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1. Introduction

Established as the world's first industrial engineering (IE) program in 1908 by then-Governor of Pa General James A. Beaver, the Harold and Inge Marcus Department of Industrial and Manufacturing Engineering has graduated more 8,000 students and has made a name for itself as one of the top industrial engineering programs in the country.

Despite this rich tradition, many people do not understand what, exactly, an industrial engineer does. What follows below will give you a brief picture of what industrial engineering is all about and the variety of career opportunities available to IE graduates.

2. What does an industrial engineer do?

To start to answer the above question, one might first consider what an engineer does. Simply put, engineering is the application of scientific and practical knowledge in order to solve problems. For certain engineering disciplines, such as civil and electrical, we have a reasonable understanding of the type of problems solved. Even though industrial is an engineering discipline, the problems they solve are very often interdisciplinary in nature.

The Institute of Industrial Engineers defines its members as "engineers concerned with the design, improvement, and installation of integrated systems of people, materials, equipment, and energy. They draw upon specialized knowledge in the mathematical, physical, and social sciences together with the principles and methods of engineering analysis and design to specify, predict, and evaluate the results to be obtained from such systems." Industrial engineers differ from other types of engineers in that they must be concerned with people as well as things, which makes them a prime source of management talent.

One of the confusing aspects about industrial engineering is the name itself. The name implies that you would expect to find these engineers in industry, which indeed you do. But you also find them in banks, hospitals, government agencies, transportation centers, construction companies, social services, etc. There are currently some 200,000 industrial engineers employed in enterprises throughout the United States.

The Engineer's Joint Council (Publication 224) predicted that "Industrial Engineering will grow more rapidly than any other engineering group." On average, there are some 7,000 job openings occurring annually with less than 5000 new IE graduates per year to claim them. According to the College Placement Council, "Industrial Engineers are sought after by more types of employers than is true for any other formal curriculum." Thus, as an industrial engineer you could be concerned with the quality of cookies coming off a production line, the scheduling of a hospital's operating room, the location of the next motel for a motel chain, the installation of a welding robot in an automobile fabrication line, the tracking of inventories for a food distributor, the designing of an automatic material handling system for an airfreight carrier, or the ergonomic design and layout of an airplane's cockpit.

The combinations of the IE's talents and the variety of problem areas seem endless. The challenges and opportunities are there for those who become IE graduates. How does the IE curriculum at Penn State prepare you for these challenges and opportunities?

3. The IE Curriculum

Based on the feedback received from corporations, current students, and alumni, the department modified the curriculum in 2013. The revised curriculum builds a strong foundation for the development of a professionally competent and versatile industrial engineer, able to function in both manufacturing and service environments. In particular, new required courses provide students with a solid background in engineering analytics, supply chain management, and service engineering. We have also added content in the areas of project management, sustainability, and business planning. Graduates of our program will be prepared for a wide variety of careers including energy systems, financial services, health care delivery, information technology, manufacturing, supply chain management, and others.

During the student's first two years, courses in the basic sciences and engineering are taken. These courses are, in general, common to all engineering majors. In addition, the student completes many of the university's general education requirements during this time. This includes courses in the humanities, social sciences, arts, (refer to the University Guidelines for General Education) communications, and physical education. A student can complete the freshman and sophomore years at a Commonwealth Campus, Behrend College, or University Park.

Students start taking I E courses during the junior and senior years. The required I E courses are designed to introduce the student to basic industrial engineering fields of interest which include *human factors/ergonomics, manufacturing, operations research, and service engineering*. A total of six course credits from an approved list of technical electives is also required, in addition to the three-credit capstone design course. A list of the required and elective courses is given in section 9. The required courses are grouped by fields of interest and a table on page 16 lists the courses that count as technical electives. By reading each course's brief description of content, one can obtain a better understanding of the nature of industrial engineering.

