved is relatively small (approximately 20-25 students/year), the effects on course enrollment in other units are expected to be minimal. The following assessments of effects on other departments, unless noted otherwise, have all been confirmed by and are acceptable to the respective departments. These assessments assume steady-state IESE enrollments in the short term.

- (1) Chemistry. Chemistry will see a reduction of about 15-20 IE students enrolling annually in CHEM 104 and CHEM 105 for 4 credit hours since a few of the students will be likely to have advance credit for CHEM 105. This reduction, spread over the fall and spring terms is not deemed significant enough in and of itself to impact the total number of CHEM 105 sections.
- (2) Computer Science. Computer Science will see a small increase in enrollment divided between two courses listed as Computer Science electives. Assuming the students' choices will be evenly split, the increase will be approximately 10 students for each of the two CS courses and spread over the fall and spring terms, not enough to impact staffing or resource needs.
- (3) Electrical and Computer Engineering. IE students will continue to take 4 credit hours in ECE courses, but instead of ECE 205 and ECE 206, they will take ECE 110. This is a small increase in demand for ECE 110, which amounts to a shift of what course about 20 IE students do lab work and is thus staffing-neutral. Due to limited lab space and typically high course demand, ECE 110 would be subject to additional pressure. But this will be offset by the enrollment cap recently placed on entering GE students.
- (4) Mechanical Science and Engineering. The MechSE department will see the following changes: (1) An enrollment shift of about 20 students annually from TAM 210 (2 hrs) to TAM 211 (3 hrs). The two courses are taught together in "meets with" mode so this change is inconsequential. (2) A small reduction of IE students enrolling in the manufacturing design course ME 350 (in the range of 0 to 20 students annually). This course is now a track elective and an IE elective in the proposed curriculum, whereas it used to be required of all IE students.
- (5) Physics. The Physics department will see an annual reduction of about 15-20 IE students enrolling annually in PHYS 214. This reduction, spread over the fall and spring terms, is not deemed significant enough to impact the total number of course lab and discussion sections.

Courses in the new curriculum that are from other departments have been reviewed to make sure they will be accessible to IE students. In one case the home department was asked to change the prerequisite to a course (ME 350) to accommodate IE students, and they have willingly done so. Regarding the IE track options, over the years the Department has successfully developed relationships with other departments to accommodate similar GE track options and to allow students to take restricted courses. The IESE department will periodically monitor courses in other departments to make sure that they satisfy the needs of the IE curriculum.

Some IE courses that become electives under the new curriculum could see reduced enrollments and less frequent offerings. However, this would not jeopardize the completion of an IE track or the IE degree, because alternative courses will be available. The proposed IE track system provides multiple paths to degree completion instead of a fixed set of required IE courses. If a particular course or instructor is not available one semester, the student can choose another course in the same track, or sometimes a track that overlaps with the original one. This redundancy is a strength of the proposed new curriculum. It should also be noted that the Department will periodically monitor and update tracks and courses to ensure that the needs of IE students are met.

d. Impact on the University Library

We expect no significant change since this is not a new program.

e. Impact on computer use, laboratory use, equipment, etc.

We expect no significant change in computer use since this is not a new program, and since no new facilities or equipment requirements have been added. There will be a neutral effect on ECE laboratory use as described in subsection c(3).

DESIRED EFFECTIVE DATE: Fall, 2010

STATEMENT FOR PROGRAMS OF STUDY CATALOG: See Appendix B.

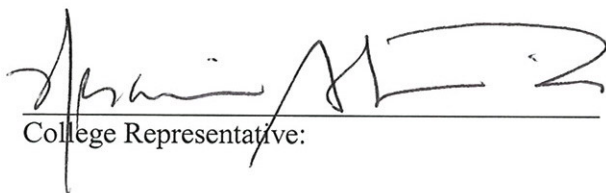
CLEARANCES:

Signatures:



Unit Representative:

9/24/2009
Date:



College Representative:

2/24/10
Date:

Graduate College Representative:

Date:

Provost Representative:

Date:

Educational Policy Committee Representative:

Date:

EP 10.40 Course Change E-mail approvals

Dear Prof Jankowski,

Physics is aware of this change (drop of PHYS 214 requirement); it has no significant impact on the course.

