

Proposal

Master of Science in Engineering

Indiana University-Purdue University Fort Wayne

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INSTITUTION: Indiana University – Purdue University Fort Wayne

COLLEGE: School of Engineering, Technology, and Computer Science

DEPARTMENT: Engineering

DEGREE PROGRAM TITLE: Master of Science in Engineering

FORM OF RECOGNITION TO BE AWARDED /

DEGREE CODE: Master of Science in Engineering / MSE

SUGGESTED CIP CODE: 140101

LOCATION OF PROGRAM / CAMPUS CODE: IPFW / 1812

PROJECTED DATE OF IMPLEMENTATION: Fall 2007

DATE PROPOSAL WAS APPROVED BY

INSTITUTIONAL BOARD OF TRUSTEES: _____

SIGNATURE OF AUTHORIZING INSTITUTIONAL OFFICER

DATE

DATE RECEIVED BY COMMISSION FOR HIGHER EDUCATION

COMMISSION ACTION

(DATE)

**MASTER OF SCIENCE IN ENGINEERING (MSE)
TO BE OFFERED AT INDIANA UNIVERSITY – PURDUE UNIVERSITY FORT WAYNE (IPFW)**

A. ABSTRACT

Objectives:

The Department of Engineering at Indiana University Purdue University Fort Wayne (IPFW) seeks to establish a Master of Science in Engineering (MSE) degree program. The objectives of the proposed program are:

- To provide opportunities for qualified individuals who wish to work towards a Master of Science in Engineering (MSE).
- To provide a nationally recognized graduate program in engineering of high quality through the combination of theoretical and practical education, especially the education that develops professional expertise based upon the skills of discovery and synthesis that support problem solving and innovation.
- To meet the need for a comprehensive engineering program in northeastern Indiana at the graduate level.

There are four initial areas of specialization for the MSE degree: Computer Engineering, Electrical Engineering, Mechanical Engineering, and Systems Engineering.

Clientele to be Served:

- The proposed graduate program provides advanced degree opportunities that are needed in northeastern Indiana. The program focuses on the latest advances in Computer Engineering, Electrical Engineering, Mechanical Engineering, and Systems Engineering. These areas are of great interest to industry and students in northeastern Indiana.
- No public institution offers an engineering master's degree in northeastern Indiana. The closest public institution that offers the master's degree is Purdue University (WL), which is 110 miles from Fort Wayne. The University of Notre Dame, at a distance of 80 miles from Fort Wayne, is the closest private institution with equivalent degree offerings. The proposed master's program will be the first one in engineering to be based in northeastern Indiana. It will prepare students to be competitive in regional high-tech industries and/or to pursue a PhD at other universities.
- The graduate engineering program will provide a direct and substantial benefit to the undergraduate engineering programs at IPFW. It will also provide opportunities for faculty and students, both undergraduate and graduate, to be exposed to state of the art technologies, to pursue funding, and to collaborate with industry. The activities associated with the graduate program will propagate into the undergraduate programs through increased technical elective offerings, funded research projects, and enhanced laboratories.
- In establishing an engineering graduate program, cooperative efforts will involve local industry, the IPFW Center of Excellence in Systems Engineering, and Purdue University (WL). Local industries currently provide support for IPFW undergraduate engineering senior design projects. New opportunities are expected to develop local corporations to collaborate on graduate-level work in support of a thesis. In addition, Dr. Steve Walter has been hired to develop the systems engineering program and establish the IPFW Center of

Systems Engineering as the result of a collaborative agreement between local industry and the IPFW College of Engineering, Technology, and Computer Science. This cooperative relationship should significantly expand opportunities for graduate-level research, teaching, and funding.

Curriculum:

A minimum of 30 credit hours of graduate-level coursework is required for each student in the MSE program. The courses making up the graduate curriculum are organized as follows:

Graduate engineering courses:

- Required graduate engineering courses 12 credit hours
- Other graduate engineering courses ≥ 6 credit hours

Graduate Mathematics, Statistics, or Computer Science courses ≥ 6 credit hours

Graduate general elective courses ≤ 6 credit hours

Both thesis and non-thesis options will be available.

The non-thesis option requires the student to complete the 30 credit hours outlined in their approved plan of study. These credits will be distributed as described in the above table. Additionally, the student must pass a comprehensive exam.

The thesis option allows a student to earn credit for conducting independent research leading to a publishable report or thesis. The thesis track requires that the student have an approved plan of study with a minimum of 21 graduate semester course hours. Research credits will be used to fulfill the remainder of the 30-credit hour requirement. If it is appropriate, the student can take additional research credits in excess of the 30 credit hour requirement. The thesis project is always undertaken and completed under the supervision of a graduate faculty member and the thesis committee. The student's thesis committee is responsible for approving the project plan, monitoring progress and reviewing the thesis prior to acceptance.

Employment Possibilities:

The trend in our increasingly advanced technological society is toward advanced degrees. The northeastern Indiana community in which the IPFW campus is located has a strong industrial base which includes high technology industries such as ITT Industries, Raytheon, Northrop Grumman, International Truck & Engine, BAE Systems, General Dynamics, General Electric, General Motors, Logikos Systems & Software, DePuy, and Zimmer. These companies require engineers with advanced degrees. For example, at Raytheon in Fort Wayne, over 250 of its nearly 1000 engineers have advanced degrees. In fact, all of these employers encourage advanced study and many support it through tuition reimbursement and tuition assistance.

Recently, local industry has expressed a strong demand for Systems Engineers and has shown tangible support for Systems Engineering at the IPFW campus through the establishment of a Center of Excellence in Systems Engineering and the funding for an endowed chair in Systems Engineering. A letter of support from local industry indicates that the proposed "...*Systems Engineering Program addresses a critical need for trained people in this key discipline...*," while another letter notes that "*your masters program will provide us with a valuable pool from which to choose new employees.*"

The engineering graduate program at IPFW will provide a supply of educated engineers to high-technology industries in northeastern Indiana.

B. PROGRAM DESCRIPTION

1. Proposed Program

The Department of Engineering at Indiana University Purdue University Fort Wayne (IPFW) seeks to establish a Master of Science in Engineering (MSE) degree program.

There are four initial areas of specialization for the MSE degree: *Computer Engineering, Electrical Engineering, Mechanical Engineering, and Systems Engineering.*

The program will be offered by the Department of Engineering from the College of Engineering, Technology, and Computer Science.

Objectives:

- a. To provide opportunities for qualified individuals who wish to work towards a Master of Science in Engineering (MSE).
- b. To provide a nationally recognized graduate program in engineering of high quality through the combination of theoretical and practical education, especially the education that develops professional expertise based upon the skills of discovery and synthesis that support problem solving and innovation.
- c. To meet the need for a comprehensive engineering program in northeastern Indiana at the graduate level.

2. Admission Requirements, Anticipated Student Clientele, and Student Financial Support

a. *Admission requirements*

Applicants ordinarily will be expected to hold baccalaureate degrees from institutions of recognized standing prior to registration as graduate students. Applicants for the MSE program should have achieved an undergraduate grade point average of 3.0 or have other academic indices indicating superior performance.

b. *Prerequisite coursework or degrees*

To be considered for admission into the MSE program, applicants ideally should have graduated from an approved, accredited engineering program with a Bachelor of Science degree in their selected area of specialization. Graduates with Bachelor of Science degrees from programs in the physical sciences, computer science, mathematics or technology will be considered for admission. Formal admission to the MSE program requires a Bachelor of Science degree as well as:

1. Completion of the engineering mathematics sequence which includes MATH 165 and 166 Integrated Calculus and Analytical Geometry I and II, MATH 261 Multivariate Calculus, MA 351 Linear Algebra, and MA 363 Differential Equations or an equivalent sequence of courses.
2. Completion of at least two semesters of calculus-based physics.