4. Educational Objectives

I. Program Educational Objectives

Within three to five years after obtaining a B.S. in industrial engineering, we anticipate graduates will be able to:

1. Participate in and lead cross-functionally defined project teams, designing, implementing, and improving processes, products and systems in the manufacturing, service or government sectors.

2. Work effectively in managerial and leadership positions, to establish and execute engineering and business strategies.

3. Work and communicate effectively with internal and external stakeholders in the global environment, while satisfying engineering, business and financial goals, and the end customers.

4. Embrace the importance of continuous learning through varied work assignments, graduate school, professional training programs and independent study, for the purpose of ongoing professional development.

5. Demonstrate proficiency in data analysis using state-of-the art tools, to assist with decision-making.

II. Course Performance Indicators

- Understand and apply cognitive systems engineering: identify visual, auditory, cognitive, perceptual, and environmental aspects of human performance; Perform task analysis and evaluate human-computer interfaces.
- Apply time value of money and select cost-effective engineering solutions.
- Apply probability concepts to engineering problems, including reliability issues.
- Apply statistical concepts to solve real life problems, such as hypotheses testing, design of experiments and statistical quality control methods such as process capability and control charts.
- Formulate and solve real world problems using linear programming or network flow techniques, and perform sensitivity analysis of results.
- Formulate and solve mathematical and probabilistic models to support effective management decision-making in real-word complex systems that operate under randomness and uncertainty.
- Create simulation models of manufacturing and service systems and analyze simulation output.
- Apply mathematical models to design and control service systems.
- Analyze and design both the job and the worksite in a cost-effective manner, as well as measure the resulting output.
- Program flexible manufacturing equipment and system controllers; design logical manufacturing layouts.
- Design a system, component, or process to meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- Present engineering study results in technical reports that can be given to a person in management.
- Present engineering study results in technical reports that can be given to engineering peers.
- Present engineering project results that can be given to the public.
- Understand professional and ethical responsibility.
- Understand the impact of engineering decisions in a global and societal context.
- Understand the impact of engineering decisions in an economic and environmental context.
- Work effectively in groups on case studies.
- Work effectively in groups on projects.
- Perform time study and work sampling study.
- Develop and experiment with simulation models of manufacturing and service systems to analyze and interpret simulation output to make decisions.
- Acquire and apply new knowledge as needed, using appropriate learning strategies.

5. Academic Integrity (Senate Policy 49-20)

Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner. Academic integrity is a basic guiding principle for all academic activity at The Pennsylvania State University, and all members of the University community are expected to act in accordance with this principle. Consistent with this expectation, the University's Code of Conduct states that all students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts.

Academic integrity includes a commitment not to engage in or tolerate acts of falsification, misrepresentation or deception. Such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others.

To protect the rights and maintain the trust of honest students and support appropriate behavior, faculty and administrators should regularly communicate high standards of integrity and reinforce them by taking reasonable steps to anticipate and deter acts of dishonesty in all assignments (Senate Policy 44-40: Proctoring of Examinations). At the beginning of each course, it is the responsibility of the instructor to provide students with a statement clarifying the application of University and College academic integrity policies to that course. It is the student's responsibility to understand and abide by that statement.

6. Faculty Responsibilities

- To be prepared for every class.
- To develop a comprehensive syllabus covering topics to be studied, exam timing, policies, office hours, etc. for distribution during the first week of class.
- To treat students and staff with respect and courtesy.
- To administer courses in a fair manner and in accordance with university policy.
- To assign meaningful homework.
- To provide meaningful feedback on graded material in a timely manner.
- To post and hold sufficient office hours, to be accessible to most students, and be available during those times.
- To do everything possible to enhance and enforce academic integrity.
- To develop fair assessment instruments which will be impartially and fairly graded.
- To cover the prescribed topics in each course as published in this handbook.
- To encourage student professional growth and participation in preparation for future careers.
- To provide an atmosphere conducive to learning.
- To instruct, as needed, on the use and safety of equipment.
- To provide informed advice on academic matters (such as course selection, scheduling, etc.).
- To inform students when classes or office hours cannot be met.
- To display enthusiasm in courses taught and be concerned about student learning.