Gary Gladding
Prof and Assoc Head, Physics. .

----- Forwarded Message

> From: "Pitt, Leonard B" <pitt@illinois.edu>
> Date: Thu, 18 Mar 2010 10:40:55 -0500
> To: "Moeinzadeh, Manssour H" <manssour@illinois.edu>
> Conversation: Letter of concurrence-CS Electives (IE Revised Curriculums)
> Subject: Re: Letter of concurrence-CS Electives (IE Revised Curriculums)
>
> Manssour, after consideration of the new IESE curricular changes as
> described in your attached proposals, the CS department is pleased to offer
> its endorsement.
>
> --
> Leonard Pitt
> Professor and Director of Undergraduate Programs
> Department of Computer Science
> University of Illinois
> pitt@illinois.edu

Dear Manssour,

Apologies for the delays in getting you the letter concurrence of ECE with the changes in the IE curriculum concerning the replacement of ECE 205/206 hrs by ECE 110 hours. We do not anticipate major difficulties in meeting the new demand for 20-30 seats in ECE 110 in Sp 2011. I'll also be taking my furlough tomorrow morning although I can get you a more formal letter tomorrow afternoon.

Best regards,
Erhan

The only 'major' change in the required IE 'Technical Core' is the ECE 205/206 substitution with ECE 110 which I just forwarded the ECE concurrence. Replacement of TAM 210 (2hr) with TAM 211 (3hr) is considered 'minor' as TAM 210 " Meets with TAM 211" as a non-standard term course during the first 2/3 of the term and therefore no impact on overall enrollment. We have informally confirmed this with TAM, however, if you need a formal e-mail we can certainly get one. Hope this helps.

Regards,
-Manssour

Dear Manssour,

Thank you for your e-mail about the change in your curricula in which you no longer will require Chem 105 & 106.

Best,
Anne Baranger

Approved Minutes
College of Engineering Executive Committee (EC) Meeting
Tuesday, 1:00 p.m., February 9, 2010
301 Engineering Hall

Present:

D. Abrams (CEE)*	B. Heuser (NPRE)	C. Tucker (Admin)
N. Cheng (MNTL)	D. Jones (ECE)	M. Wong (CSL)
B. Cunningham (BioE)	P. Kalita (ABE)	H. Zhao (ChBE)
G. Dullerud (MechSE)	S. Kamin (CS)	
P. Goldbart (Phys)	R.S. Sreenivas (IESE)	

Absent:

I. Adesida (Admin)	V. Coverstone (Admin)	J. Weaver (MatSE)
B. Conway (AE)	M. Rood (CEE)	

* = alternate, ** = guest

1. The meeting was called to order at 1:00, Sam Kamin presiding.

2. Approval of the Draft Minutes from February 2, 2010.
The minutes were approved unanimously.

3. New/Old Business

Final report on New Paradigms of Engineering Education – R. S. Sreenivas

There was some discussion about this report. Some members asked whether other methods, such as mentoring and undergraduate research, had been considered. Brent Heuser noted that NPRE had taken a number of steps to retain its students, and he felt these were successful; Geir Dullerud suggested that the college might look for ways to encourage departments to work on this problem, since the College might not be the right level at which to address it. Much of the discussion was about whether the problem addressed by this report – primarily, the retention problem (the COE loses about 40% of its incoming freshman class) – is really a problem. Do other colleges experience fewer retention problems? It was noted that the cost of educating upperclassmen is probably higher than educating freshmen, so that solving this problem would have a cost. Furthermore, the numbers that are lost are largely, though not completely, made up by transfers students; the graduating class is roughly 90% of the size of the incoming class. Chuck Tucker responded that the broader question concerns how we will view our undergraduate teaching responsibilities. He stated that for a middle-class family, the cost of sending a child to our college is *higher* than the cost of sending that child to Northwestern University, when financial aid is taken into account. Thus, we can no longer truly “sell” our college on the basis of low prices, but will instead need to do so on the basis of high quality. **After this discussion, the subcommittee’s report was accepted by unanimous vote.**