3. Completion of all undergraduate engineering courses that are the prerequisites to the graduate courses on the student's plan of study.

An applicant whose native language is not English must demonstrate that you are proficient in written English by satisfying one of the following three options:

1. Earn a score of 550 (213 computer-based) on the paper-based Test of English as a Foreign Language (TOEFL).
2. Minimum TOEFL Internet-based Testing (iBT) exam scores of
Writing 18,
Speaking 18,
Listening 14,
Reading 19,
Overall 77
All five of these scores must be met for Graduate School admission.
3. Earn at least a 6.5 band score on the International English Language Testing System (IELTS) exam.

Students admitted to the program will be granted either unconditional admission or conditional admission. Depending upon the undergraduate GPA, the student conditionally admitted will be required to maintain a GPA of 3.0 or better for the first one to three sessions of graduate work. In some cases, an applicant may be advised or required to complete additional courses to fill deficiencies in their academic background.

Admission for *post-baccalaureate (non-degree) studies* can be granted to a qualified student who wants to take engineering courses for career development or to work toward a degree. However, such an admission does not in any way imply that later admission will be granted for regular status to work towards a degree, and all course prerequisites must be satisfied.

The sum of credits earned as undergraduate excess or earned in post baccalaureate or graduate certificate status that can be transferred to IPFW is limited to 12 credit hours.

c. *Specific student clientele*

This program is designed to meet the needs of both part-time and full-time students. Courses will be offered during the daytime and evenings, as demand dictates. The program will be accessible to currently employed professionals.

d. *Limitations on enrollment*

Enrollment restrictions are not expected.

e. *Student financial support*

Students in the program will be eligible for all forms of financial aid available to other IPFW students. In addition, graduate assistantships may be developed when the program begins to attract full-time students. Funding for these stipends will be sought from grants. Graduate teaching assistantships are likely to be developed. Moreover, based on the strong letters of support (see letters in Appendix D), tuition reimbursement and tuition assistance from employers is expected.

3. Proposed Curriculum

a. *General Requirements*

The curriculum was developed after review of industry needs and of master degree curricula offered at Purdue University West Lafayette and other similar institutions. There are four areas of specialization: Computer Engineering, Electrical Engineering, Mechanical Engineering, and Systems Engineering. Upon acceptance into the program, students must select an area of specialization and formulate a plan of study.

Each graduate student admitted to the MSE degree program must submit a plan of study tailored to his/her interests and needs. A tentative plan of study should be drawn up in advance of registration for the first graduate course and the formal plan of study should be submitted by the end of the first school semester. The plan, which itemizes the full set of courses required to complete the MSE degree, will be approved by the IPFW Engineering Graduate Committee and the Graduate Director. They will review the plan of study to determine the acceptability of transfer credits, compliance with degree requirements, potential schedule conflicts and general appropriateness. These plans shall conform to the Policy and Procedures published by Purdue's Graduate School.

To earn the Master of Science in Engineering (MSE) degree, students must complete 30 credit hours. The courses in each area of specialization are divided into four categories: (1) engineering required, (2) mathematics/statistics/computer science elective, (3) engineering elective, and (4) general elective.

The required engineering courses (12 credit hours) provide students with a solid, yet broad foundation in the fundamentals of their selected area of specialization. These specific courses (see below) were selected to meet the needs of students and local industry, with the strengths and abilities of the IPFW engineering faculty in mind. Each of the required engineering courses will be offered on campus at least once a year.

Computer Engineering

ECE 502 Linear Control Systems
ECE 547 Intro. to Computer. Comm. Networks
ECE 565 Computer Architecture
ACS 560 Software Engineering

Mechanical Engineering

ME 505 Intermediate Heat Transfer
ME 509 Intermediate Fluid Mechanics
ME 550 Advanced Strength of Materials
ME 562 Intermediate Dynamics

Electrical Engineering

ECE 502 Linear Control Systems
ECE 538 Digital Signal Processing I
ECE 547 Intro. to Computer. Comm. Networks
ECE 565 Computer Architecture

System Engineering

SE 510 Systems Engineering
SE 520 Engineering Economics
SE 530 Engineering Management
SE 540 System Architecture

The mathematics/statistics/computer science electives (6 credit hours) provide the students with the opportunity to sharpen their analytical skills and obtain useful tools to apply to future work within their selected area of specialization. Many of these graduate courses are offered at IPFW. Students will also have the opportunity to take some of these courses via video (e.g., video tape or streaming video).

The engineering electives (6 credit hours) offer the student a chance to develop depth in his/her area of specialization and to explore new technologies of interest. Students will have the option of taking engineering elective courses on campus or via video.

The last category of courses, the general electives (6 credit hours), give the student flexibility to tailor the program to meet his or her specific needs. For example, a student wishing to eventually move into a management position might opt for courses in Business or Organizational Leadership and Supervision, while another student might decide to perform research in areas such as robotics, controls, signal processing, tribology, or heat transfer and produce a thesis.

Students from one area of specialization may chose to take required courses from another area of specialization to satisfy the elective requirements, e.g. computer, electrical, or mechanical engineering students might take courses in Systems Engineering to satisfy their engineering elective and general elective requirements.

b. Sample curriculum and sequence of courses

The distribution of the credit hours for each area of specialization is summarized on the Tables 1-4 on the next two pages.

Following the distribution of credit hours is a table showing the frequency of the offering of the required engineering courses—each required engineering course will be offered once a year at the Fort Wayne campus. Students will be allowed satisfy some of their requirements with courses delivered from the West Lafayette campus via video.

Table 1. Curriculum for MSE-Computer Engineering

Category	Course	IPFW Video		Cr. Hrs.
	ECE 502 Linear Control Systems	x		3
Engineering Required	ECE 547 Intro. to Computer Communication Networks	x	x	3
	ECE 565 Computer Architecture	x		3
	ACS 560 Software Engineering	x		3
Math/Stat Electives	select two MATH/STAT/CS graduate courses (5xx/6xx)	x	x	6
Engineering Electives	select additional engineering courses or CS courses	x	x	6
General Electives	select engineering, CS, OLS, TECH, MATH/STAT, BUS, PHYS, CHEM, BIOL courses	x	x	6
Total				30

Table 2. Curriculum for MSE-Electrical Engineering.