7. Student Responsibilities

- To attend every class unless extenuating circumstances occur (such as illness, emergencies, etc.).
- To treat faculty and staff with respect and courtesy.
- To come to class prepared to actively listen and participate (having completed reading and other assignments).
- To exhibit academic integrity.
- To respect other students and faculty in class through appropriate conduct (such as on-time attendance, attention to class activities, etc.)
- To exhibit academic integrity.
- To put forth an honest effort to understand material and prepare specific questions for faculty or teaching assistants when problems arise.
- To provide prior information and documentation for situations meriting special attention (such as illness, athletic team travel, etc.).
- To meet with his/her adviser regularly to ensure that all academic requirements are met.
- To follow the stated policies of each course.
- To plan for their professional development and future.
- To review prerequisite material as needed.
- To properly and safely use and care for all department facilities and equipment.
- To equally participate in all group labs, assignments, and projects.
- To take SRTEs seriously and provide a fair assessment, of course and faculty.
- To display enthusiasm for courses with a real concern for learning.

8. Areas of Emphasis

Manufacturing Design

Design for Assembly, Concurrent Engineering, Mechanism Configurations, Optimization of Clamping Systems, Flexible Fixturing, Computer-aided Pattern Design, Feature Base Design, Workplace Design, Engineering Design Optimization, Optimization of Tolerance Specification, Automated Fixture Design

Manufacturing Systems and Automation

Group Technology, Computer-aided Process Planning, Manufacturing Database Design, Intelligent Computer-aided Manufacturing, Material Handling, Automated Inspection, Numerical Control, Adaptive Control and Machine Monitoring, Cell Control

Manufacturing Process

Material Casting Processes, Welding Processes, Machining Processes, Soldering, Mechanics of Deformation, Intelligent Processing of Materials, Sensor Systems and Nondestructive Evaluation, Electronic Assembly, Robotic Welding, Cutting Tool Development

Human Factors

Ergonomics, Cumulative Trauma Disorders, Workplace Analysis, Visual Inspection, Mental Workload Evaluation, Human/Computer Interface, Biomechanics of Back Injuries, Modeling Crash Impacts, Agricultural Safety, Human Reliability Modeling, Safety Planning, Human-Computer Interaction, Cognitive Modeling

Artificial Intelligence and Expert Systems

Expert Systems for Fixture Design, Process Diagnostics in Manufacturing Processes, Expert Systems in Production Scheduling, Neural Networks for Sensor Based Diagnostics, Learning Through Examples, Rule Based Systems with Sampled Data, Knowledge Based Design, Sensor Data Fusion, Robotic Task Planning

Machine Vision and Inspection

Image Processing, Model Based Inspection, Algorithms for Surface Identification, Inspection of Compound Profiles, Component Insertion, Off-line Programming of Coordinate Measuring Machines, Neural Network Based Vision

Operations Research and Optimization

Location Theory, Network Optimization, Discriminant Analysis, Linear Programming, Integer Programming for Logical Deduction, Communication and Computer Networks, Network Equilibrium, Nonlinear Optimization, Optimization of Traffic Networks, Queuing, Stochastic Processes, Decision Theory

Operations, Services and Analytics

Health Care Systems, Lean Manufacturing, Retail Engineering, Data Mining, Demand Management, Pricing, Resource Allocation, Supply Chain Engineering and Logistics, Enterprise Integration

Production Planning and Control

Material Handling Systems, Material Requirements Planning, Facility Planning, Capacity Expansion, Adaptive Forecasting, Economic Order Quantity, Multi-stage Sequencing, Just-In-Time

Simulation

Production Modeling, Operational Scheduling, Plant Design and Layout, Process Flow Analysis, Robust Optimization

Productivity Engineering

Productivity Improvement, Incentive Design, Technological Forecasting, Methods Improvement, Wage Payment Systems, Resource Planning and Control