4. Course and Program Proposals/Reports

a. New/Revised Course and Program Proposals

GE B.S. Degree Revision

Kamin reported that there was an urgency to this proposal, as indicated in a message from Michael Pleck. Nonetheless, it was not felt that the EC could properly review the proposal. It

will be forwarded to the Srikant committee (see I.E. B.S. revision below), with a request for expedited consideration.

b. Ad hoc committee Reports

ECE 109

The ad hoc committee's positive report was accepted unanimously.

ME 562

The ad hoc committee's positive report was accepted unanimously.

IE B.S. Degree Revision

The ad hoc committee's positive report was accepted unanimously. This committee, chaired by R. Srikant (ECE) was originally going to review both the IE and GE BS degree revisions, but the GE revision proposal was not ready until recently. As noted above, this committee will now be asked to review the GE proposal on an expedited basis; it is hoped that this is possible because the GE proposal is similar in spirit to the IE proposal.

5. The meeting adjourned at 2:15.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'S. Kamin', with a long horizontal flourish extending to the right.

Sam Kamin, Secretary

cc: Robin Dennis
Michael Pleck

Appendix A:

Proposed Industrial Engineering Track Options and Elective Courses

Note: These lists of courses will be periodically reviewed and updated by the IESE Department. The lists will be available on the Department Web site and from the IESE Undergraduate Advising Office, 209 Transportation Building.

1. Track Options

a. Industrial Engineering Fundamentals (IEF)

Track Core: Complete the 4 following courses

- IE 330—Industrial Quality Control
- IE 340—Human Factors
- IE 360—Facilities Planning and Design –or–
IE 411—Optimization of Large Systems
- IE 361—Production Planning & Control –or–
IE 412—OR Models for Mfg Systems

b. Operations Research (OR)

Track Core: Complete the following 2 courses

- IE 360—Facilities Planning and Design
- IE 411—Optimization of Large Systems

Track Electives: Complete 2 courses from the following list

- ECE 490—Introduction to Optimization
- GE 411—Reliability Engineering
- MATH 444—Elementary Real Analysis –or–
MATH 447—Real Variables
- MATH 484—Nonlinear Programming
- STAT 410—Statistics and Probability II
- STAT 420—Methods of Applied Statistics
- STAT 424—Analysis of Variance (Prereq: STAT 410)
- STAT 425—Applied Regression and Design (Prereq: STAT 410)

c. Quality Engineering (QE)

Track Core: Complete the following 3 courses

- IE 330—Industrial Quality Control
- IE 400—Design of Experiments
- IE 435—Reliability engineering

Track Electives:(Complete 1 course from the following list

- IE 431—Quality Engineering
- STAT 410—Statistics and Probability II

- STAT 420—Methods of Applied Statistics
- STAT 424—Analysis of Variance (Prereq: STAT 410)
- STAT 426—Sampling and Categorical Data (Prereq: STAT 410)

d. Supply Chain, Manufacturing, and Logistics (SC&L)

Track Core: Complete the following 2 courses

- IE 361—Production Planning & Control
- IE 412—OR Models for Mfg Systems

Track Electives: Complete 2 courses from the following list

- IE 330—Industrial Quality Control
- IE 360—Facilities Planning and Design
- GE 412—Nondestructive Evaluation
- ME 445—Introduction to Robotics
- ME 446—Robot Dynamics and Control
- ME 451—Computer-Aided Mfg Systems
- ME 452—Numerical Control of Mfg Processes
- ME 498—Special Topics (Section SK – topic: EcoDesign and Environmentally Conscious Manufacturing)

e. Economics and Finance (E&F)

Track Core: The following course, used to fulfill a portion of the Social Sciences and Humanities requirement, is considered to be the Track Core