Category	Course	IPFW Video		Cr. Hrs.
	ECE 502 Linear Control Systems	x		3
Engineering Required	ECE 538 Digital Signal Processing I	x		3
	ECE 547 Intro. to Computer Communication Networks	x	x	3
	ECE 565 Computer Architecture	x		3
Math/Stat Electives	select two MATH/STAT/CS graduate courses (5xx/6xx)	x	x	6
Engineering Electives	select two additional engineering courses	x	x	6
General Electives	select engineering CS, OLS, TECH, MATH/STAT, BUS, PHYS, CHEM, BIOL courses	x	x	6
Total				30

Table 3. Curriculum for MSE-Mechanical Engineering

Category	Course	IPFW Video		Cr. Hrs.
Engineering Required	ME 505 Intermediate Heat Transfer	x	x	3
	ME 509 Intermediate Fluid Mechanics	x	x	3
	ME 550 Advanced Strength of Materials	x		3
	ME 562 Intermediate Dynamics with Applications	x	x	3
Math/Stat Electives	select two MATH/STAT/CS graduate courses (5xx/6xx)	x	x	6
Engineering Electives	select two additional engineering courses	x	x	6
General Electives	select engineering, CS, OLS, TECH, MATH/STAT, BUS, PHYS, CHEM, BIOL courses	x	x	6
Total				30

Table 4. Curriculum for MSE-Systems Engineering

Category	Course	IPFW Video		Cr. Hrs.
Required Engineering	SE 510 Systems Engineering	x		3
	SE 520 Engineering Economics	x		3
	SE 530 Engineering Management	x		3
	SE 540 System Architecture	x		3
Math/Stat Electives	select two MATH/STAT/CS graduate courses (5xx/6xx)	x	x	6
Engineering Electives	select additional engineering courses or CS courses	x	x	6
General Electives	select engineering, CS, OLS, TECH, MATH/STAT, BUS, PHYS, CHEM, BIOL courses	x	x	6
Total				30

Table 5. Proposed schedule of the IPFW MSE core courses.

Courses	Fall 07	Spring 08	Summer 08	Fall 08	Spring 09	Summer 09	Fall 09	Spring 10	Summer 10	Fall 10	Spring 11
Computer Engineering											
ECE 502	X			X			X			X	
ECE 547		X			X			X			X
ECE 565	X			X			X			X	
ACS 560		X			X			X			X
Electrical Engineering											
ECE 502	X			X			X			X	
ECE 547		X			X			X			X
ECE 538		X			X			X			X
ECE 565	X			X			X			X	
Mechanical Engineering											
ME 505	X			X			X			X	
ME 509		X			X			X			X
ME 550	X			X			X			X	
ME 562		X			X			X			X
Systems Engineering											
SE 510	X			X			X			X	
SE 520		X			X			X			X
SE 530		X			X			X			X
SE 540	X			X			X			X	

Required engineering courses will be offered on campus at least once an academic year. Students will also be permitted to use approved courses delivered from the West Lafayette campus via video.

c. *Engineering Courses*

The proposed engineering classes include both new courses and existing courses. These courses will either be taught at the IPFW campus or be accessible from Purdue University via video. The delivery method, frequency, timing and approval status of these courses are summarized in Tables 6 and 7. A description of new courses is provided in Appendix B.

Table 6. Graduate Level Electrical, Computer and Systems Engineering Courses

Course to be taught at IPFW	ECE 502 Linear Control Systems	ECE 538 Digital Signal Processing I	ECE 539 Digital Image Processing	ECE 543 Wireless and Mobile Networking	ECE 544 Digital Communications	ECE 547 Intro. to Computer Comm. Networks	ECE 549 Wireless Sensor Network	ECE 555 Microwave Engineering	ECE 565 Computer Architecture	ECE 569 Intro to Robotic Systems	ECE 584 Robust Control	ECE 595 Selected Topics in Elec and Computer Eng.	ECE 687 Intelligent Robotic Systems	ECE 698 Masters Thesis	SE 510 Systems Engineering	SE 520 Engineering Economics	SE 530 Engineering Management	SE 540 System Architecture	SE 595 Selected Topics in Systems Engineering	SE 698 Thesis
Frequency (Legend: Y:Every year, R:As requested, S:Every semester, V:Video only)	Y	Y	R	R	R	Y	R	R	Y	R	R	R	R	S	Y	Y	Y	Y	R	S
Initial offering at IPFW	Fall 2007	Spring 2008	2010 or Later	Fall 2007	2010 or Later	Spring 2008	2010 or Later	Fall 2009	Fall 2008	2010 or Later	Spring 2009	2010 or Later	2010 or Later	Fall 2008	Fall 2007	Fall 2006	Spring 2007	Fall 2007	Spring 2007	Fall 2007

Table 7. Graduate Level Mechanical and Industrial Engineering Courses

Course to be taught at IPFW	IME 505 Intermediate Heat Transfer	IME 509 Intermediate Fluid Mechanics	IME 550 Advanced Strength of Materials	IME 551 Finite Element Analysis	IME 562 Advanced Dynamics	IME 563 Mechanical Vibrations	IME 565 Vehicle Dynamics	IME 570 Machine Design	IME 571 Reliability-Based Design	IME 572 Anal. and Design of Robotic Manipulators	IME 581 Numerical Methods in Mech. Engr.	IME 595 Selected Topics in Mechanical Engineering	IME 604 Diffusion of Heat and Mass	IME 605 Convection of Heat and Mass	IME 660 Advanced Kinematics	IME 664 Vibrations of Continuous Systems	IME 698 Masters Thesis	IE 533 Industrial Applications of Statistics	IE 545 Engineering Economic Analysis	IE 546 Economic Decisions in Engineering	IE 570 Manufacturing Process Engineering
Frequency (Legend: Y:Every year, R:As requested, S:Every semester, V:Video only)	Y	Y	Y	R	Y	R	R	R	V	V	R	R	R	R	R	R	S	V	V	V	V
Initial offering at IPFW	Fall 2007	Spring 2008	Fall 2007	Spring 2008	Spring 2009	2010 or Later	2010 or Later	2010 or Later	N/A	N/A	Fall 2009	Spring 2007	2010 or Later	2010 or Later	2010 or Later	2010 or Later	Fall 2008	N/A	N/A	N/A	N/A

d. *Electives*

A number of graduate courses are already being offered at IPFW by other departments. Appended in Table 8 is a sampling of graduate courses that have been recently taught at the Fort Wayne campus. Students *with the proper academic background* will be able to select these courses and others to include in their proposed plan of study.

Table 8. Non-Engineering Electives

Course Number	Course Name	Times Taught in Last 3 years
<i>Department of Computer Science (CS)</i>		
ACS 560	Software Engineering	2
ACS 562	Systems Analysis and Design	0
ACS 564	Human-Computer Interaction	1
ACS 574	Advanced Computer Networks	1
CS 543	Intro. to Simulation & Modeling of Computer Systems	1
CS 580	Algorithm Design, Analysis, and Implementation	1
CS 590	Topics in Computer Science	7
<i>Division of Organizational Leadership and Supervision (OLS)</i>		
OLS 590	Individual Research Problems in Supervision and Personnel	8
<i>Department of Mathematical Sciences (Math/Stat)</i>		
MA 510	Vector Calculus	1
MA 511	Linear Algebra with Applications	2
MA 521	Introduction to Optimization Problems	2
MA 525	Introduction to Complex Analysis	1
MA 540	Analysis I	1
MA 541	Analysis II	1
MA 553	Introduction to Abstract Algebra	2
MA 554	Linear Algebra	2
MA 560	Fundamental Concepts of Geometry	3
MA 571	Elementary Topology	2
MA 575	Graph Theory	2
STAT 511	Statistical Methods	6
STAT 512	Applied Regression Analysis	3
STAT 514	Design of Experiments	1
STAT 516	Basic Probability and Applications	2
STAT 517	Statistical Inference	3
STAT 519	Introduction to Probability	2
STAT 528	Introduction to Mathematical Statistics	2
<i>School of Business & Management Sciences (BUFW)</i>		
BUFW D542	Strategic Cost Management	4
BUFW E540	Microeconomic Analysis and Decision-Making	3
BUFW E550	Business Conditions Analysis	2
BUFW F542	Financial Analysis and Decision Making	5
BUFW G545	Collective Bargaining	2
BUFW M540	Data Analysis and Management Science	5
BUFW M542	Leadership and Management of People in Organizations	5
BUFW M552	Management of Information Technology	2
BUFW M570	Operations and Supply Chain Management	6
BUFW M588	Strategic Management of Global Operations	4
BUFW M590	Strategic Management	6
BUFW M592	Communication, Team Building, Ethics, and Regulatory Environment	3

