Ingram School of Engineering

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Degree Programs Offered

Bachelor of Science (BS), major in Electrical Engineering
(Computer Engineering Specialization)
Bachelor of Science (BS), major in Electrical Engineering
(Micro and Nano Devices and Systems Specialization)
Bachelor of Science (BS), major in Electrical Engineering
(Networks and Communication Systems Specialization)
Bachelor of Science (BS), major in Industrial Engineering
Bachelor of Science (BS), major in Manufacturing Engineering
(General Manufacturing Concentration)
Bachelor of Science (BS), major in Manufacturing Engineering
(Mechanical Systems Concentration)
Bachelor of Science (BS), major in Manufacturing Engineering
(Semiconductor Manufacturing Concentration)

The BS with a major in Electrical Engineering provides students the background that is essential for the conception, design, development, and manufacture of electrical, electronic and information technology products and systems. Students may specialize in the areas of networks and communication systems, micro and nano devices and systems, or computer engineering. Proficiency in mathematics is especially important in Electrical Engineering. In order to be admitted to the EE program, a student needs to be qualified to take MATH 2417 or higher.

The BS with a major in Industrial Engineering provides students the background that is essential for improving the productivity, quality, safety, and cost effectiveness of all types of systems and processes. Industrial engineers are typically engaged in the areas of quality assurance, ergonomics, production and operations management, facilities design, work design, system optimization, information technology, and industrial safety.

The BS with a major in Manufacturing Engineering is designed to provide students with the mathematics, science, management, engineering, and applications skills needed to become manufacturing engineers. These engineers are typically responsible for promoting manufacturability, process planning, tool design, cost estimation, factory layout, work methods, quality assurance, automation, and systems integration. The degree has a concentration in general manufacturing, mechanical systems or semiconductor/high technology manufacturing. The BS with a major in Manufacturing Engineering is accredited by ABET, Inc.

For information on engineering technology or industrial technology, please see the Department of Engineering Technology and Physics section of this catalog.

The Ingram School of Engineering Mission Statement

1. To provide students with an exceptional education in various disciplines of engineering,
2. To establish, through dedicated faculty, a nationally recognized research program, preparing interested students to achieve excellence in graduate studies and research, and
3. To serve the State of Texas and the nation by creating highly skilled, diverse, and motivated professionals capable of technological innovation and dedicated to the improvement of society.

The Ingram School of Engineering Vision Statement

The Ingram School of Engineering will be a nationally recognized institution of higher education, serving students and employers with a complete set of accredited engineering programs supported by a faculty which maintains high standards of teaching, research, and service. To accomplish this vision, we will:

1. Engage undergraduate and graduate students with innovative, multidisciplinary, and nationally recognized funded research programs,
2. Emphasize quality undergraduate and graduate education using a practical, interactive, and contemporary learning environment,
3. Produce first-generation professional college graduates as part of an HSI-designated university; be recognized for exceptional community service; and create tight bonds with alumni who will serve as professional mentors, sponsors, and advisors.
4. Promote a student-centered culture based on collegiality, scholarship, enthusiasm, integrity, and mutual respect among diverse faculty, staff, and students.

The Electrical Engineering Mission Statement & Objectives

Our mission is:
To lead students to be innovative, ethical engineering professionals through solid education at the undergraduate level, by providing opportunities to participate in research, and by responding to the needs of the Central Texas region, the state of Texas, and the nation. We achieve this mission by:

* Engaging colleagues and students in new and more effective ways to transmit knowledge to the next generation of electrical engineers.
* Engaging colleagues and students in pioneering, scholarly, multidisciplinary research efforts.
* Creating an inclusive environment which emphasizes ethics and integrity and fosters creativity, appreciation for all ideas, and respect for others
* Seeking and maintaining bonds with our alumni and the industries which hire them.
* Maintaining a student-centered atmosphere for undergraduate education and research.

The objectives of the program are to produce graduates who:

1. Analyze, design, develop, optimize, and implement complex systems in the context of modern interdisciplinary engineering work.
2. Contribute to the solution of practical problems in industrial, service, and government organizations by applying skills acquired

through formal and lifelong learning.
3. Enjoy fulfilling engineering careers, including professional advancement, entrepreneurship, and the pursuit of graduate studies.
4. Practice engineering while observing appropriate technological, organizational, societal, global, and ethical contexts.

The Industrial Engineering Mission Statement & Objectives

Our mission is:

To provide an excellent and innovative education setting to our students so they can learn and discover how complex systems work better. The IE program strives to maintain a comprehensive curriculum that enables students to become leading engineers and/or creative researchers in the global marketplace and/or in graduate studies. The program seeks to collaborate with private and public sectors in the search of methodologies and creative solutions to problems that contribute to the advancement of education, technology, and professional development. Through plans and activities that search to embrace a student population of strong diversity, the program attempts to be a significant provider of global workforce.

The objectives of the program are to produce graduates who:

1. Perform as industry leaders in the global marketplace, capable of successfully planning, controlling, and implementing large-scale projects.
2. Understand and apply the principles of science, technology, engineering, and math involving industry-relevant problems.
3. Contribute to the profitable growth of industrial economic sectors by using IE analytical tools, effective computational approaches, and systems thinking methodologies.
4. Maintain high standards of professional and ethical responsibility.
5. Flourish and work effectively in diverse, multicultural environments emphasizing the application of teamwork and communication skills.
6. Practice life-long learning to sustain technical currency and excellence throughout one's career. Promote the profession and its benefits to society.

The Manufacturing Engineering Mission Statement & Objectives

Our mission is:

* To sustain a quality, student-centered, industry-oriented engineering curriculum.
* To attract students and prepare them with the knowledge, practical skills, and abilities to perform as highly competent engineers in the global marketplace and/or in graduate studies.
* To produce graduates skilled in materials and manufacturing processes: process; assembly and product engineering; manufacturing competitiveness and systems design.

The objectives of the program are to produce graduates who:

1. Perform as engineering leaders in the global marketplace.
2. Understand and apply the principles of math, science, and engineering in design and manufacturing related activities.
3. Contribute to the profitable growth of manufacturing businesses.
4. Maintain high standards of professional and ethical responsibility.
5. Practice life-long learning.

