The Charles V. Schaefer, Jr. School of Engineering

Undergraduate Programs

BACHELOR OF ENGINEERING

The Stevens engineering curriculum is rooted in a tradition that has set it apart since the founding of the Institute in 1870, yet it remains responsive to the changing demands of the workplace into which you graduate. The Stevens tradition recognizes the value of a broad core curriculum that provides significant breadth in engineering, the sciences and the humanities, combined with the necessary depth in your chosen engineering discipline.

To meet these goals, the Charles V. Schaefer, Jr. School of Engineering offers a demanding curriculum. It prepares you technically and instills a work ethic that has proven of considerable value to our graduates throughout their lives. In addition to strong technical competencies in general engineering and the specific discipline, the curriculum teaches key competencies that are highly valued by employers. These include strong problem-solving skills, effective team-participation skills and the ability to communicate effectively, in both written and oral modes.

A major vehicle for achieving these competencies in the engineering curriculum is the Design Spine. The Design Spine is a sequence of design courses each semester; initially it is integrated with science and engineering core courses and, in future semesters, the discipline-specific program. Design is at the heart of engineering. Design activities allow you to gain confidence in applying and reinforcing the knowledge learned in the classroom.

As an engineering student, you take core courses for the first three semesters. The choice of the engineering discipline in which you will concentrate is made late in the third semester. You are provided many opportunities to explore the various engineering fields.

You may choose to specialize in biomedical, chemical, civil, computer, electrical, environmental or mechanical engineering, as well as engineering management. A program in engineering is also available which presently has concentrations in information systems engineering, naval engineering and biomedical engineering.

A strength of the Stevens engineering curriculum is the requirement of a humanities course in each of the eight semesters of the program. You may take advantage of this as a platform when opting to add a humanities minor by taking several extra courses, or to pursue the double degree program, a B.A. degree in addition to the B.E. degree.

The following pages outline the structure of the engineering curriculum by semester, showing core course and technical elective requirements. Specific concentrations are described by the department, as are requirements for their minor programs.

Mission and Objectives

The Charles V. Schaefer, Jr. School of Engineering is dedicated to educating students to have the breadth and depth required to lead in their chosen profession in an environment replete with the excitement of new knowledge and technology creation.

The graduates of the Charles V. Schaefer, Jr. School of Engineering shall:

- Demonstrate technical competence in engineering design and analysis consistent with the practice of a specialist and with the broad perspective of the generalist.
- Develop the hallmarks of professional conduct, including a keen cognizance of ethical choices, together with the confidence and skills to lead, to follow, and to transmit ideas effectively.
- Inculcate learning as a lifelong activity and as a means to the creative discovery, development,

and implementation of technology.

Our graduate programs prepare students to:

- expand the scope of their professional activities in academia, industry and government, and increase the diversity of their careers; and
- create and transfer knowledge through cutting-edge research, and succeed in bringing innovations to the marketplace.

Course Sequence

The general template of the engineering curriculum for all programs is as follows:

Freshman Year

Term I

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
Ch 107	General Chemistry IA	2	0	2
Ch 117	General Chemistry Lab I	0	3	1
Ma 115	Math Analysis I	3	0	3
PEP 101	Physics I	3	0	3
E 121	Engineering Design I	0	3	2
E 120	Engineering Graphics	0	2	1
E 115	Intro. To Programming	1	1.5	2
Hu	Humanities	3	0	3
PE 200	Phys. Ed. I	0	2	1
	TOTAL	**12**	**11.5**	**18**

Term II

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
Ch 116	General Chemistry II	3	0	3
Ch 118	General Chemistry Lab II	0	3	1
Ma 116	Math Analysis II	3	0	3
PEP 102	Physics II	3	0	3
E 122	Engineering Design II	0	3	2
E 126	Mechanics of Solids	4	0	4
Hu	Humanities	3	0	3
PE 200	Phys Ed. II	0	2	1
	TOTAL	**16**	**8**	**20**

Sophomore Year

Term III

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.