Course Number	Course Name	Times Taught in last 3 years
BUFW X501	Essentials of Accounting	2
BUFW X502	Basic Finance	1
<i>Department of Physics (PHYS)</i>		
PHYS 515	Thermal and Statistical Physics	1
PHYS 520	Mathematical Physics	1
PHYS 522	Coherent Optics and Quantum Electronics	1
PHYS 550	Introduction to Quantum Mechanics	1
<i>Department of Chemistry (CHEM)</i>		
CHM 533	Introductory Biochemistry	3
<i>Department of Biology (BIOL)</i>		
BIOL 506	Human Molecular Genetics	2
BIOL 509	Molecular Biology and Applications	1
BIOL 516	Molecular Biology of Cancer	1
BIOL 533	Medical Microbiology	3
BIOL 540	Biotechnology	1
BIOL 544	Principles of Virology	2
BIOL 556	Physiology I	2
BIOL 559	Endocrinology	1
BIOL 566	Developmental Biology	2
BIOL 579	Fate of Chemicals in the Environment	1

In order to take the above graduate courses, students must satisfy all necessary prerequisites and have approval from the department offering the course. Students also have the option to take some of the above courses via video.

e. *Required courses delivered by another institution*

Students will be allowed to transfer credits from other institutions as long as the following requirements are met:

1. At least one-half of the total credit hours satisfying degree requirements must be earned while registered at Purdue University.
2. More than 50% of the Purdue credits must be earned through the campus where the degree is conferred (e.g., IPFW).
3. Course credits earned while an undergraduate at Purdue University or other accredited institutions of higher learning may be applied toward an advanced degree if these credits are in excess of any requirements for the baccalaureate degree. Such credits must be certified as available for graduate credit by the institution from which the student received the baccalaureate degree and will be accepted only if: (1) the student had senior standing when taking the course, (2) the student received a grade of B or better, (3) the course was designated as a graduate course, and (4) the course was taken at the graduate level. The sum of credits earned as undergraduate excess or earned in post-baccalaureate or graduate-certificate status is limited to 12 credit hours.
4. Students will be allowed to obtain credit from classes offered from the Purdue West Lafayette campus via video with approval of the student's advisor and the graduate committee.

4. Form of Recognition

- a. Upon successful completion of the degree requirements, students will be awarded the Master of Science in Engineering (MSE) degree.
- b. The suggested CIP Code for the program is 140101.
- c. The diploma will read “Master of Science in Engineering, Purdue University, awarded at Indiana University Purdue University Fort Wayne.”

5. Program Faculty and Administrators

a. *Engineering Faculty (see Appendix C for complete vitae)*

The faculty and administrators of the Department of Engineering, all full-time and members of the Purdue graduate faculty, who will be directly involved with the MSE program include:

Hosni Abu-Mulaweh, Ph.D., Associate Chair of the Department of Engineering, Professor of Mechanical Engineering; convective heat and mass transfer, turbulent heat transfer, HVAC systems, laminar natural and mixed convection.

Chao Chen, Ph.D., Assistant Professor of Electrical Engineering; communication networks.

Bongsu Kang, Ph.D., Associate Professor of Mechanical Engineering; structural dynamics and vibration, applied mechanics, system dynamics, wave propagation analysis.

Josué Njock Libii, Ph.D., Associate Professor of Mechanical Engineering; fluid dynamics and wave phenomena, stratified flow and vibration of continuous systems.

Yanfei Liu, Ph.D., Assistant Professor of Electrical Engineering; robotics and computer vision.

David Mauritzen, Ph.D., Assistant Professor of Electrical Engineering; electronics, computer applications, interdisciplinary applications.

Scott Moor, Ph.D., P.E., Assistant Professor of Engineering; engineering education, design of experiments, process development, spray drying

Donald Mueller, Ph.D., P.E., Assistant Professor of Mechanical Engineering; thermal sciences, heat transfer, machine design, numerical methods.

Hossein Oloomi, Ph.D., Associate Professor of Electrical Engineering; control theory, robust control, singular perturbation.

Carlos Pomalaza-Ráez, Ph.D., Chair of the Department of Engineering, Professor of Radio Frequency Communications; wireless communications networks, signal processing, pattern recognition and computer vision.

Elizabeth Thompson, Ph.D., Associate Professor of Electrical Engineering; signal processing, microprocessor embedded systems.

Gerard Volland, Ph.D., Dean and Professor of Engineering; systems engineering.

Steven Walter, Ph.D.. Distinguished Professor of Systems Engineering; product development, aerospace systems, remote sensing, project management.

Guoping Wang, Ph.D., Assistant Professor of Computer Engineering; digital system design, computer architecture, VLSI design.

Nashwan Younis, Ph.D., Professor of Mechanical Engineering; solid mechanics, experimental stress analysis, experimental fracture mechanics.

Jiaxin Zhao, Ph.D., Assistant Professor of Mechanical Engineering; tribology: friction, lubrication and wear, machine design, solid mechanics, numerical methods including finite elements, and parallel computing.

Tianxia Zhao, Ph.D., Assistant Professor of Electrical Engineering; applied electromagnetics.

b. *New faculty positions required*

Initially, this program will be supported by IPFW with *replacement time*¹ for the current faculty. One faculty member, the *Graduate Director*, will be granted 50% replacement time to initiate the program. Once the program is established, this replacement time will be reduced to 25% to direct the program. The Graduate Director's administrative duties will include: developing guidelines for the program, preparing the curriculum and scheduling class offerings, advertising the program, and coordinating admissions. In addition to administrative duties, the Graduate Director will also develop relationships with local industry, pursue grants for the program, contact alumni, seek scholarships/fellowships opportunities, and coordinate and administer program assessment

Current faculty members will be given replacement time to develop graduate-level courses although they will continue to be primarily involved at the undergraduate level. As enrollment levels dictate, new faculty positions will be required. In AY 2008-2009, one new faculty member in Systems Engineering will be required. By the fall of 2009 enrollment levels are expected to rise so that each area of specialization will require a new faculty position. The timeline for the faculty positions and the financial commitment by IPFW is given in Table 9.

6. Needed Learning Resources

Available Resources

As part of the Indiana University Libraries system, Walter E. Helmke Library holds (as of 2005) more than 359,036 volumes (including bound serials), 115,766 government publications, and 542,026 microforms. Helmke Library is a depository library providing open access to a large portion of federal government publications. The library's document delivery system and membership in resource-sharing networks support rapid, reliable interlibrary loan of a wide range of resources not held locally. Helmke Library provides access to a great variety of bibliographic databases related to science, engineering, and technology; specifically the following are directly related to the proposed master's degree in engineering: ACM Digital Library, Compendex (Ei Engineering Village 2), Web of Science (including Science Citation Index), Society of Automotive Engineers Digital

¹ This refers to the cost of replacing a regular faculty by IPFW from his/her teaching assignments with an adjunct faculty member.