Bachelor of Science (BS)
Major in Electrical Engineering
(Micro and Nano Devices and Systems Specialization)
Minimum required: 137 semester hours

General Requirements:

1. In order to declare Electrical Engineering as a major, students must meet one of the following prerequisites: ACT Math score of 24 or higher, SAT Math score of 520 (re-centered) or higher, or credit for one of the following math courses with a grade of "C" or higher: MATH 1315, 1317, 1319, or 1329. Students who do not meet the above prerequisites may choose Pre- Electrical Engineering as their major. Pre- Electrical Engineering students who complete one of the following math courses with a grade of "C" or higher may declare Electrical Engineering as their major: MATH 1315, 1317, 1319, or 1329.
2. All Electrical Engineering majors must complete Electrical Engineering (EE) course prerequisites with a grade of "C" or higher.
3. A minimum of 9 writing intensive hours and a total of 36 advanced hours are required to graduate. An advanced course is one that is numbered above 3000 and below 5000.
4. Departmental requirements that also satisfy the general education core curriculum requirements for the following components: mathematics- MATH 2471; natural science- CHEM 1341/1141 and PHYS 1430; and social science- ECO 2301 or ECO 2314,. See the Academic Services section of this catalog for the English literature requirements.
5. If two years of the same language are taken in high school, then no additional language hours will be required for the degree. In the absence of such high school language, two semesters of the same modern language must be taken at the college level.
6. Electrical Engineering degrees include all the courses required for an Applied Mathematics Minor.

Freshman Year - 1st Semester		Freshman Year - 2nd Semester		Freshman Year - Summer		Sophomore Year - 1st Semester	
Course	Hr	Course	Hr	Course	Hr	Course	Hr
CHEM 1341, 1141	4	PHYS 1430	4	ENG Lit (see gen. req. 2)	3	EE 2400	4
COMM 1310	3	ENGR 2300	3	HIST 1320	3	MATH 3323	3
MATH 2471	4	MATH 2472	4	PFW one course	1	MATH 3373	3
US 1100	1	ENG 1320	3	PHIL 1305 or 1320	3	PHYS 2425	4
ENG 1310	3	HIST 1310	3			CS 1428	4
Total	15	Total	17	Total	10	Total	18

Sophomore Year - 2nd Semester		Sophomore Year - Summer		Junior Year - 1st Semester		Junior Year - 2nd Semester	
Course	Hr	Course	Hr	Course	Hr	Course	Hr
EE 2420	4	POSI 2310	3	EE 3400	4	MFGE 4392	3
MATH 3375	3	PFW one course	1	EE 3340	3	EE 3350	3
MATH 3377	3			EE 3420	4	EE 3355	3
PHYS 2435	4			IE 3320	3	EE 3370	3
ECO 2301	3			POSI 2320	3	ART, DAN, MU, or TH 2313	3
Total	17	Total	4	Total	17	Total	15

Senior Year - 1st Semester		Senior Year - 2nd Semester	
Course	Hr	Course	Hr
EE 4350	3	EE 4355 or MFGE 4394	3
EE 4352	3	EE 4321, 4351, 4353, 4354, or 4358	6
EE 4390	3	EE 4391	3
ENGR 3315	3		
Total	12	Total	12

Bachelor of Science (BS)
Major in Electrical Engineering
(Networks and Communication Systems Specialization)
Minimum required: 137 semester hours

General Requirements:

1. In order to declare Electrical Engineering as a major, students must meet one of the following prerequisites: ACT Math score of 24 or higher, SAT Math score of 520 (re-centered) or higher, or credit for one of the following math courses with a grade of "C" or higher: MATH 1315, 1317, 1319, or 1329. Students who do not meet the above prerequisites may choose Pre- Electrical Engineering as their major. Pre- Electrical Engineering students who complete one of the following math courses with a grade of "C" or higher may declare Electrical Engineering as their major: MATH 1315, 1317, 1319, or 1329.
2. All Electrical Engineering majors must complete Electrical Engineering (EE) course prerequisites with a grade of "C" or higher.
3. A minimum of 9 writing intensive hours and a total of 36 advanced hours are required to graduate. An advanced course is one that is numbered above 3000 and below 5000.
4. Departmental requirements that also satisfy the general education core curriculum requirements for the following components: mathematics- MATH 2471; natural science- CHEM 1341/1141 and PHYS 1430; and social science- ECO 2301 or ECO 2314. See the Academic Services section of this catalog for the English literature requirements.
5. If two years of the same language are taken in high school, then no additional language hours will be required for the degree. In the absence of such high school language, two semesters of the same modern language must be taken at the college level.
6. Electrical Engineering degrees include all the courses required for an Applied Mathematics Minor.

Freshman Year - 1st Semester		Freshman Year - 2nd Semester		Freshman Year - Summer		Sophomore Year - 1st Semester	
Course	Hr	Course	Hr	Course	Hr	Course	Hr
CHEM 1341, 1141	4	PHYS 1430	4	ENG Lit (see gen. req. 2)	3	EE 2400	4
MATH 2471	4	ENGR 2300	3	HIST 1320	3	MATH 3323	3
US 1100	1	MATH 2472	4	PFW one course	1	MATH 3373	3
ENG 1310	3	ENG 1320	3	PHIL 1305 or 1320	3	PHYS 2425	4
COMM 1310	3	HIST 1310	3			CS 1428	4
Total	15	Total	17	Total	10	Total	18

Sophomore Year - 2nd Semester		Sophomore Year - Summer		Junior Year - 1st Semester		Junior Year - 2nd Semester	
Course	Hr	Course	Hr	Course	Hr	Course	Hr
EE 2420	4	POSI 2310	3	EE 3400	4	EE 3420	4
MATH 3375	3	PFW one course	1	EE 3340	3	EE 3350	3
MATH 3377	3			ENGR 3315	3	EE 3355	3
PHYS 2435	4			IE 3320	3	EE 3370	3
ECO 2301	3			POSI 2320	3	ART, DAN, MU, or TH 2313	3
Total	17	Total	4	Total	16	Total	16