Ma 221	Differential Equations	4	0	4
PEP 201	Physics III	2	0	2
PEP 211	Physics Lab for Engin.	0	3	1
E 234	Thermodynamics	3	0	3
E 245	Circuits & Systems	2	3	3
E 231	Engineering Design III	0	3	2
Hu	Humanities	3	0	3
PE 200	Phys Ed. III	0	2	1
	TOTAL	**14**	**11**	**19**

Term IV

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
Ma 227	Multivariate Calculus	3	0	3
E 246	Electronics & Instrument	3	0	3
E 232	Engineering Design IV	0	3	2
E 243	Prob & Stat or	3	0	3
T.E.	Technical Elective ‡			
T.E.	Technical Elective ‡	4	0	4
Hu	Humanities	3	0	3
PE 200	Phys Ed. IV	0	2	1
	TOTAL	**16**	**5**	**19**

Junior Year

Term V

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
E 342	Transport/Fluid Mech. ‡	3	3	4
E 344	Materials Processing	3	0	3
E 321	Engineering Design V	0	3	2
E 243	Prob & Stat or	3	0	3
T.E.	Technical Elective ‡			
T.E.	Technical Elective ‡	3	0	3
Hu	Humanities	3	0	3
PE 200	Phys. Ed. V	0	2	1
	TOTAL	**15**	**8**	**19**

Term VI

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
E 345	Modeling & Simulation ‡	3	0	3

E 355	Engineering Economics	3	3	4
E 322	Engineering Design VI ‡	1	3	2
T.E.	Technical Elective ‡	3	0	3
T.E.	Technical Elective ‡	3	0	3
Hu	Humanities	3	0	3
PE 200	Phys Ed. VI	0	2	1
	TOTAL	**16**	**8**	**19**

Senior Year

Term VII

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
T.E.	Technical Elective ‡	3	0	3
T.E.	Technical Elective ‡	3	0	3
E	Elective	3	0	3
E 423	Engineering Design VII[1]	0	8	3
E 421	Entr. Analysis of Design	1	3	2
Hu	Humanities	3	0	3
	TOTAL	**13**	**11**	**17**

Term VIII

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
T.E.	Technical Elective ‡	3	0	3
T.E.	Technical Elective ‡	3	0	3
E	Elective	3	0	3
E 424	Engineering Design VIII ‡	0	8	3
Hu	Humanities	3	0	3
	TOTAL	**12**	**8**	**15**

‡ Discipline specific course
All students must satisfy an English Language proficiency requirement.

ENGINEERING PROGRAM

In addition to offering accredited B.E. degree programs in specific engineering disciplines, Stevens also offers an accredited B.E. Degree program in Engineering. The B.E. in Engineering is founded on the strength of the extensive Stevens' core curriculum in exposing students to a breadth of engineering topics while allowing for concentration in an engineering area. In this regard it allows for a somewhat more flexible program than is typically available in a specialized B.E. program. At present, concentrations are offered in Information Systems Engineering, Naval Engineering and in Biomedical Engineering under the Engineering program*. Several technical electives within the program can be tailored to a student's interests under the guidance of the program faculty advisor.

*Note: This program differs from the recently instituted specialized B.E. Program in biomedical engineering. The latter is not yet eligible for accreditation.

Engineering with a concentration in Information Systems Engineering

The Departments of Systems Engineering and Engineering Management (SEEM) and Electrical and Computer Engineering (ECE) jointly offer an Information Systems Engineering (ISE) concentration under the Engineering Program in the undergraduate curriculum.

The goal of the ISE concentration is to produce graduates with a broad engineering foundation who can be effective in the analysis, design, construction, implementation and management of information systems.

The program consists of a core of 6 classes taken by all students in the concentration. A student can choose either a focus area in information systems management or networked information systems. The following lists typical electives within each focus. Other appropriate electives can be chosen with the approval of a faculty advisor.