Library, and IEEE All-Society Periodicals Package. IPFW's new license for the latter resource provides full-text access to 118 journals published by the Institute for Electrical & Electronic Engineers (although online access to IEEE and member-society conference papers and standards would entail significant additional annual expense). By means of the library's printed and online serial holdings and document delivery services, students and faculty have access to a wide range of technical materials. In support of existing undergraduate engineering programs, a large number of engineering-related books and other library materials are already available to the students. The Department of Engineering has worked with Helmke Library's librarian who is liaison to the School of Engineering, Technology, and Computer Science (ETCS) to purchase resources through the library's special-needs grant process that will support the proposed curriculum (e.g., the 21-volume ASM Handbook was recently acquired through this funding source for the science reference collection).

The proposed MSE program will use existing engineering laboratories and facilities within the Department of Engineering, including Materials and Mechanics, Fluid and Heat Transfer, and Electronics and Controls Laboratories.

In addition, the School of Engineering, Technology, and Computer Science (ETCS) operates four student computer laboratories, which are in addition to a broad range of computing services available to IPFW students including E-mail accounts, supported software, web space and technical support. The engineering labs are integrated into the school's network and provide access to numerous licensed engineering software packages. IPFW also has a number of student computer laboratories at various locations that provide a campus-wide intranet system.

a. *Additional learning resources needed*

IPFW will provide resources to initiate the MSE program. Table 9 provides the time-phasing of the required resources. The rationale for these resources are as follows:

Graduate Director

Half-time replacement support for a Graduate Director is initially requested to launch and administer the MSE program (e.g., develop procedures, manages admissions, review and approve plan of studies, etc.). After the MSE program is established, the administration of the program is expected to be a quarter-time job.

Adjunct Professors/Lecturers

Initially, it is necessary to free up graduate faculty to offer the graduate courses, thus funding is required to support adjunct faculty/lecturers to cover their current assignments teaching introductory-level undergraduate courses. After there is demonstrated graduate enrollment, the hiring of tenure-track graduate faculty will be justified.

Faculty

After the program is established, it is projected that one faculty member in mechanical computer and electrical engineer and two faculty members in systems engineering will need to be hired to handle the graduate program enrollment growth

Secretarial Support

A half-time secretary will be needed to assist with admissions, reviews, administrative tasks, etc.

Graduate Assistantships

After the first year, two half-time graduate teaching assistantships will be available to assist faculty with some of their teaching duties. Funding for additional graduate research assistantships will be sought from local industry and government sources.

Student Office, Computer and Supplies

Initially, a shared graduate student office equipped with computers will be provided by IPFW. Funding for computers and miscellaneous supplies are assumed. The funding profile is phased to increase graduate assistant support with increasing enrollment.

Table 9. Time-phasing of program resource requirements

Academic Year	Description
Fall 2007	50% Replacement Time for Graduate Director 25% Time for an EE Adjunct Professor 25% Time for a Computer Eng Adjunct Professor 25% Time for a ME Adjunct Professor Half time Secretarial Support Student Office, Computer and Supplies
Spring 2008	25% Replacement Time for Graduate Director 50% Time for an EE Adjunct Professor 50% Time for a Computer Eng Adjunct Professor 50% Time for ME Adjunct Professor Half time Secretarial Support Student Office, Computer and Supplies
Fall 2008	1 Systems Engineering Faculty (1 st faculty) 25% Replacement Time for Graduate Director 50% Time for an EE Adjunct Professor 50% Time for a Computer Eng Adjunct Professor 50% Time for ME Adjunct Professor 1 FTE Graduate Teaching Assistantship Half time Secretarial Support Student Office, Computer and Supplies

Table 9. (Continued)

Academic Year	Description
Spring 2009	1 Systems Engineering Faculty (1 st faculty) 25% Replacement Time for Graduate Director 50% Time for an EE Adjunct Professor 50% Time for a Computer Eng Adjunct Professor 50% Time for ME Adjunct Professor 1 FTE Graduate Teaching Assistantship Half time Secretarial Support Student Office, Computer and Supplies
Fall 2009 – Spring 2011	1 Computer Engineering Faculty 1 Electrical Engineering Faculty 1 Mechanical Engineering Faculty 2 Systems Engr. Faculty (1 st & 2 nd faculty) 25% Replacement Time for Graduate Director 1 FTE Graduate Teaching Assistantship Half time Secretarial Support Student Office, Computer and Supplies

These resource assumptions combined with the enrollment assumptions discussed in Section D.8. are the basis of the financial projections provided in Appendix A.

7. Other Program Strengths

a. *Special features of the program*

The curriculum in this program is extremely flexible. Students will be able to tailor the program to meet their needs by blending courses offered by the IPFW Department of Engineering and the Purdue College of Engineering, as well as approved courses offered by the IPFW Departments of Physics, Chemistry, Biology, Mathematics, Computer Science, and the division of Organizational Leadership and Supervision (OLS).

The development of an engineering graduate program at IPFW will benefit the long-term growth of the northeastern Indiana community by enhancing its attractiveness to additional high technology corporations that rely on knowledge and innovation.

The graduate degree in Systems Engineering is unique to Indiana. Students in all areas of specialization will have the opportunity to take courses in Systems Engineering. Engineers with this type of education are in high demand in northeastern Indiana and nationwide.

b. *Anticipated collaborative arrangements*

Research projects will be developed with industry; however, no formal collaborative arrangements are in place at this time.

C. PROGRAM RATIONALE

1. Institutional Factors

a. *Program compatibility with the IPFW mission*

The proposed graduate program provides advanced degree opportunities that are needed in northeastern Indiana. The program focuses on the latest advances in Computer Engineering, Electrical Engineering, Mechanical Engineering, and Systems Engineering. These areas are of great interest to industry and students in northeastern Indiana. The proposed degree is in accordance with the mission of Indiana University-Purdue University Fort Wayne (IPFW) to play an important role in the cultural and economic life of northeastern Indiana, to support the workforce, and to respond to changes in the economy. More specifically, an objective of the IPFW strategic plan is to “*make IPFW the graduate education center for northeastern Indiana.*” The proposed graduate program in engineering will also prepare students to pursue a Ph.D. degree at other universities.

b. *Planning process for the program*

The planning process was initiated during AY 2003/2004 by the faculty of the Department of Engineering. A survey was sent to local industry regarding interest in an engineering graduate program. Responses indicated substantial support. In addition, since January 2004, the IPFW Office of Research & External Support in conjunction with the School of Engineering, Technology, and Computer Science has sponsored three Systems Engineering Symposiums with local industry. An outcome of these was a commitment from local industry to support a graduate program in Systems Engineering. Specifically, they have committed to a Center for Systems Engineering as well as an Endowed Chair in Systems Engineering.

A pre-proposal to offer an engineering graduate program was prepared and submitted in AY 2004/2005. In November 2005, the Purdue Graduate School approved it and requested a full proposal. The planned timeline for implementation of the graduate program, pending approval, is fall 2007.

c. *Impact of the proposed program on the IPFW campus*

No program at IPFW has the scope and objectives of the one proposed. The graduate engineering program will provide a direct and substantial benefit to the undergraduate engineering program at IPFW. It will also provide opportunities for faculty and students, both undergraduate and graduate, to be exposed to state of the art technologies, to pursue funding, and to collaborate with industry. The activities associated with the graduate program will propagate into the undergraduate program through increased technical elective offerings, funded research projects, and enhanced laboratories.

d. *Utilization of existing resources*

In addition to supporting current graduate courses in the Departments of Physics, Biology, Mathematics, Computer Science, and Organizational Leadership and Supervision, the proposed program will more fully utilize existing laboratories, as well as computer and library resources at IPFW.