Senior Year - 1st Semester		Senior Year - 2nd Semester	
Course	Hr	Course	Hr
EE 4350	3	EE 4372	3
EE 4370	3	EE 4321, 4355, 4374, 4378 (choose two)	6
EE 4323 or 4377	3	EE 4391	3
EE 4390	3		
Total	12	Total	12

Bachelor of Science (BS)
Major in Electrical Engineering
(Computer Engineering Specialization)
Minimum required: 136 semester hours

General Requirements:

1. In order to declare Electrical Engineering as a major, students must meet one of the following prerequisites: ACT Math score of 24 or higher, SAT Math score of 520 (re-centered) or higher, or credit for one of the following math courses with a grade of "C" or higher: MATH 1315, 1317, 1319, or 1329. Students who do not meet the above prerequisites may choose Pre- Electrical Engineering as their major. Pre- Electrical Engineering students who complete one of the following math courses with a grade of "C" or higher may declare Electrical Engineering as their major: MATH 1315, 1317, 1319, or 1329.
2. All Electrical Engineering majors must complete Electrical Engineering (EE) course prerequisites with a grade of "C" or higher.
3. A minimum of 9 writing intensive hours and a total of 36 advanced hours are required to graduate. An advanced course is one that is numbered above 3000 and below 5000.
4. Departmental requirements that also satisfy the general education core curriculum requirements for the following components: mathematics- MATH 2471; natural science- CHEM 1341/1141 and PHYS 1430; and social science- ECO 2301 or ECO 2314. See the Academic Services section of this catalog for the English literature requirements.
5. If two years of the same language are taken in high school, then no additional language hours will be required for the degree. In the absence of such high school language, two semesters of the same modern language must be taken at the college level.
6. Electrical Engineering degrees include all the courses required for an Applied Mathematics Minor.

Freshman Year - 1st Semester		Freshman Year - 2nd Semester		Sophomore Year - 1st Semester		Sophomore Year - 2nd Semester	
Course	Hr	Course	Hr	Course	Hr	Course	Hr
CHEM 1341, 1141	4	PHYS 1430	4	ENG Literature (see gen. req. 4)	3	EE 3420	4
CS 1428	4	CS 2308	3	MATH 2358	3	MATH 3398	3
MATH 2471	4	MATH 2472	4	EE 2400	4	MATH 3373	3
US 1100	1	ENG 1320	3	PHYS 2425	4	EE 3400	4
ENG 1310	3	EE 2420 or CS 2420	4	MATH 3323	3	CS 3358	3
PFW one course	1						
Total	17	Total	18	Total	17	Total	17

Junior Year - 1st Semester		Junior Year - 2nd Semester		Senior Year - 1st Semester		Senior Year - 2nd Semester	
Course	Hr	Course	Hr	Course	Hr	Course	Hr
HIST 1310	3	HIST 1320	3	PHIL 1305 or 1320	3	ART, DAN, MU, or TH 2313	3
ECO 2301	3	POSI 2310	3	POSI 2320	3	COMM 1310	3
PFW	1	CS 3339	3	CS 3398	3	EE 4391	3
CS 4328	3	EE 3370	3	EE 4372 or CS 4310	3	EE 4321, 4323, CS 4332, 4388 (choose 6	
EE 3350	3	EE 4352	3	EE 4377	3	hours)	6
MATH 3377	3	IE 3320	3	EE 4390	3		
Total	16	Total	18	Total	18	Total	15

Bachelor of Science (BS)
Major in Industrial Engineering
Minimum required: 135 semester hours

General Requirements:

1. In order to declare Industrial Engineering as a major, students must meet one of the following prerequisites: ACT Math score of 24 or higher, SAT Math score of 520 (re-centered) or higher, or credit for one of the following math courses with a grade of "C" or higher: MATH 1315, 1317, 1319, or 1329. Students who do not meet the above prerequisites may choose Pre-Industrial Engineering as their major. Pre-Industrial Engineering students who complete one of the following math courses with a grade of "C" or higher may declare Industrial Engineering as their major: MATH 1315, 1317, 1319, or 1329.
2. A minimum of 9 writing intensive hours and a total of 36 advanced hours are required to graduate. An advanced course is one that is numbered above 3000 and below 5000.
3. Departmental requirements that also satisfy the general education core curriculum requirements for the following components: mathematics- MATH 2471; natural science- CHEM 1341/1141 and PHYS 1430; and social science- ECO 2301. See the Academic Services section of this catalog for the English literature requirements.
4. If two years of the same language are taken in high school, then no additional language hours will be required for the degree. In the absence of such high school language, two semesters of the same modern language must be taken at the college level.
5. Six hours of IE electives to be chosen from: IE 4330 (fall), IE 4340 (fall); MFGE 4367 (spring), MFGE 4392 (spring), IE 4399A, IE 4399B, IE 4399C, IE 4399D.
6. Industrial Engineering degrees include all the courses required for an Applied Mathematics Minor.

Freshman Year - 1st Semester		Freshman Year - 2nd Semester		Sophomore Year - 1st Semester		Sophomore Year - 2nd Semester	
Course	Hr	Course	Hr	Course	Hr	Course	Hr
CHEM 1341, 1141	4	PHYS 1430	4	PHYS 2425	4	CS 1428	4
ENG 1310	3	ENG 1320	3	COMM 1310	3	MATH 3323	3
ENGR 1313	3	ENGR 2300	3	MATH 3377	3	MATH 3375	3
MATH 2471	4	HIST 1310	3	POSI 2310	3	ART, DAN, MU, or TH 2313	3
US 1100	1	MATH 2472	4	MFGE 2332	3	ECO 2301	3
				HIST 1320	3	POSI 2320	3
Total	15	Total	17	Total	19	Total	19