- ECON 102—Microeconomic Principles –or–
ECON 103—Macroeconomic Principles

Track Electives: Complete 4 courses from the following list

- IE 420—Financial Engineering
- GE 450—Decision Analysis I
- ECON 203—Economic Statistics II (Prereq: ECON 202)
- ECON 302—Inter Microeconomic Theory (Prereq: ECON 102)
- ECON 465—Mathematical Economics (Prereq: ECON 302)
- FIN 300—Financial Markets (Prereq: FIN 221 or IE 430)
- FIN 311—Investment (Prereq: FIN 300)
- FIN 321—Advanced Corporate Finance (Prereq: FIN 300)
- FIN 412—Options and Futures Markets (Prereq: FIN 300)

f. Human Factors Engineering (HFE)

Track Core: Complete the following course

- IE 340—Human Factors

Track Electives: Complete 3 courses from the following list

- IE 440—Occupational Biomechanics

- IE 441—Interactive Syst Model & Design
- IE 442—Safety Engineering
- IE 445—Hum Perf and Eng Psych
- IE 446—Hum Comp Interaction Lab
- AVI 447—Human Error
- AVI 455—Aviation Accident Analysis
- PSYC 245—Industrial Org Psych

2. Computer Science Elective

Complete 1 course from the following list

- CS 225—Data Structures
- CS 357—Numerical Methods I
- CS 411—Database Systems (Prereq: CS 225)

3. Industrial Engineering Technical Electives

Complete 2 courses from the following list

- IE 330—Industrial Quality Control
- IE 340—Human Factors
- IE 360—Facilities Planning and Design
- IE 361—Production Planning & Control
- IE 398—Special Topics (up to two sections with 3 or more credit hours each)
- IE 400—Design & Anlys of Experiments
- IE 411—Optimization of Large Systems
- IE 412—OR Models for Mfg Systems
- IE 440—Occupational Biomechanics
- IE 441—Interactive Syst Model & Design
- IE 442—Safety Engineering
- IE 445—Hum Perf and Eng Psych
- IE 446—Hum Comp Interaction Lab
- IE 470—Senior Engineering Project
- IE 485—MEMS Devices & Systems
- IE 496—Honors Project
- IE 497—Independent Study
- IE 498—Special Topics (up to two sections with 3 or more credit hours each)
- GE 320—Control Systems
- GE 411—Reliability Engineering
- GE 412—Nondestructive Evaluation

- GE 424—State Space Design for Control
- ME 451—Computer-Aided Mfg Systems
- ME 452—Num Control of Mfg Processes
- Any additional courses listed under IE Track Electives

4. Engineering Science Electives

Complete 1 course from the following list

- AE 322—Aerospace Structures II
- AE 353—Aerospace Control Systems
- AE: All 400-level except 497¹, 498²
- ABE 374—Environ Control for Buildings
- ABE: All 400-level except 440, 445, 498²
- AVI: Any 200- or 300-level cross-listed with IE
- AVI 447—Human Error
- BIOC: All 400-level except 460
- BIOE: All 400-level except 498²
- BIOP: All 400-level
- CHBE: All 400-level except 430, 431, 454¹, 494², 497¹
- CHEM 232—Elementary Organic Chemistry I
- CHEM 233—Elementary Organic Chem Lab I
- CHEM 236—Fundamental Organic Chem I
- CHEM 237—Structure and Synthesis
- CHEM: All 400-level except 484, 492², 494, 495, 499
- CEE: All 200- or 300-level except 201, 202, 300
- CEE: All 400-level except 495, 497¹, 498²
- CS: All 200- or 300-level except 210, 296, 397¹, 398²
- CS: All 400-level except 417, 491, 492², 493², 498², 499
- ECE 280—Biomedical Imaging
- ECE 290—Computer Engineering I
- ECE 328—Computer Solutions EM Probs
- ECE 329—Intro Electromagnetic Fields
- ECE 385—Digital Systems Laboratory
- ECE 390—Computer Engineering II
- ECE 395—Advanced Digital Projects Lab
- ECE: All 400-level except 445, 497², 498², 499
- ECON 302—Inter Microeconomic Theory
- ECON 440—Economics of Labor Markets
- ECON 465—Mathematical Economics
- ECON 471—Intro to Applied Econometrics
- ECON 480—Industrial Comp and Monopoly
- GE: All 400-level except 400, 494, 495, 497¹, 498²
- IE: All 200, 300, and 400-level