2. Student Demand

a. Enrollment Narrative

In 2003 the Department of Engineering at IPFW conducted a survey of 32 graduating engineering students to assess their interest in a graduate program at IPFW. Their responses are shown in Table 10. Their strong support for an engineering graduate program at IPFW is significant because the majority of IPFW graduates remain in the Northeast Indiana region. This would provide a strong pool of candidates from which to initiate the program.

Table 10. Results from a 2003 survey of 32 IPFW engineering seniors.

<i>Would you be interested in a graduate program in engineering at IPFW?</i>	
Yes	No
21	11

A survey was distributed to local industry with the assistance of the engineering department's industrial advisory board and posted on the internet. Seventy on-line responses were obtained, along with 16 paper copies. Employees of companies such as International Truck and Engine, Raytheon, UnderSea Sensors, and ITT returned most of the surveys. The results are summarized in Table 11.

Table 11. Results of industry surveys.

Degree obtained	B.S. Computer Engineering	6%
	B.S. Electrical Engineering	27%
	B.S. Mechanical Engineering	29%
	B.A./B.S. Computer Science	20%
	Other (physics, technology, etc.)	18%
Desired area of specialization	Computer Engineering	30%
	Electrical Engineering	32%
	Mechanical Engineering	20%
	Systems Engineering	18%

Due to the nature of the survey, almost all respondents indicated some interest in the program. The background of the respondents was diverse with approximately 38% having a degree in a non-engineering field. The results from the survey indicate that there is a strong interest in an engineering graduate program at IPFW, and that all four proposed areas of specialization are of interest.

There is significant evidence of strong interest in the systems engineering focus. In 2004, six local companies contributed money to endow a chair to start a Systems Engineering program at IPFW. In spring 2006, the first graduate-level systems engineering course was offered. Even though it was informally advertised via word-of-mouth, it attracted 28 students from local companies including Raytheon, International Truck and Engine, Logikos, Ultra Undersea-Sensors and General Dynamics. Additionally, discussions have been initiated with the Department of Aeronautics and Astronautics on the West Lafayette campus to explore the possibility of streaming the IPFW Systems Engineering courses to students at the Purdue main campus.

- b. Enrollment projections for the MSE program are shown in Table A-1—Program Enrollments and Completions in Appendix A.

3. Transferability

Students should not incur problems in transferring credits earned in the proposed MSE program to other similar programs in the state or in the nation.

4. Access to Graduate and Professional Programs

Upon completion of the MSE, students will be prepared to enter PhD graduate programs that emphasize further study in Computer, Electrical, Mechanical, or Systems Engineering. Doctorate degrees in these disciplines exist at major universities in the State of Indiana and nationally.

5. Demand and Employment Factors

The trend in our increasingly advanced technological society is toward advanced degrees. The U.S. Department of Labor, Bureau of Labor Statistics, predicts a 23.4 percent increase in job openings that require a Master's degree during 2000-2010. They also project a 40.3 percent increase in Computer and Information Scientist Researchers with a Doctoral Degree for the same time period.²

The northeastern Indiana community in which the IPFW campus is located has a strong industrial base which includes high technology industries such as ITT Industries, Raytheon, Northrop Grumman, International Truck & Engine, BAE Systems, General Dynamics, General Electric, General Motors, Logikos Systems & Software, DePuy, and Zimmer. These companies require engineers with advanced degrees. For example, at Raytheon in Fort Wayne, over 250 of its nearly 1000 engineers have advanced degrees. Furthermore, many of these employers encourage advanced study and support it through tuition reimbursement.³ Thus, employees at several of these corporations are currently pursuing engineering master's degrees via distance learning. Establishment of an engineering graduate program at IPFW will serve employees of these and other local industries. Indeed, letters of support from several major companies in the northeastern Indiana have been solicited recently indicating a strong support for a graduate engineering program. Copies of the letters are provided in Appendix D.

² <http://www.bls.gov>

³ "Findings about post-baccalaureate education needs from focus groups conducted November 2001 and April 2002," Report prepared by David McCants, Associate Vice Chancellor, Indiana University-Purdue University Fort Wayne, June 12, 2002.

Support for a graduate program in engineering also comes from the report of the Hudson Institute, which did a study for the Indiana Chamber of Commerce titled, “*Economic Vision 2010 Report Card*”⁴ stating that “*graduate degrees have become critical in the knowledge economy. The premium paid for them continues to rise, as do the number of occupations that require them.*”

Figure 1 gives percentage of graduate degrees granted in Indiana and surrounding states with respect to each state’s 24-, 25- and 29-year-old population (ages at which holders of these degrees are likely to enter the workforce). Indiana trails three surrounding states. No graduate engineering degrees are currently granted by IPFW, the largest university in northeastern Indiana.

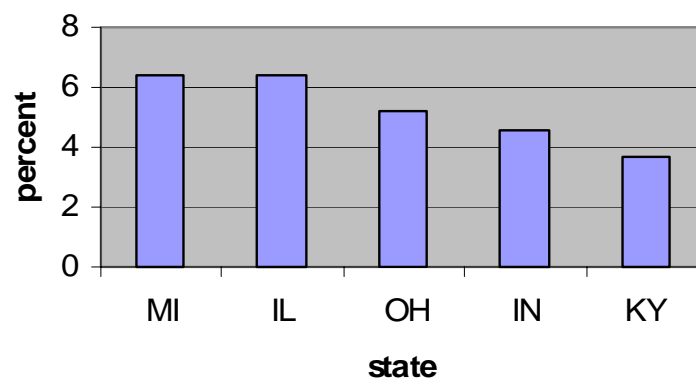


Figure 1. Percentage of graduate degrees granted in Indiana and surrounding states with respect to the state’s total 24-, 25-, and 29-year-old population—ages at which holders of these degrees are likely to enter the workforce.

This same report uses the terms *knowledge economy* and *innovation economy* interchangeably and states that many of the “*occupations associated with the innovation economy are technical in nature... They rely on such an advanced level of knowledge that a master’s degree or better is essential for their practice. The proportion of innovation economy graduate degrees is an indicator of whether a state can support innovation economy firms with a strong supply of advanced knowledge workers.*” The report defined an innovation economy as one “*characterized by scientific discovery, technological innovation, the creative commercialization of new products and services, and the rapid penetration of new markets.*” It emphasized that states most competitive in the innovation economy may differ from those in the old industrial economy. The top 10 states that are most competitive in the innovation economy consist of states that lead in software, information technology, and “high tech” transformation.