Junior Year - 1st Semester		Junior Year - 2nd Semester		Senior Year - 1st Semester		Senior Year - 2nd Semester	
Course	Hr	Course	Hr	Course	Hr	Course	Hr
ENGR 3311	3	IE 3310	3	IE 4310	3	IE 4320	3
ENGR 3315	3	IE 3330	3	IE 4355	3	IE 4350	3
ENGR 3373	3	IE 3340	3	IE 4380	3	IE Elective (see gen. req. 5)	3
IE 3320	3	IE 3360	3	IE Elective (see gen. req. 5)	3	IE 4390	3
PHIL 1305 or 1320	3	ENG Literature (see gen. req. 3)	3	IE 4360	3	MFGE 4396	3
PFW one course	1	PFW one course	1	IE 4370	3		
Total	16	Total	16	Total	18	Total	15

Bachelor of Science (BS)
Major in Manufacturing Engineering
(General Manufacturing Concentration)
Minimum required: 132 semester hours

General Requirements:

1. A minimum of 9 writing intensive hours and a total of 36 advanced hours are required to graduate. An advanced course is one that is numbered above 3000 and below 5000.
2. Departmental requirements that also satisfy the general education core curriculum requirements for the following components: mathematics- MATH 2471; natural science- CHEM 1341/1141 and PHYS 1430; and social science- ECO 2301. See the Academic Services section of this catalog for the English literature requirements.
3. If two years of the same language are taken in high school, then no additional language hours will be required for the degree. In the absence of such high school language, two semesters of the same modern language must be taken at the college level.
4. Six hours of Manufacturing Processes elective to be chosen from:, TECH 4330 (fall), MFGE 4355, MFGE 4357, MFGE 4367 (spring), or MFGE 4392 (spring), MFGE 4399A, MFGE 4399B, or MFGE 4399C.
5. Three to four hours of Math/ Science elective to be chosen from: MATH 3373, MATH 3330, PHYS 2435, PHYS 3315, or CHEM 1342 and 1142.
6. Manufacturing Engineering degrees include all the courses required for an Applied Mathematics Minor.

Freshman Year - 1st Semester		Freshman Year - 2nd Semester		Sophomore Year - 1st Semester		Sophomore Year - 2nd Semester	
Course	Hr	Course	Hr	Course	Hr	Course	Hr
CHEM 1341, 1141	4	PHYS 1430	4	IE 3320	3	CS 1428	4
ENGR 1313	3	ENGR 2300	3	MATH 3323	3	MATH 3375	3
MATH 2471	4	ENG 1320	3	MFGE 2332	3	ART, DAN, MU, or TH 2313	3
US 1100	1	MATH 2472	4	PHYS 2425	4	ECO 2301	3
ENG 1310	3	COMM 1310	3	HIST 1310	3	HIST 1320	3
PFW one course	1			PFW one course	1		
Total	16	Total	17	Total	17	Total	16

Sophomore Year - Summer		Junior Year - 1st Semester		Junior Year - 2nd Semester		Senior Year - 1st Semester	
Course	Hr	Course	Hr	Course	Hr	Course	Hr
MGT 3303	3	ENGR 3311	3	ENGR 3315	3	MFGE 4363	3
MATH 3377	3	ENGR 3373	3	IE 3330	3	MFGE 4395	3
		Math/Science Elective (see gen. req. 5)	3-4	IE 3360	3	Manufacturing Processes (see gen. req. 4)	3
		PHIL 1305 or 1320	3	MFGE 4365	3	POSI 2320	3
		MFGE 3316	3	POSI 2310	3	IE 4355	3
Total	6	Total	15-16	Total	15	Total	15

Senior Year - 2nd Semester	
Course	Hr
MGT 4330	3
MFGE 4376	3
MFGE 4396	3
Manufacturing Processes (see gen. req. 4)	3
ENG Literature (see gen. req. 2)	3
Total	15

Bachelor of Science (BS)
Major in Manufacturing Engineering
(Mechanical Systems Concentration)
Minimum required: 132 semester hours

General Requirements:

1. A minimum of 9 writing intensive hours and a total of 36 advanced hours are required to graduate. An advanced course is one that is numbered above 3000 and below 5000.
2. Departmental requirements that also satisfy the general education core curriculum requirements for the following components: mathematics- MATH 2471; natural science- CHEM 1341/1141 and PHYS 1430; and social science- ECO 2301. See the Academic Services section of this catalog for the English literature requirements.
3. If two years of the same language are taken in high school, then no additional language hours will be required for the degree. In the absence of such high school language, two semesters of the same modern language must be taken at the college level.
4. Six hours of Mechanical Systems elective to be chosen from: TECH 4330, MFGE 4367, MFGE 4392, MFGE 4399A, MFGE 4399B or MFGE 4399C.
5. Manufacturing Engineering degrees include all the courses required for an Applied Mathematics Minor.

Freshman Year - 1st Semester		Freshman Year - 2nd Semester		Sophomore Year - 1st Semester		Sophomore Year - 2nd Semester	
Course	Hr	Course	Hr	Course	Hr	Course	Hr
CHEM 1141, 1341	4	ENGR 2300	3	MFGE 2332	3	IE 3330	3
ENGR 1313	3	MATH 2472	4	MATH 3323	3	MATH 3375	3
MATH 2471	4	PHYS 1430	4	IE 3320	3	CS 1428	4
US 1100	1	COMM 1310	3	PHYS 2425	4	ECO 2301	3
ENG 1310	3	ENG 1320	3	HIST 1310	3	HIST 1320	3
PFW one course	1			PFW one course	1		
Total	16	Total	17	Total	17	Total	16

Sophomore Year - Summer		Junior Year - 1st Semester		Junior Year - 2nd Semester		Senior Year - 1st Semester	
Course	Hr	Course	Hr	Course	Hr	Course	Hr
MATH 3377	3	MFGE 3316	3	MFGE 4365	3	MFGE 4357	3
PHIL 1305 or 1320	3	ENGR 3311	3	MFGE 4396	3	MFGE 4363	3
		ENGR 3315	3	IE 3360	3	MFGE 4395	3
		ENGR 3373	3	PHYS 3315	3	IE 4355	3
		POSI 2310	3	ENG Literature (see gen. req. 2)	3	Mechanical Systems Elective (see gen. req. 4)	3
Total	6	Total	15	Total	15	Total	15

Senior Year - 2nd Semester	
Course	Hr
MFGE 4355	3
MFGE 4376	3
Mechanical Systems Elective (see gen. req. 4)	3
POSI 2320	3
ART, DAN, MU, or TH 2313	3
Total	15