- MCB 401—Cell & Membrane Physiology
 - MCB 402—Sys & Integrative Physiology
 - MCB 403—Cell & Membrane Physiology Lab
 - MCB 404—Sys & Integrative Physiol Lab
 - MCB 450—Introductory Biochemistry
 - ME: All 200, 300, and 400-level
 - MSE: All 400-level except 492, 497¹, 498², 499
 - MATH 380—Advanced Calculus
 - MATH: All 400-level except 402, 405, 406, 408, 439, 463, 496, 490², 499
 - NPRE 201—Energy Systems
 - NPRE 241—Intro to Radiation Protection
 - NPRE: All 400-level except 432, 458, 480-483, 498²
 - PHYS: All 400-level except 419, 420, 497¹, 498²
 - PSYC 230—Perception & Sensory Processes
 - PSCY 245—Industrial Org Psych
 - PSYC 455—Organizational Psych
 - PSYC 457—Human Error
 - STAT: All 400-level except 400, 408
 - TAM 335—Introductory Fluid Mechanics
 - TAM: All 400-level except 497¹, 498², 499
-

1. Engineering Science Elective credit for independent study courses from other departments is given only by petition. It is expected that a final report will be prepared and submitted to the faculty advisor at the conclusion of an independent study.
2. Depending on the technical content, some Special Topics courses (typically, new lecture-discussion courses) may or may not be approved for Engineering Science Elective credit. A Curriculum Modification Petition should be submitted to the Undergraduate Programs Office to request the use of these courses for Engineering Science Elective credit. The petition should be submitted **before** registering in the respective course.
3. Credit is allowed for only one of any two or more Engineering Science Electives with significant overlap, for example, ME 310 & TAM 335; IE 411 & MATH 482; ME 430 & TAM 424.

Appendix B: Statement for the Programs of Study Catalog

The *Overview of Curricular Requirements* section shown with Track Changes markup to the existing 2009-10 Programs of Study statement to facilitate comparison with the *Brief Description* section of the proposal narrative. The *Suggested Sequence* is shown in final form without Track Changes since it's just a manifestation of implementation and the extensive mark up clutter would render it difficult to comprehend.

Industrial and Enterprise Systems Engineering

Industrial and Enterprise Systems Engineering

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Curriculum in Industrial Engineering

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For the Degree of Bachelor of Science in Industrial Engineering

Industrial engineering is a discipline that encompasses the analysis, development, improvement, implementation and evaluation of integrated systems and their components, including materials, information, energy, people, money, time, equipment, and associated processes. Industrial engineering draws upon a variety of disciplines, from mathematics to psychology, from communications to computer science, and from production management to process control. Industrial engineers design efficient, productive systems in a wide range of business, industrial, and governmental settings.

The technical portion of the industrial engineering curriculum is designed as a sequence of increasingly specialized experiences. The entering student's first year is spent mastering the basics of science: math, chemistry, and physics. Second-year students begin to take fundamental engineering courses such as statics, dynamics, statistics, and strength of materials. Third-year, students take a core of industrial engineering courses and begin their chosen area of specialization in one of five tracks, including: Operations Research; Quality Engineering; Supply Chain, Manufacturing, and Logistics; Economics and Finance; and Industrial Engineering Fundamentals. During their senior year, students broaden and deepen their knowledge with additional technical elective courses. Finally, all students participate in the practice of engineering through the capstone senior design course in which they work in teams to solve problems submitted by industry partnering companies, and present their solutions in reports and presentations supported

by complete economic analyses. Engineering design, communication, teamwork, and laboratory experiences are integrated throughout all four years of the curriculum

A combined B.S.-M.S. Industrial Engineering degree program is available. Its admission and course requirements are described in the [College of Engineering program information section](#).