The development of an engineering graduate program at IPFW will benefit the long-term growth of the northeastern Indiana community by enhancing its attractiveness to additional high technology corporations that rely on knowledge and innovation. In a 1999 report “*America’s High-Tech Economy: Growth, Development and Risks for Metropolitan Areas,*” the

⁴ <http://www.indianachamber.com/rc03.asp>

Milken Institute underscored both the importance of high technology to a metropolitan area's economy and the importance of research and educational institutions, as stated in the following excerpt:

"Research centers and institutions are undisputedly the most important factor in incubating high-tech industries. A side effect of the technical capability and scientific research activities of these institutions is the training and education of the skilled labor that will be critical to the expansion and reinforcement of regional high-tech industries. A form of public and private venture that aims to establish and maintain leading-edge regional research centers and educational institutes is a critical long-term economic growth strategy."⁵

Regional, State, and National Factors

- a. This program has similarities to engineering masters programs offered at other Indiana institutions. The Master of Science in Engineering (MSE) degree in the state of Indiana is offered at Purdue University (WL), Indiana University-Purdue University Indianapolis (IUPUI), and Purdue University Calumet. The Master of Science in Electrical and Computer Engineering (MSECE) and the Master of Science in Mechanical Engineering (MSME) degrees are offered at Purdue University (WL), University of Notre Dame, and Indiana University-Purdue University Indianapolis (IUPUI). The Master of Science (MS) degree is offered at Purdue University (WL), Indiana University-Purdue University Indianapolis (IUPUI), Purdue University Calumet, and Rose-Hulman Institute of Technology.

However, no public institution offers an engineering master's degree in northeastern Indiana. The closest public institution that offers the master's degree is Purdue University (WL), which is 110 miles from Fort Wayne. The University of Notre Dame, at a distance of 80 miles from Fort Wayne, is the closest private institution with similar degree offerings.

The proposed master's program will be the first one in engineering to be based in northeastern Indiana. Additionally, the Systems Engineering specialization is unique to Indiana. It will prepare students to be competitive in regional high-tech industries and/or pursue a PhD at other universities.

- b. The Accreditation Board of Engineering and Technology (ABET) does not accredit a master's program in a school in which the undergraduate engineering program is ABET accredited. IPFW's undergraduate mechanical and electrical engineering programs are ABET accredited (and the computer engineering program is currently undergoing accreditation review), so the proposed graduate program is ineligible for ABET accreditation. The proposed graduate program has been patterned after similar nationally existing programs.

⁵ http://www.hrp.org/leg_agenda_technology.php 2000 Legislative Agenda on Technology Related Economic Development, Hampton Roads Partnership, Norfolk, VA 23510.

D. PROGRAM IMPLEMENTATION AND EVALUATION

1. Quality and Efficiency

Annual assessment reviews of each undergraduate engineering program are conducted by the engineering department in accordance with IPFW requirements. For each program, these assessment reviews include goals and measurements of success for the goals. Measures used for assessment include interim evaluations, exit surveys, and surveys of alumni and employers. A continuous improvement component is contained in each assessment plan.

The Department of Engineering has maintained continuous ABET accreditation for the electrical and mechanical engineering undergraduate programs for the last 14 years, and computer engineering undergraduate program is undergoing accreditation review currently. Although ABET accreditation is not applicable for the proposed graduate program, it will be evaluated and assessed using the same techniques as those of the ABET accredited undergraduate programs.

2. Appropriateness

All graduates will be included in follow-up studies after they have been on the job for one year and again after three years. A comprehensive assessment plan will be developed by the Department of Engineering to evaluate the strengths and weaknesses of the proposed program and to implement a continuous improvement cycle.

3. Availability of Similar Programs

The proposed master's program will be the first one in engineering to be based in northeastern Indiana and the only one in the state of Indiana offering the Systems Engineering specialization.

4. Personal and Social Utility

IPFW Students are involved in active student organizations, including student chapters of the American Society of Mechanical Engineers (ASME), the Society of Automotive Engineers (SAE), the Society of Manufacturing Engineers (SME), the Society of Women Engineers (SWE), the Institute of Electrical and Electronic Engineers (IEEE), and the National Society of Black Engineers (NSBE). Engineering students are also involved in campus-wide organizations such as the Indiana Purdue Student Government Association (IPSGA), Student Activity Board (SAB), Delta Gamma, National Pan-Hellenic Organization, Phi Kappa Theta, Pi Beta Phi, and Sigma Phi Epsilon. Engineering students have also been very involved in outreach activities such as the Lego Robotics Tournaments, Robotics Summer Camps for children, Robotics Workshops for Teachers, Engineering Career Days, and design competitions sponsored by SAE and ASME.

5. Student Demand

Survey data, interviews with current and prospective students, and feedback from industrial representatives indicate a strong student demand for the opportunities offered by the

engineering master's program. Conservative projected enrollments are shown in Table A-1. Continuous monitoring of actual enrollment and retention rates will be conducted along with the annual program assessment to show student demand and satisfaction level.

6. Student Access

IPFW has a strong commitment to facilitate student academic success. A wide range of academic assistance programs are available through the Center for Academic Support and Advancement, Services for Students with Disabilities office, Department of Mathematical Science and Department of English and Linguistics. In addition, the Purdue University Graduate School Ombudsman Office is a resource for addressing student concerns, reconciling disputes and providing referrals.

The Center for Academic Support and Advancement (CASA) provides and coordinates access to academic support services on campus. CASA's core mission is to help both undergraduate and graduate students acquire the skills they need to succeed. Among the many services they provide is language assistance to non-native speakers of English. They can recommend English classes, provide tutoring, furnish conversation partners and can direct students to language resources within the Fort Wayne community,

The IPFW Services for Students with Disabilities office is chartered to ensure that students with disabilities can freely and actively participate in all facets of university life, provide support services and coordinate programs that enable students with disabilities to achieve their educational potential.

7. Flexibility of Program Design

The continuous integration into the curriculum of advances in the appropriate areas of engineering will be a priority in the proposed program. As student demand changes, the course offerings will be adjusted accordingly. The option for students to use video courses makes the program extremely flexible.

8. Market Demand

The majority of engineers in northeast Indiana are employed in the aerospace/defense, transportation or orthopedic/medical device industry. In the aerospace/defense sector the primary employers are ITT Industries, Raytheon, BAE Systems and Ultra Underseas Sensors. In addition, General Dynamics and Northrop Grumman maintain small operations in the region. The dominant employer of automotive engineers in Fort Wayne is Navistar International Truck and Engine, which designs and prototypes trucks at their Fort Wayne facility. The orthopedic and medical device industry, centered in Warsaw, IN, employs engineers at De Puy, Zimmer, Biomet and a number of small companies and start-ups.

In the near future, the aerospace/defense sector will hire more new engineers than the other sectors due to the aging workforce and associated wave of retirements that is forecast for the industry. According to the Aerospace Industries Association, the defense/aerospace industry retirement rates will reach double digits by 2008. The industry expects a shortage of engineers. A recent *National Defense Industrial Association* study cited systems engineering positions as the second most "difficult to fill." Electrical engineers were listed as number four and mechanical engineers were number six. This trend has caused companies to significantly

increase the number of young engineers they are hiring and planning to hire in the next few years. They have told us that they need post baccalaureate educational opportunities for their junior engineers to further develop their skills. The increased need for educational services is an industry-wide trend. For example, Lockheed Martin has reported that the number of employees participating in their tuition reimbursement programs increased by 50% in 2005, alone.

Overall, Northeast Indiana will need roughly 1,100 new engineers between 2002 and 2012 according to a 2002 report by the Indiana Workforce Development Office. Given that this forecast was tied to a total engineering workforce estimate of 4300 engineers, and given that 20% to 30% of the engineers working in the companies previously cited have advanced degrees there is a demand of upwards of 100 new Master-level students per year. Recognizing that some of these engineers will come to the region already having Master's degrees and others will take advantage of on-line and distance learning programs we have estimated that the IPFW MSE program will reach and maintain a steady state enrollment of 25 students per year. The accompanying financial data assumes this conservative estimate to derive the tuition revenue in Appendix A.