Bachelor of Science (BS)
Major in Manufacturing Engineering
(Semiconductor Manufacturing Concentration)
Minimum required: 139 semester hours

General Requirements:

1. A minimum of 9 writing intensive hours and a total of 36 advanced hours are required to graduate. An advanced course is one that is numbered above 3000 and below 5000.
2. Departmental requirements that also satisfy the general education core curriculum requirements for the following components: mathematics- MATH 2471; natural science- CHEM 1341/1141 and PHYS 1430; and social science- ECO 2301. See the Academic Services section of this catalog for the English literature requirements.
3. If two years of the same language are taken in high school, then no additional language hours will be required for the degree. In the absence of such high school language, two semesters of the same modern language must be taken at the college level.
4. Three semester hours of Semiconductor Manufacturing elective to be chosen from: PHYS 4320 (see dept.), PHYS 4340 (see dept.), or MFGE 4394 (see dept.).
5. Three to four hours of Math/Science elective chosen from: MATH 3330, MATH 3373, PHYS 2435, PHYS 3315, or CHEM 1342 & 1142.
6. Manufacturing Engineering degrees include all the courses required for an Applied Mathematics Minor.

Freshman Year - 1st Semester		Freshman Year - 2nd Semester		Sophomore Year - 1st Semester		Sophomore Year - 2nd Semester	
Course	Hr	Course	Hr	Course	Hr	Course	Hr
CHEM 1141, 1341	4	ENGR 2300	3	IE 3320	3	CS 1428	4
ENGR 1313	3	MATH 2472	4	MATH 3323	3	MATH 3375	3
MATH 2471	4	PHYS 1430	4	MFGE 2332	3	ART, DAN, MU, or TH 2313	3
US 1100	1	COMM 1310	3	PHYS 2425	4	ECO 2301	3
ENG 1310	3	ENG 1320	3	HIST 1310	3	HIST 1320	3
PFW one course	1			PFW one course	1		
Total	16	Total	17	Total	17	Total	16

Sophomore Year - Summer		Junior Year - 1st Semester		Junior Year - 2nd Semester		Senior Year - 1st Semester	
Course	Hr	Course	Hr	Course	Hr	Course	Hr
MGT 3303	3	ENGR 3311	3	MFGE 4392	3	IE 4355	3
MATH 3377	3	ENGR 3373	3	MFGE 4365	3	MFGE 4363	3
EE 2400	4	TECH 4374 or EE 2420	3-4	IE 3330	3	MFGE 4395	3
PHIL 1305 or 1320	3	Math/Science Elective (see gen. req. 5)	3-4	IE 3360	3	ENGR 3315	3
		MFGE 3316	3	POSI 2310	3	POSI 2320	3
Total	13	Total	15-17	Total	15	Total	15

Senior Year - 2nd Semester	
Course	
Semiconductor Manufacturing Elective (see gen. req. 4)	3
MGT 4330	3
ENG Literature (see gen. req. 2)	3
MFGE 4376	3
MFGE 4396	3
Total	15

Courses in Electrical Engineering (EE)

2400 Circuits I. (3-2) This course provides an introduction to the profession of Electrical Engineering and its specialties. Fundamental DC and sinusoidal steady-state circuit analysis techniques and properties of electrical components are studied, and laboratory skills are developed. Analysis techniques include Ohm's law, power, Kirchoff's law, and Thevenin and Norton equivalent circuits. Prerequisites: MATH 2471.

2420 Digital Logic. (3-2) An introduction to fundamental computer technologies, including Boolean logic design, logic circuits and devices, and basic computer hardware are studied. Laboratories provide hands-on experience with electricity, combinational and sequential digital circuits, and computer hardware. Prerequisite: C or higher in CS1428.

3340 Electromagnetics. (3-0) Wave propagation, Maxwell's equations, transmission lines, wave guides, and antennas. Prerequisites: MATH 3373 and PHYS 2435. Corequisite: EE 3300 or 3400.

3350 Electronics I. (3-3) Analysis and design of active device equivalent circuits with emphasis on transistors, switching circuits, and operational amplifiers. Prerequisites: EE 3300 or 3400 with a C or better.

3355 Solid State Devices. (3-0) Semiconductor materials, principles of carrier motion, operating principles and circuit models for diodes, bipolar transistors and field-effect transistors. Introduction to integrated circuits. Prerequisites: EE 3300 or 3400 with a C or better.

3370 Signals and Systems. (3-0) Frequency domain representation of signals and systems and frequency domain concepts for circuit analysis and design. Transfer function and frequency response, Laplace and z-transforms, Fourier series, Fourier transform, and sampling. Prerequisites: EE 3300 or 3400 with a C or better.

3400 Circuits II. (3-2) This course includes a brief review of EE 2400, transient analysis, application of Laplace transforms, Bode plots, and network principles. Material learned in EE 2400 is extended and applied here. Prerequisites: EE 2400 and Math 3323.

3420 Microprocessors. (3-3) Introduction to microprocessors, principles of operation, assembly language programming, timing analysis, and I/O interfacing. Prerequisites: 3 hrs from EE 2320, EE 2420 or CS 2420 with a C or better. (WI)

4321 Digital Systems Design Using HDL. (3-0) This course will cover the design of digital systems using HDL including implementation of custom microprocessor and peripheral architectures. Prerequisites: EE 3420.

4323 Digital Image Processing. (3-0) This course provides the necessary fundamental techniques to analyze and process digital images. It covers principles, concepts, and techniques of digital image processing and computer vision. Prerequisites: EE 3420, CS 2308.

4350 Electronics II. (3-3) Analysis and design of integrated circuits, feedback, and frequency response. Prerequisites: EE 3350.

4351 Fundamentals of Electroceramics. (3-3) Introduction to binary and ternary phase diagrams, non-centro-symmetric crystal structures and symmetry groups, nonlinear dielectrics (including ferroelectricity, piezoelectricity, pyroelectricity), nonlinear magnetics, oxide wideband gap semiconductors, detectors and sensors, brief introduction to MEMS, radhard electronics, and spintronics technology. Research oriented labs related to materials processing, characterization, fabrication, and testing. Prerequisite: ENGR 2300 or equivalent; Co-requisite: EE3355; GPA of 2.25 or higher.