Overview of Curricular Requirements

The curriculum requires 128 hours for graduation and is organized as shown below.

Technical grade point average requirements for graduation and advanced-level course registration apply to students in this curriculum. These rules are summarized at the College of Engineering's [undergraduate advising Web site](#).

Orientation and Professional Development

These courses introduce the opportunities and resources your college, department, and curriculum can offer you as you work to achieve your career goals. They also provide the skills to work effectively and successfully in the engineering profession.

Hours	Requirements
0	ENG 100—Engineering Orientation ¹
0	GE 100—Introduction to IESE ¹
0	GE 390—Seminar
0	Total

1. External transfer students take ENG 300—Engrg Transfer Orientation instead.

Foundational Mathematics and Science

These courses stress the basic mathematical and scientific principles upon which the engineering discipline is based.

Hours	Requirements
3	CHEM 102—General Chemistry I
1	CHEM 103—General Chemistry Lab I
4	MATH 221—Calculus I ¹
3	MATH 231—Calculus II

4	MATH 241—Calculus III
3	MATH 285—Intro Differential Equations
3	MATH 415—Applied Linear Algebra
4	PHYS 211—University Physics: Mechanics
4	PHYS 212—University Physics: Elec & Mag
2	PHYS 213—Univ Physics: Thermal Physics
31	Total

1. MATH 220—Calculus may be substituted, with four of the five credit hours applying toward the degree. MATH 220 is appropriate for students with no background in calculus.

Industrial Engineering Technical Core

These courses stress fundamental concepts and basic laboratory techniques that comprise the common intellectual understanding of industrial engineering.

Hours	Requirements
3	CS 101—Intro Computing: Engrg & Sci
4	ECE 110—Intro Elec & Computer Engrg
3	GE 101—Engineering Graphics & Design
1	GE 161—Business Side of Engineering
3	GE 494—Senior Engineering Project I
2	GE 495—Senior Engineering Project II
3	IE 300—Analysis of Data
3	IE 310—Operations Research
1	IE 311—Operations Research Lab
3	IE 410—Stochastic Processes
3	IE 413—Simulation
3	IE 430—Economic Found of Quality Syst

4	ME 330—Engineering Materials
3	TAM 211—Statics
3	TAM 212—Introductory Dynamics
3	TAM 251—Introductory Solid Mechanics
45	Total

Track Option Electives

These courses enable the student to tailor his or her studies to one's interests and career goals in the major subdisciplines of industrial engineering.

Hours	Requirements
12	Track option electives. Selected from lists established by the department or by petition to the department. The current list of Track options includes: <i>Industrial Engineering Fundamentals (IEF)</i> <i>Operations Research (OR)</i> <i>Quality Engineering (QE)</i> <i>Supply Chain, Manufacturing and Logistics (SC&L)</i> <i>Economics and Finance (E&F)</i> <i>Human Factors Engineering (HFE)</i>

Technical Electives

These courses augment and strengthen the rigorous analysis and design principles practiced in the major subdisciplines of industrial engineering.

Hours	Requirements
3	Computer science elective chosen from a departmentally approved list
6	IE technical elective chosen from a departmentally approved list
3	Engineering Science elective chosen from a departmentally approved list
12	Total

Social Sciences and Humanities

The social sciences and humanities courses, as approved by the College of Engineering, ensure that students have exposure in breadth and depth to areas of intellectual activity that are essential to the general education of any college graduate.

Hours	Requirements
3	ECON 102—Microeconomic Principles or ECON 103—Macroeconomic Principles
15	Electives in social sciences and humanities approved by the College of Engineering and satisfying the campus general education requirements for social sciences and humanities, including cultural studies western and non-western.
18	Total

Composition

These courses teach fundamentals of expository writing.

Hours	Requirements
4	RHET 105—Principles of Composition
	Advanced Composition (satisfied by completing GE 494 in the Industrial Engineering Technical Core)
4	Total

Free Electives

These unrestricted electives, subject to certain exceptions as noted at the [College of Engineering advising Web site](#), give the student the opportunity to explore any intellectual area of unique interest. This freedom plays a critical role in helping students to define research specialties or to complete minors.