Network Information Systems (NIS)
CpE 360 Data Structures and Algorithms
CpE 491 Information Systems II
CpE xxx Wireless Network Systems

Information Systems Management (ISM)
EM 301 Engineering Cost Management
EM 466 Total Quality Control
SYS 5xx Business Process Engineering

Engineering – Concentration in Information Systems Engineering

Freshman Year

Term I

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
Ch 107	General Chemistry I	2	0	2
Ch 117	General Chemistry Lab I	0	3	1
Ma 115	Math Analysis I	3	0	3
PEP 101	Physics I	3	0	3
E 121	Engineering Design I	0	3	2
E 120	Engineering Graphics	0	2	1
E 115	Intro to Programming	1	1.5	2
Hu	Humanities	3	0	3
PE 200	Physical Education	0	2	1
	Total	**12**	**11.5**	**18**

Term II

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
Ch 116	General Chemistry II	3	0	3
Ch 118	General Chemistry Lab II	0	3	1
Ma 116	Math Analysis II	3	0	3
PEP 102	Physics II	3	0	3
E 122	Engineering Design II	0	3	2

E 126	Mechanics of Solids	4	0	4
Hu	Humanities	3	0	3
PE 200	Physical Education II	0	2	1
	Total	**16**	**8**	**20**

Sophomore Year

Term III

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
Ma 221	Differential Equations	4	0	4
PEP 201	Physics III	2	0	2
PEP 211	Physics Lab	0	3	1
E 234	Thermodynamics	3	0	3
E 245	Circuits and Systems	2	3	3
E 231	Engineering Design III	0	3	2
Hu	Humanities	3	0	3
PE 200	Physical Education III	0	2	1
	Total	**14**	**11**	**19**

Term IV

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
Ma 227	Multivariate Calculus	3	0	3
E 246	Electronics and Instrument	3	0	3
E 232	Engineering Design IV	0	3	2
EM 275	Project Management	3	0	3
CpE xxx	Intro to Network Systems	3	0	3
Hu	Humanities	3	0	3
PE 200	Physical Education IV	0	2	1
	Total	**15**	**5**	**18**

Junior Year

Term V

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
E 342	Transport/Fluid Mech.[1]	3	3	4
E 344	Materials Processing	3	0	3
E 321	Engineering Design V	0	3	2
E 243	Prob. & Stat	3	0	3
CpE 490	Information Systems I	3	0	3
Hu	Humanities	3	0	3

PE 200	Physical Education V	0	2	1
	Total	**15**	**8**	**19**

Term VI

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
E 345	Modeling & Simulation[1]	3	0	3
E 355	Engineering Management	3	3	4
E 322	Engineering Design VI[1]	1	3	2
T.E.	Technical Elective[1]	3	0	3
T.E.	Technical Elective[1]	3	0	3
Hu	Humanities	3	0	3
PE 200	Physical Education VI	0	2	1
	Total	**16**	**8**	**19**

Senior Year

Term VII

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
SYS/CpE 5xx	Database Systems & Knowledge & Data Mining	3	0	3
CpE 493	Data and Comp. Comm	3	0	3
E	Elective	3	0	3
E 423	Engineering Design VII	0	8	3
SYS 402	Innovative Systm. Design	3	0	3
Hu	Humanities	3	0	3
	Total	**15**	**8**	**18**

Term VIII

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
E 421	Entr. Analysis of Design	1	3	2
T.E.	Technical Elective[1]	3	0	3
E	Elective	3	0	3
E 424	Engineering Design VIII[1]	0	8	3
Hu	Humanities	3	0	3
	Total	**10**	**11**	**14**

[1] Discipline specific courses

Engineering with a concentration in Naval Engineering

Building on its research strengths and long-term leadership in the fields of Naval Architecture and Ocean Engineering, Stevens is well-positioned to offer a unique program in Naval Engineering under the auspices of the broad-based Engineering curriculum. The program is offered as a concentration under the Engineering program and makes extensive use of the Davidson Laboratory's world-class experimental and modeling facilities. Emphasis is on the applied sciences and engineering courses that provide the groundwork for true innovation in ship design. The program culminates in a comprehensive, one-year ship design project that includes hands-on physical modeling in the towing tank and computer modeling using CFD codes resident in the Laboratory.