4352 Introduction to VLSI Design. (3-1) Analysis of design of CMOS integrated circuits. Introduction to CAD tools for VLSI design. Prerequisites: CS 2420/EE 2420, EE 3350.

4353 Fundamentals of Advanced CMOS Technology. (3-0) Key concepts of advanced semiconductor technology including Moore's law, transition from NMOS to CMOS, CMOS scaling, high-K gate dielectrics, metal electrodes, source/drain scaling technology, new channel materials replacing silicon, and three dimensional device structures. Prerequisite: EE 3355.

4354 Flexible Electronics. (3-0) This course will cover the materials systems, processes, device physics and applications of flexible electronics. The materials range from amorphous and nanocrystalline silicon, organic and polymeric semiconductors to solution cast films of carbon nanotubes. Real device discussions include high speed transistors, photovoltaics, flexible flat-panel displays, medical image sensors, etc. Prerequisites: EE 3350, EE 3355, and EE 4350 or permission of the instructor.

4355 Analog and Mixed Signal Design. (3-2) Operational amplifier design applications, feedback, offset, stability, and compensation. Introduction to random signals and noise, discrete time circuitry analog-to-digital converters, and digital-to-analog converters. Prerequisites: EE 3370 and 4350.

4358 Introduction to Microelectromechanical Systems. (3-1) This course will cover fabrication techniques for microelectromechanical devices and systems as well as provide an introduction to the design of micromechanical transducers. Corequisite: MFGE 4392.

4370 Communication Systems. (3-3) Transmission of signals through linear systems, analog and digital modulation, filtering, and noise. Prerequisites: EE 3370, IE 3320, and 3 hrs from EE 3300 or EE 3400 with a C or better.

4372 Communication Networks. (3-1) Data communication concepts, protocols, algorithms, 7-layer OSI model, physical media, LAN architecture and components, Ethernet, FDDI, TCP/IP, and related standards. Prerequisite: 3 hrs from EE 2300 or EE 2400 and 3 hrs from EE 3320 or EE 3420 with a C or better.

4374 Introduction to Wireless Communication. (3-1) Principles, practice, and system overview of mobile systems. Modulation, demodulation, coding, encoding, and multiple access techniques. Prerequisites: EE 4370.

4376 Introduction to Telecommunications. (3-1) Fundamentals of telecommunications, telephone networks, switching and transmission systems, circuit and packet switching, cell processing, and queuing theory and applications. Prerequisite: None, Co-requisite: EE 4370.

4377 Introduction to Digital Signal Processing. (3-1) Discrete systems, convolution, spectral analysis, and FIR and IIR filter design. Prerequisites: EE 3370.

4378 Data Compression and Error Control Coding. (3-2) Introduction to information theory, information content

of messages, entropy and source coding, data compression, channel capacity data translation codes, and fundamentals of error correcting codes. Prerequisite: None, Corequisite: EE 4370.

4390 Electrical Engineering Design I. (1-3) This course is a team-based design of a system or component, which will include oral presentations and written reports. Corequisites: EE 4350, EE 4352 or EE 4370. Prerequisites: EE 3350, EE 3370, and EE 3420. (WI)

4391 Electrical Engineering Design II. (1-3) Advanced team-based design of a system or component, which will include oral presentations and written reports. Prerequisites: EE 4390. (WI)

4399 Special Topics in Electrical Engineering. (3-0) This course will cover advanced topics that cannot be fitted into a regular course in the curriculum. Prerequisite: Faculty advisor approval.

4399A Dynamic Data Acquisition and Analysis. (3-0)

4399B Overview of Information Theory and Coding. (3-0)

4399C Digital Systems Design Using VHDL. (3-0) Design of digital systems using VHDL including implementation of custom microprocessor and peripheral architectures. Prerequisites: EE 3420, CS 2308.

4399E Digital Image Processing. (3-0) This course provides the necessary fundamental techniques to analyze and process digital images. It covers principles, concepts, and techniques of digital image processing and computer vision. Prerequisites: EE 3420, CS 2308.

4399F Fundamentals of Electroceramics. (3-3) Introduction to binary and ternary phase diagrams, non-centro-symmetric crystal structures and symmetry groups, nonlinear dielectrics (including ferroelectricity, piezoelectricity, pyroelectricity), nonlinear magnetics, oxide wideband gap semiconductors, detectors and sensors, brief introduction to MEMS, radhard electronics, and spintronics technology. Research oriented labs related to materials processing, characterization, fabrication, and testing. Prerequisite: ENGR 2300 or equivalent; Co-requisite: EE 3355; GPA of 2.25 or higher.

4399G Fundamentals of Advanced CMOS Technology. (3-0) Key concepts of advanced semiconductor technology including Moore's law, transition from NMOS to CMOS, CMOS scaling, high-K gate dielectrics, metal electrodes, source/drain scaling technology, new channel materials replacing silicon, and three dimensional device structures. Prerequisite: ENGR 3355.

4399H Flexible Electronics. (3-0) This course will cover the materials systems, processes, device physics and applications of flexible electronics. The materials range from amorphous and nanocrystalline silicon, organic and polymeric semiconductors to solution cast films of carbon nanotubes. Real device discussions include high speed transistors, photovoltaics, flexible flat-panel displays, medical image sensors, etc. Prerequisite: EE 3350

Courses in Engineering (ENGR)

1313 Engineering Design Graphics. (2-2) An introductory communications course in the tools and techniques utilized to produce various types of working drawings. Principles of multiview projections, geometric relationships, shape and size description, and pictorial methods are included with emphasis on technical applications and design problem solving.

2300 Materials Engineering. (3-0) Structure, properties and behavior of engineering materials including metals, polymers, composites and ceramics. Mechanical, electrical, magnetic, thermal, and optical properties are covered. Prerequisites: MATH 1315; CHEM 1341.

3190 Cooperative Education. (0-1) Completion of technical/engineering practice-related special projects. Projects must relate to students' major and result in a term paper. Prerequisite: Approval of program coordinator.