Hours	Requirements
6	Free electives. Additional unrestricted course work, subject to certain exceptions as noted at the College of Engineering advising Web site , so that there are at least 128 credit hours earned toward the degree.

Suggested Sequence

The schedule that follows is illustrative, showing the typical sequence in which courses would be taken by a student with no college course credit already earned and who intends

to graduate in four years. Each individual's case may vary, but the position of required named courses is generally indicative of the order in which they should be taken.

First year

Hours	First Semester
3	CHEM 102—General Chemistry I
1	CHEM 103—General Chemistry Lab I
0	ENG 100—Engineering Orientation
0	GE 100—Introduction to IESE
3-4	GE 101—Engineering Graphics & Design or RHET 105—Principles of Composition ²
4	MATH 221—Calculus I ¹
3	Elective in social sciences or humanities ³
14-15	Total

Hours	Second Semester
3	CS 101—Intro Computing: Engrg & Sci
4	ECE 110—Intro Elec & Computer Engrg
3	MATH 231—Calculus II
4	PHYS 211—University Physics: Mechanics
4-3	RHET 105—Principles of Composition or GE 101—Engineering Graphics & Design ²
18-17	Total

Second year

Hours	First Semester
1	GE 161—Intro Business Side of Engrg
4	MATH 241—Calculus III

4	PHYS 212—University Physics: Elec & Mag
3	TAM 211—Statics
3	Elective in social sciences or humanities ³
15	Total

Hours	Second Semester
3	IE 300—Analysis of Data
3	MATH 285—Intro Differential Equations
2	PHYS 213—Univ Physics: Thermal Physics
3	TAM 212—Introductory Dynamics
3	TAM 251—Introductory Solid Mechanics
3	Elective in social sciences or humanities ³
17	Total

Third year

Hours	First Semester
3	IE 310—Operations Research
1	IE 311—Operations Research Lab
3	IE 430—Economic Found of Quality Syst
3	MATH 415—Applied Linear Algebra
4	ME 330—Engineering Materials
3	Elective in social sciences or humanities ³
17	Total

Hours	Second Semester
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0	GE 390—Seminar
3	IE 410—Stochastic Processes
6	Track option electives ⁴
3	CS elective ³
3	IE technical elective ⁶
15	Total

Fourth year

Hours	First Semester
3	IE 413—Simulation
3-5	IE technical elective ⁶ or GE 494—Senior Engineering Project I and GE 495—Senior Engineering Project II ⁷
3	Track option elective ⁴
3	Engineering science elective ⁸
3	Elective in social sciences or humanities ³
15-17	Total

Hours	Second Semester
5-3	GE 494—Senior Engineering Project I and GE 495—Senior Engineering Project II ⁷ or IE technical elective ⁶
3	Track option elective ⁴
3	Elective in social sciences or humanities ³
6	Free electives
17-15	Total

1. MATH 220—Calculus may be substituted, with four of the five credit hours applying toward the degree. MATH 220 is appropriate for students with no background in calculus.
2. RHET 105 may be taken in the first or second semester of the first year as authorized. The alternative is GE 101.
3. Each student must satisfy the 18-hour social sciences and humanities requirements of the College of Engineering, including ECON 102 or 103, and the campus general education requirements for social sciences and humanities.
4. Track option elective—12 hours required. Choose from a departmentally approved list of courses from the following approved tracks:
 - I. Industrial Engineering Fundamentals (IEF)
 - II. Operations Research (OR)
 - III. Quality Engineering (QE)
 - IV. Supply Chain Manufacturing and Logistics (SC&L)
 - V. Economic & Finance (E&F)
 - VI. Human Factors Engineering (HFE)
5. CS elective—3 hours required. Choose from a departmentally approved list.
6. IE technical electives—6 hours required. Choose from a departmentally approved list.
7. GE 494 & 495 may be taken in the first or second semester of the fourth year as authorized. The alternative is an IE technical elective.
8. Engineering science elective—3 hours required. Choose from a departmentally approved list.