Engineering – Concentration in Naval Engineering

Freshman Year

Term I

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
Ch 107	General Chemistry I	2	0	2
Ch 117	General Chemistry Lab I	0	3	1
Ma 115	Math Analysis I	3	0	3
PEP 101	Physics I	3	0	3
E 121	Engineering Design I	0	3	2
E 120	Engineering Graphics	0	2	1
E 115	Intro to Programming	1	1.5	2
Hu	Humanities	3	0	3
PE 200	Physical Education	0	2	1
	Total	**12**	**11.5**	**18**

Term II

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
Ch 116	General Chemistry II	3	0	3
Ch 118	General Chemistry Lab II	0	3	1
Ma 116	Math Analysis II	3	0	3
PEP 102	Physics II	3	0	3
E 122	Engineering Design II	0	3	2
E 126	Mechanics of Solids	4	0	4
Hu	Humanities	3	0	3
PE 200	Physical Education II	0	2	1
	Total	**16**	**8**	**20**

Sophomore Year

Term III

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
Ma 221	Differential Equations	4	0	4
PEP 201	Physics III	2	0	2

PEP 211	Physics Lab for Engin.	0	3	1
E 234	Thermodynamics	3	0	3
E 245	Circuits and Systems	2	3	3
E 231	Engineering Design III	0	3	2
Hu	Humanities	3	0	3
PE 200	Physical Education III	0	2	1
	Total	**14**	**11**	**19**

Term IV

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
Ma 227	Multivariate Calculus	3	0	3
E 246	Electronics and Instrument	3	0	3
E 232	Engineering Design IV	0	3	2
E 243	Probability and Statistics	3	0	3
CE 373	Structural Analysis	3	0	3
Hu	Humanities	3	0	3
PE 200	Physical Education IV	0	2	1
	Total	**15**	**5**	**18**

Junior Year

Term V

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
E 342	Transport/Fluid Mech.[1]	3	3	4
E 344	Materials Processing	3	0	3
E 321	Engineering Design V	0	3	2
OExxx	Intro to Ship Design and Shipbuilding	3	0	3
OE 527	Laboratory in Naval Arch.	1	3	3
Hu	Humanities	3	0	3
PE 200	Physical Education V	0	2	1
	Total	**13**	**11**	**19**

Term VI

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
OE 528	Comp.-aided Ship Design	3	0	3
E 355	Engineering Economics	3	3	4
E 322	Engineering Design VI[1]	1	3	2
OE 525	Principles of Naval Arch.	3	0	3
OExxx	Marine Structures	3	0	3

Hu	Humanities	3	0	3
PE 200	Physical Education VI	0	2	1
	Total	**16**	**8**	**19**

Senior Year

Term VII

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
E 421	Entr. Analysis of Design	1	3	2
E	Elective	3	0	3
E 423	Engineering Design VII[1]	0	8	3
T.E.	Technical Elective	3	0	3
T.E.	Technical Elective	3	0	3
Hu	Humanities	3	0	3
	Total	**13**	**11**	**17**

Term VIII

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
OExxx	Total Ship Design	4	0	4
T.E.	Hydrodynamics or Underwater Acoustics	3	0	3
E	Elective	3	0	3
E 424	Engineering Design VIII[1]	0	8	3
Hu	Humanities	3	0	3
	Total	**13**	**8**	**16**

[1] Discipline specific course

Engineering with a Concentration in Biomedical Engineering

In addition to offering Biomedical Engineering as a separate program, it is also offered as a concentration under the Engineering program. As such the elective selection can be made to provide a broader engineering reach at the expense of some depth within the biomedical engineering discipline.