3311 Mechanics of Materials. (3-1) This course covers the principles of mechanic materials and includes the following topics: stress and strain; elastic modulus and Poisson's ratio; constitutive equations; torsion; bending; axial, shear and bending moment diagrams; deflection of beams; and stability of columns. Prerequisite: MATH 3375.

3315 Engineering Economic Analysis. (3-0) Interest formulas, economic equivalence, rate of return analysis, techniques of economic analysis for engineering decisions and an introduction to cost estimation. Prerequisite: MATH 1315.

3360 Structural Analysis. (3-1) Structural engineering fundamentals to include design loads, reactions, force systems, functions of a structure, and the analysis of statically determinate and indeterminate structures by classical and modern techniques. Prerequisite: ENGR 3311.

3373 Circuits and Devices. (3-1) DC and AC circuit analysis, network theorems, electromechanical devices, electronic devices and an introduction to amplifiers, oscillators and operational amplifiers. Prerequisite: PHYS 2425.

4390 Internship. (0-20) Supervised on-the-job professional learning experience in engineering and other technical areas. This course provides practical work experience in their particular field of interest.

4395 Independent Studies in Engineering. (3-0). Open to undergraduate students on an independent basis by arrangement with the faculty member concerned. Requires department chair approval. Repeatable for credit with different emphasis. Prerequisite: junior or senior standing.

Courses in Industrial Engineering (IE)

3310 Project Management for Engineers. (3-0) Basic principles governing the efficient and effective management of engineering projects. Topics include project planning, scheduling, and cost estimation procedures. Prerequisite: ENGR 3315. (WI)

3320 Engineering Statistics. (3-1) Fundamentals of probability and statistical inference for engineering applications, probability distributions, parameter estimation, hypothesis testing, and analysis of variance. Prerequisite: MATH 2472.

3330 Quality Engineering. (3-0) Quality assurance systems, quality costs, statistical quality control, and approaches for engineering quality into products and processes. Prerequisite: IE 3320.

3340 Operations Research. (3-0) This course teaches models in operations research including linear programs, the simplex method, duality theory, sensitivity analysis, integer programs, and network flows. The emphasis is in learning to recognize, formulate, solve, and analyze practical industrial

problems. The course also teaches commercial mathematical programming languages. Prerequisites: CS 1428, MATH 3377, ENGR 3315.

3360 Methods Engineering and Ergonomics. (3-0) This course is a survey of methods for assessing and improving performance of individuals and groups in organizations. Techniques include various basic industrial engineering tools, work analysis, data acquisition and application, performance evaluation and appraisal, and work measurement procedures. Prerequisite: IE 3320.

4310 Statistical Design of Experiments. (3-0) Statistically designed experiments for engineering applications. Topics include analysis of variance, randomized complete block designs, factorial designs, empirical models generated from controlled experiments, and response surfaces. Prerequisite: IE 3320.

4320 Integrated Production Systems. (3-0) Basic concepts in the design and control of integrated production systems to include forecasting, inventory models, material requirements planning, scheduling, planning, and shop floor control. Coverage will include both traditional and kanban systems. Prerequisite: IE 3340.

4330 Reliability Engineering. (3-0) Reliability of components and systems, reliability models, life testing, failure analysis, and maintainability. Prerequisite: IE 3320.

4340 Optimization Techniques. (3-0) Mathematical modeling and computational methods for linear, integer, and nonlinear programming problems. Prerequisite: IE 3340.

4350 Supply-Chain Engineering. (3-0) The analysis of supply chain problems to include facility location, customer assignment, vehicle routing, inventory management, and the role of information and decision support systems in supply chains. Prerequisite: IE 3340.

4355 Facilities Planning. (3-0) Planning, design, and analysis of facilities. Emphasizes the principles and methods used for solving plant layout, facility location, material handling, automation, computer integration, and warehouse operations.

4360 Human Factors Design. (3-1) This course will emphasize the applications of human factors engineering to systems design. Prerequisites: IE 3360. (WI)

4370 Probabilistic Operations Research. (3-0) Probabilistic models in operations research to include queuing theory, simulation, and Markov chains. Emphasis will be placed on modeling applications to solve problems in industry and computing. Prerequisite(s): IE 3320 and CS 1428.

4380 Industrial Safety. (3-0) This course is a survey of occupational safety and hazards control. Topics include the history of occupational safety; hazard sources related to humans, environment, and machines; and engineering management of hazards.

4390 Industrial Engineering Capstone Design. (3-2) Students form teams and apply industrial engineering principles to develop and implement solutions to industrial problems and/or systems engineering issues. Includes incorporation of engineering standards and realistic constraints. Prerequisite: IE3310, IE 3330 and at least two of: IE 4355, IE 3360, MFGE 4396, and IE 4310. Co-requisite: At least two courses from: IE 4320, IE 4350, and IE 4360.

4399 Special Topics in Industrial Engineering. (3-0) This course will cover advanced topics that cannot be fitted into a regular course in the curriculum. Prerequisite: Faculty advisor approval.

4399A Six Sigma Methodologies. (3-0)

4399B Human Computer Interaction. (3-0)

4399C Engineering Statistics II. (3-1) This course is the continuation of IE 3320 Engineering Statistics I and covers simple and multiple regression analysis, analysis of variance, 2^k Factorial Experiments, and the use of statistical packages. Prerequisite: IE 3320.

4399D Modern Heuristic Optimization Techniques. (3-0) Heuristic methods that search beyond local optima such as simulated annealing, tabu search, genetic algorithms, ant-colony systems, and particl swarm. Papers from the literature, problem-specific heuristics, evaluation methods and serial/parallel implementations are discussed. This course is an advanced undergraduate course for students in engineering and related fields. Prerequisites: IE 3340, CS 1428.

Courses in Manufacturing Engineering (MFGE)

2132 Manufacturing Processes Lab. (0-2) Hands-on experience in variety of material removal processes such as turning, milling, drilling, and CNC machining; joining processes such as gas/arc welding, and soldering; metal casting, polymer and composite processing, and microelectronics manufacturing. Corequisite: ENGR 2300.