9. Inter-Institutional and Inter-department Cooperation

The Departments of Computer Science, Chemistry, Physics, the School of Business and Management Science, and the Division of Organizational Leadership and Supervision will provide basic science courses and electives for the curriculum. Distance education courses offered by other Purdue campuses will provide additional options for students.

10. Flexibility of Providing Instruction

The courses in the graduate program will be taught by qualified full-time faculty members of the Department of Engineering and will be continuously updated to meet the rapid advances in the appropriate engineering areas. The program will be organized to support both full-time and part-time students through course scheduling in both day and evening time periods. Distance-learning courses provided by IPFW and other Purdue University campuses will add additional flexibility to the program.

Appendix A

Tables of Enrollments, Completions, and Costs

Appendix C

Brief Engineering Faculty Vita

Appendix D

Letters of Support from Local Industry

*Appendices A, C and D are available from the
Department of Engineering
upon request.*

Appendix B

Description of New Courses

Computer Engineering

Electrical Engineering

ECE 502	LINEAR CONTROL SYSTEMS
Credit:	3
Area:	Electrical and Computer Engineering
Specialization:	Automatic Control
Prerequisite:	ECE 382 or graduate standing
Description:	Linear spaces and linear operators, mathematical representations of linear systems, canonical forms, state space description, controllability, observability, realization, canonical decomposition, stability, introduction to Lyapunov methods, eigenstructure assignment, partial and full order observers, disturbance decoupling.
ECE 539	DIGITAL IMAGE PROCESSING
Credit:	3
Area:	Electrical Engineering
Specialization:	Communications and Signal Processing, Computer Engineering
Prerequisite:	ECE 301, ECE 302, and experience with Matlab or C
Description:	This is an introductory course in Image Processing. The course covers both mathematical fundamentals and implementation. Topics include: image digitization, representation and compression; image analysis including filtering, feature detection and segmentation; image enhancement; discrete transforms.
ECE 543	WIRELESS AND MOBILE NETWORKING
Credit:	3
Area:	Electrical and Computer Engineering
Specialization:	Communications and Signal Processing, Computer Engineering
Prerequisite:	ECE 547
Description:	Introduction and overview of different wireless and mobile networks. This course will involve the study of the impact of wireless network characteristics on existing network protocols and newer protocols that are suited to such characteristics. Protocols for medium access control, routing, and reliable transport; in addition, middleware and custom-made applications for wireless networks are covered.
ECE 549	WIRELESS SENSOR NETWORKS
Credit:	3
Area:	Electrical and Computer Engineering
Specialization:	Communications and Signal Processing, Computer Engineering
Prerequisite:	ECE 547
Description:	This course covers fundamental issues in designing and analyzing sensor network information processing applications. Topics include design implications of energy-constrained nodes, network self-configuration and adaptation,

localization and time synchronization, collaborative signal processing, fault tolerance and security issues.

ECE 555**Credit:****Area:****Specialization:****Prerequisite:****Description:****MICROWAVE ENGINEERING**

3

Electrical and Computer Engineering

Communications and Signal Processing

ECE 311

Transmission lines, waveguides, microstrip circuits, microwave circuit theory, scattering matrices, impedance transformers, passive microwave devices, resonators, microwave tubes, solid-state active devices.

ECE 584**Credit:****Area:****Specialization:****Prerequisite:****Description:****ROBUST CONTROL**

3

Electrical and Computer Engineering

Automatic Control

ECE 502

Robustness of control systems to disturbances, parameter uncertainty, and modeling errors; fundamental issues arising in the study of feedback systems including well-posedness, internal stability, uncertainty and robustness, and controller parameterizations; multivariable design techniques including H₂ and H-infinity optimal controls, mixed sensitivity, loop shaping, and mu analysis and synthesis methods; computational methods using the linear matrix inequality; applications of robust control design.

ECE 687**Credit:****Area:****Specialization:****Prerequisite:****Description:****INTELLIGENT ROBOTIC SYSTEMS**

3

Electrical Engineering

Automatic Control, Computer Engineering

ECE 569 (Introduction to Robotics)

This course examines some of the fundamental problems involved in robot motion planning, sensing, and control. Topics include: mobile robot path planning, obstacle avoidance and control; image processing and computer vision techniques used in robotics; sensor-based robot control; robot language and programming.

Systems Engineering

SE 510	SYSTEMS ENGINEERING
Credit:	3
Area:	Systems Engineering
Specialization:	Systems Engineering
Prerequisite:	Senior or Graduate standing
Description:	This course will introduce systems engineering (SE) methodologies spanning the product development lifecycle from initial scope definition through delivery of the first production item. Emphasis will be placed on SE techniques used to define and manage requirements, analyze and optimize product architectures, develop comprehensive designs, plan and supervise manufacturing, test and evaluation, and implement the production line. Additionally, SE balance and control functions will be addressed that ensure that the final product meets the initial requirement and is designed to be integrated, tested and manufactured.
SE 520	ENGINEERING ECONOMICS
Credit:	3
Area:	Systems Engineering
Specialization:	Systems Engineering
Prerequisite:	Senior or Graduate standing
Description:	This course will provide an overview of financial accounting and economic principles employed by engineers involved in product and system development. It is intended to familiarize engineers with methods in project accounting, budgeting, cost estimation, financial management, design optimization and economics.
SE 530	ENGINEERING MANAGEMENT
Credit:	3
Area:	Systems Engineering
Specialization:	Systems Engineering Management
Prerequisite:	Senior or Graduate standing and Systems Engineering (SE510)
Description:	The systems engineering (SE) management team is responsible for planning and managing all systems engineering activities required to successfully develop complex products and systems. They are in charge of ensuring that all system elements are compatible, available on schedule, work together seamlessly, and satisfy customer requirements. Topics will include planning, management of scope, risk and cost, configuration and interface control, reviews, performance measures, team building, and communications.

SE 540	SYSTEM ARCHITECTURE
Credit:	3
Area:	Systems Engineering
Specialization:	System Architecture and Design
Prerequisite:	Senior or Graduate standing
Description:	Systems engineering best practices prescribes a set of methodologies for architecting and designing complex systems leading to development of a set of functional and physical architectures and functional, allocated and product baselines. This course will cover the requirements analysis, functional analysis/allocation, and synthesis processes as well as the associated requirement, design and verification loops. Additionally, the interaction of the architecture process with balance and control functions will be addressed in detail.
SE 595	SELECTED TOPICS IN SYSTEMS ENGINEERING
Credit:	3
Area:	Systems Engineering
Specialization:	Variable
Prerequisite:	Admission by consent of instructor
Description:	This course number serves as a vehicle for specialty topics in Systems Engineering. Topics could include requirements management, specialty engineering (<i>i.e.</i> , reliability, manufacturability, survivability, etc.) and risk assessment and management .
SE 698	THESIS
Credit:	1-18
Area:	Systems Engineering
Specialization:	Variable
Prerequisite:	Admission by consent of advisor
Description:	Original research in systems engineering leading to the preparation of a thesis or dissertation. Projects proposed in cooperation with an industrial sponsor are highly encouraged.