A typical Sequence for Engineering with a concentration in biomedical engineering

Freshman Year

Term I

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
Ch 107	General Chemistry IA	2	0	2
Ch 117	General Chemistry Lab I	0	3	1
Ma 115	Math Analysis I	3	0	3

PEP 101	Physics I	3	0	3
E 121	Engineering Design I	0	3	2
E 120	Engineering Graphics	0	2	1
E 115	Intro to Programming	1	1.5	2
Hu	Humanities	3	0	3
PE 200	Physical Education	0	2	1
	Total	**12**	**11.5**	**18**

Term II

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
Ch 116	General Chemistry II	3	0	3
Ch 118	General Chemistry Lab II	0	3	1
Ma 116	Math Analysis II	3	0	3
PEP 102	Physics II	3	0	3
E 122	Engineering Design II	0	3	2
E 126	Mechanics of Solids	4	0	4
Hu	Humanities	3	0	3
PE 200	Physical Education II	0	2	1
	Total	**16**	**8**	**20**

Sophomore Year

Term III

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
Ma 221	Math Analysis III	4	0	4
PEP 201	Physics III	2	0	2
PEP 211	Physics Lab for Engin.	0	3	1
E 234	Thermodynamics	3	0	3
E 245	Circuits and Systems	2	3	3
E 231	Engineering Design III	0	3	2
Hu	Humanities	3	0	3
PE 200	Physical Education III	0	2	1
	Total	**14**	**11**	**19**

Term IV

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
Ma 227	Math Analysis IV	3	0	3
E 246	Electronics and Instrumentat	3	0	3
E 232	Engineering Design IV	0	3	2

Ch 281	Biology and Biotechnology	3	0	3
Ch 282	Intro Biology Lab	0	3	1
BME 306	Intro to BME	3	0	3
Hu	Humanities	3	0	3
PE 200	Physical Education IV	0	2	1
	Total	**15**	**8**	**19**

Junior Year

Term V

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
BME 342	Transport in Bio. Sys.	3	3	4
E 344	Materials Processing	3	0	3
E 321	Engineering Design V	0	3	2
Ch 381	Cell Biology	3	3	4
Ch 241	Organic Chemistry I	3	4	4
Hu	Humanities	3	0	3
PE 200	Physical Education V	0	2	1
	Total	**15**	**15**	**21**

Term VI

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
T.E.	Technical Elective	3	0	3
T.E.	Technical Elective	3	0	3
E 355	Engineering Economics	3	3	4
BME 322	Engineering Design VI	1	3	2
Ch 242	Organic Chemistry II	3	4	4
Hu	Humanities	3	0	3
PE 200	Physical Education VI	0	2	1
	Total	**16**	**12**	**20**

Senior Year

Term VII

		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
BME 482	Engineering Physiology	3	3	4
	Elective	3	0	3
E 243	Probability and Statistics	3	0	3
BME 423	Senior Design VII	0	8	3
E 421	Entr. Analysis of Design	1	3	2

Hu	Humanities	3	0	3
	Total	**13**	**14**	**18**

Term VIII				
		Hrs. Per Wk.		
		Class	Lab	Sem. Cred.
BME 445	Biosystems Sim. & Con	3	3	4
	Elective	3	0	3
T.E.	Technical Elective	3	0	3
BME 424	Senior Design VIII	0	8	3
Hu	Humanities	3	0	3
	Total	**12**	**11**	**16**

DOUBLE DEGREE PROGRAM

You may elect to pursue a B.E. Degree concurrently with a B.S. Degree, or a second B.E. Degree You must satisfy all of the requirements for both degrees (including two Senior Design sequences for the case of two B.E. degrees), and to have completed at least 24 credits beyond the higher of the two program requirements. Two Study Plans are required if you elect this option.

Core Curriculum

E 115 Introduction to Programming for Engineers
(1-1.5-2)
An introduction to the use of an advanced programming language for use in engineering applications, using C++ as the basic programming language and MS Visual C++ as the program development environment. Topics covered include basic syntax (data types and structures, input/output instructions, arithmetic instructions, loop constructs, functions, subroutines, etc.) needed to solve basic engineering problems as well as an introduction to advanced topics (use of files, principles of objects and classes, libraries, etc.). Algorithmic thinking for development of computational programs and control programs from mathematical and other representations of the problems will be developed. Basic concepts of computer architectures impacting the understanding of a high-level programming language will be covered. Basic concepts of a microcontroller architecture impacting the use of a high-level programming language for development of microcontroller software will be covered, drawing specifically on the microcontroller used in E121 (Engineering Design I). Corequisite: E121.