2332 Material Selection and Manufacturing Processes. (3-1) Overview of material processing, material selection and process parameter determination. Processes covered include: material removal, forming, casting, polymer processing, semiconductor manufacturing and assembly processes. Laboratory activities provide opportunities for applying the design through manufacture activities of the product cycle. Corequisite: ENGR 2300.

3316 Computer Aided Design and Manufacturing. (3-1) Topics include design process, description of wireframe/surface/solid models, transformation and manipulation of objects, finite element analysis, data exchange, process planning, machine elements, fundamentals of numerical control programming for turning and milling processes, fundamentals of CAD/CAM systems, CNC code generation by CAD/CAM software, waterjet, and plasma cutting. Prerequisites: ENGR 1313 and MFGE 2332.

4355 Design of Machine Elements. (3-0) This course will cover the general procedures in designing various machine elements. These elements include shafts and flexible elements, springs, welded/riveted/brazed joints, screw fasteners, rolling/sliding contact bearings, gears, cams, and followers. Emphasis will be placed on using standard design practices. Prerequisite: ENGR 3311 or TECH 2351.

4357 Dynamics of Machinery. (3-0) This course will cover kinematics and kinetics of particles; kinematics and kinetics of rigid bodies in two and three dimensions; application of dynamics to the analysis and design of machine and mechanical components; mechanical vibrations; linkages; gear trains; and balancing of machines. Prerequisites: MATH 3323 and 3375.

4363 Concurrent Process Engineering. (2-3) Integrated design and development of products and processes; impact of ethical issues on design; the discussion of real-world engineering

problems and emerging engineering issues with practicing engineers; preparation of reports; plans or specifications; cost estimation; project management, communication and the fabrication of an engineered product/system. Prerequisites: ENGR 3311, MFGE 4365, and senior standing. (WI)

4365 Tool Design. (3-1) Design of single and multi-point cutting tools, jig and fixture design, gage design, and the design of tooling for polymer processing and sheet metal fabrication. Laboratory projects will involve the use of computer aided design and rapid prototyping. Prerequisites: MFGE 3316 or ENGR 3316 or TECH 2310.

4367 Polymer Properties and Processing. (3-1) Structure, physical & mechanical properties, design considerations and processing methods for polymer-based materials are presented. Processing methods include: injection molding, blow molding, thermoforming, compression molding, extrusion, filament winding, lay-up methods, vacuum bag molding and poltrusion. Prerequisite: MFGE 2332 or TECH 4362.

4376 Control Systems and Instrumentation. (3-0) The theory of automated control systems and its applications to manufacturing systems are covered in this course. Topics covered include: modeling of systems, time and frequency domain feedback control systems, stability analysis, transducer and sensor technology and digital control. Prerequisites: PHYS 1430 and one of the following: MFGE 2332, TECH 4362, or EE 3370. Co-requisite: MATH 3323.

4392 Microelectronics Manufacturing I. (3-3) Provides an overview of integrated circuit fabrication including crystal growth, wafer preparation, epitaxial growth, oxidation, diffusion, ion-implantation, thin film deposition, lithography, etching, device and circuit formation, packaging and testing. The laboratory component involves production and testing of a functional semiconductor device. Prerequisites: CHEM 1141 and CHEM 1341.

4394 Microelectronics Manufacturing II. (3-3) Topics include: atomic models for diffusion, oxidation and ion implantation; topics related to thin film processes i.e. CVD, PVD; planarization by chemical-mechanical polishing and rapid thermal processing; and process integration for bipolar and MOS device fabrication. Students will design processes and model them using a simulation. Prerequisite: MFGE 4392.

4395 Computer Integrated Manufacturing. (3-1) An overview of computer integrated manufacturing is presented. Topics include control strategies for manufacturing systems, automated material handling systems, production planning, shop floor control, manufacturing execution systems, manufacturing databases and their integration, data communication and protocols and man/machine interfaces. Prerequisite: MFGE 3316 or ENGR 3316 or TECH 4375. (WI)

4396 Manufacturing Systems Design. (3-2) Applications of simulation modeling to the design and analysis of manufacturing systems are presented in this course. Topics covered include queuing theory and discrete event simulation methods. Design projects will involve the use of current simulation language for modeling and analysis of manufacturing systems. Prerequisites: IE 3320. (WI)

4399 Special Topics in Manufacturing Engineering. (3-0) This course will cover advanced topics that cannot be fitted into a regular course in the curriculum. Prerequisite: Faculty advisor approval.

4395 Computer Integrated Manufacturing. (3-1) Presented in this course is an overview of computer integrated manufacturing. Topics include control strategies for manufacturing systems, automated material handling systems, production planning, shop floor control, manufacturing execution systems, manufacturing databases and their integration, data communication and protocols and man/machine interfaces. Prerequisite: MFGE 3316. (WI)

4396 Manufacturing Systems Design. (3-2) Applications of simulation modeling to the design and analysis of manufacturing systems are presented in this course. Topics covered include queuing theory and discrete event simulation methods. Design projects will involve the use of current simulation language for modeling and analysis of manufacturing systems. Prerequisites: IE 3320. (WI)

4399A Reverse Engineering and Rapid Prototyping. (3-0) In this course 3D scanning technology for design, analysis, and inspection, is covered. Also, applications of the 3D scanning in reverse engineering and different rapid prototyping processes in a hands-on approach will be explained in this course. Prerequisite: MFGE 3316.

4399B Introduction to Reinforced Polymer Nanocomposites in Industrial Applications. (3-0) Introductory course in reinforced polymer nanocomposites focusing on materials, manufacturing, characterization, and applications. Include, primarily nanoclay polymer matrix composites. Thrust will be the challenges in low-cost manufacturing for industrial applications, commercial successes, its impact on current material market, and future. Prerequisite: ENGR 2300.

4399C Introduction to Industrial Robotics. (3-1) This course will cover the basic principles and techniques involved in industrial robotics. Emphasis will be placed on industrial robot applications, analysis of robot manipulators, components of industrial robots, robot programming and control. Prerequisites: MATH 3377, MFGE 4376, and PHYS 1430.