E 120 Engineering Graphics
(0-2-1)
Engineering graphics: principles of orthographic and auxiliary projections, pictorial presentation of engineering designs, dimensioning and tolerance, sectional and detail views, assembly drawings. Descriptive geometry. Engineering figures and graphs. Solid modeling introduction to computer-aided design and manufacturing (CAD/CAM) using numerically-controlled (NC) machines.

E 121 Engineering Design I
(0-3-2)
This course introduces students to the process of design and seeks to engage their enthusiasm for engineering from the beginning of the program. The engineering method is used in the design and manufacture of a product. Product dissection is exploited to evaluate how others have solved design problems. Development is started on competencies in professional practice topics, primarily: effective group participation, project management, cost estimation, communication skills and ethics. Engineering Design I is linked to and taught concurrently with the Engineering Graphics course. Engineering graphics are used in the design projects and the theme of "fit to form" is developed. Corequisite: E 115, E 120.

E 122 Engineering Design II
(0-3-2)
This course continues the freshman year experience in design. Design projects are linked to the Mechanics

of Solids course (integrated Statics and Strength of Materials) taught concurrently. The engineering method introduced in Engineering Design I is reinforced. Further introduction of professional practice topics are linked to their application and testing in case studies and project work. Basic concepts of design for environment and aesthetics are introduced. Prerequisite: E 121. Corequisite: E 126.

E 126 Mechanics of Solids
(4-0-4)
Fundamental concepts of particle statics, equivalent force systems, equilibrium of rigid bodies, analysis of trusses and frames, forces in beam and machine parts, stress and strain, tension, shear and bending moment, flexure, combined loading, energy methods, statically indeterminate structures. Prerequisites: PEP 101 or PEP 111, Ma 115.

E 127 Mechanics of Solids (Statics Module)
Fundamental concepts of particle statics, equivalent force systems, equilibrium of rigid bodies, analysis of trusses and frames, forces in beam and machine parts, stress and strain, tension, shear and bending moment, flexure, combined loading, energy methods, statically indeterminate structures. Prerequisites: PEP 101 or PEP 111, Ma 115. Must be completed along with E 122 Engineering Design II.

E 128 Mechanics of Solids (Strength of Materials Module)
Fundamental concepts of particle statics, equivalent force systems, equilibrium of rigid bodies, analysis of trusses and frames, forces in beam and machine parts, stress and strain, tension, shear and bending moment, flexure, combined loading, energy methods, statically indeterminate structures. Prerequisites: PEP 101 or PEP 111, Ma 115, E 127. Must be completed along with E 122 Engineering Design II.

E 231 Engineering Design III
(0-3-2)
This course continues the experiential sequence in design. Design projects are linked with Thermodynamics and Circuits and Systems courses taught concurrently. Core design themes are further developed. Prerequisite: E 122. Corequisites: E 234 and E 245.

E 232 Engineering Design IV
(0-3-2)
This course continues the experiential sequence in design. Design projects are linked with the Electronics and Instrumentation course taught concurrently. Core design themes are further developed. Prerequisite: E 231. Corequisite: E 246.

E 234 Thermodynamics
(3-0-3)
Concepts of heat and work, First and Second Laws for closed and open systems including steady processes and cycles, thermodynamic properties of substances and interrelationships, phase change and phase equilibrium, chemical reactions and chemical equilibrium, representative applications. Prerequisites: PEP 101 or PEP 111, Ch 107 or Ch 115, Ma 115.

E 243 Probability and Statistics for Engineers
(3-0-3)
Descriptive statistics, pictorial and tabular methods, measures of location and of variability, sample space and events, probability and independence, Bayes formula, discrete random variables, densities and moments, normal, gamma, exponential and Weibull distributions, distribution of the sum and average of random samples, the central limit theorem, confidence intervals for the mean and the variance, hypothesis testing and p-values, applications for prediction in a regression model. A statistical computer package is used throughout the course for teaching and for project assignments. Prerequisite: Ma 116.

E 245 Circuits and Systems
(2-3-3)
Ideal circuit elements; Kirchoff laws and nodal analysis; source transformations; Thevenin/Norton theorems; operational amplifiers; response of RL, RC and RLC circuits; sinusoidal sources and steady state analysis; analysis in frequently domain; average and RMS power; linear and ideal transformers; linear models for transistors and diodes; analysis in the s-domain; Laplace transforms; transfer functions. Prerequisite: PEP 102 or PEP 112. Corequisite: Ma 221.

E 246 Electronics and Instrumentation
(3-0-3)
Review of ac analysis, phasors, power, energy, node equations, transformers, maximum power transfer, Laplace transforms; Fourier series and transforms; Filters; Bode plots; Op-amps, ideal, difference, summing, integrating; Wheatstone bridge; Strain gauge; Position & Pressure Transducers; Thermistors;

Instrumentation Amplifiers; Ideal diodes, full & ½ wave rectifiers; Battery eliminator design; Non-ideal diodes, non-linear analysis; Junction transistors, DC models, saturation and cut-off; Boolean algebra; Logic gates; A to D Converters. Prerequisite: E 245.

E 321 Engineering Design V
(0-3-2)
This course includes both experimentation and open-ended design problems that are integrated with the Materials Processing course taught concurrently. Core design themes are further developed. Corequisite: E 344.

E 322 Engineering Design VI
[discipline specific]
(1-3-2)
This course allows each discipline to address design topics specific to their discipline. The latter part of this course is structured to allow for project selection, team formation and preparation of a proposal suitable for submission to a potential sponsor for the senior design capstone project. Core design themes are further developed. Prerequisite: E 321. Corequisites: E 345 (discipline specific) and E 355.

E 342 Transport/Fluid Mechanics
[discipline specific]
(3-3-4)
Offered as a specific departmental course; e.g., see ME departmental listing.

E 344 Materials Processing
(3-0-3)
An introduction is provided to the important engineering properties of materials, to the scientific understanding of those properties and to the methods of controlling them. This is provided in the context of the processing of materials to produce products. Prerequisite: Ch 116 and Ch 118.

E 345 Modeling and Simulation
[discipline specific]
(3-0-3)
Development of deterministic and non-deterministic models for physical systems, engineering applications, simulation tools for deterministic and non-deterministic systems, case studies and projects.

E 355 Engineering Economics
(3-3-4)
Basics of cost accounting and cost estimation, cost-estimating techniques for engineering projects, quantitative techniques for forecasting costs, cost of quality. Basic engineering economics, including capital investment in tangible and intangible assets. Engineering project management techniques, including budget development, sensitivity analysis, risk and uncertainty analysis and total quality management concepts. Prerequisites: E 121, E 122, E 231 and E 232.

E 400 Research in Engineering
(up to 6 credits total)
Individual research investigation under the guidance of a faculty advisor. Hours/credits to be arranged. A final report/thesis and a formal presentation in a seminar/conference is required. Prerequisite: Senior standing.

E 421 Entrepreneurial Analysis of Engineering Design
(1-3-2)
This course provides students with tools needed to commercialize their senior design technology. Topics include engineering economic analysis and issues of marketing, venture capital, intellectual property and project management. These topics are from the view of an entrepreneur who is creating knowledge that can be licensed and/or used in a start-up business. These topics are critical elements in implementing Technogenesis. Prerequisites: E 355 and E 321.

E 423-424 Engineering Design VII-VIII
[discipline specific]
(0-8-3) (0-8-3)
Senior design capstone courses include a capstone project spanning two semesters. While the focus is on the capstone disciplinary design experience, all programs include the two-credit core module on Entrepreneurial Analysis of Engineering Design (E 421) during the first semester. Prerequisite: Senior standing.