Quality Engineering

Statistical Process Control, Total Quality Systems, Process Improvement Strategies, Design for Quality, Inspection Algorithms, Engineering Design of Experiments, Reliability Modeling, Design of Supplier Qualification Procedures, Statistical Modeling of Tolerances, Taguchi Loss Functions, Continuous Improvement Reliability Assessment

9. Undergraduate Program Requirements

The following requirements must be met for students to successfully earn a Bachelor of Science degree in Industrial Engineering from Penn State. **Total credits for the Industrial Engineering major: 129**

1st Semester

Course	Subject	Units
MATH 140	***Calculus* I**	**4**
EDSGN 100	***Engineering Design & Graphics***	**3**
+ENGL 15 or 30	Rhetoric & Composition	3
CHEM 110	***Chemical Principles***	**3**
Arts, Humanities, Social Sciences		3
	Total =	16

2nd Semester

Course	Subject	Units
MATH 141	***Calculus II***	**4**
PHYS 211	***Mechanics***	**4**
CHEM 111	Experimental Chemistry	1
ECON 102 or 104	(Social Sciences)	3
Arts, Humanities, Social Sciences		3
First-Year Seminar		1
	Total =	16

3rd Semester

Course	Subject	Units
MATH 231	Calculus of Several Variables	2
+MATH 250	**Differential Equations**	3
+PHYS 212	**Electricity & Magnetism**	4
+EMCH 210 [A]	**Statics & Strength of Materials**	5
Arts, Humanities, Social Sciences		3
	Total =	17

4th Semester

Course	Subject	Units
+CAS 100	Effective Speech	3
MATH 220	Matrices	2
CMPSC 200 or 201	Matlab or C++ Programming	3
Science Elective [B]		3
Choose Six Credits of Engineering Electives [B]		6
	Total =	17

5th and 6th Semester – *the order in which you take these courses may vary. Prerequisites listed in parentheses [C]*

Course	Subject	Units
+IE 302	**Engineering Economy** (MATH 141)	**3**
+IE 305	**Product Design, Specification & Measurement** (EDSGN 100)	**3**
+IE 322	**Probabilistic Models in IE** (MATH 141)	**3**
+IE 323	**Statistical Methods in IE** (IE 322)	**3**
+IE 327	**Introduction to Work Design** (MATH 141-prerequisite; EMCH 210 or EMCH 211 - prerequisite or concurrent)	**3**
+IE 330	**Engineering Analytics** (CMPSC 200 or 201 & IE 322)	**3**
+IE 405	**Deterministic Models in OR** (MATH 220)	**3**
Manufacturing Process Elective [B] (IE 305)		3
+ENGL 202C	Technical Writing	3
MATSE 259	Materials, Properties & Processing (EMCH 210 or 213)	3
Health & Physical Activity *		1.5
Health & Physical Activity *		1.5
	Total =	33

7th and 8th Semester - *the order in which you take these courses may vary. Prerequisites listed in parentheses [C]*

Course	Subject	Units
IE 425	Stochastic Models in OR (IE 322 & MATH 220)	3
IE 453	Simulation Modeling for Decision Support (CMPSC 200 or 201, IE 323 & IE 425)	3
IE 408, 418 or 419	Human Factors Elective (see website for individual course prerequisites)	3
IE 460	Service Systems Engineering (IE 322 & IE 405)	3

IE 470	Manufacturing System Design & Analysis (Manufacturing Process elective – concurrent)	3
IE 480W	Capstone Design Course (IE 302, IE 305, IE 323, IE 327, and IE 405; IE 330 as prerequisite or concurrent)	3
Technical Elective [B] (see website for individual course prerequisites)		3
Technical Elective [B] (see website for individual course prerequisites)		3
Arts, Humanities, Social Sciences		3
Arts, Humanities, Social Sciences		3
	Total =	30

Courses listed in ***boldface italic type*** require a grade of C or better for entrance into this major.
+ Courses listed in **boldface type** require a grade of C or better for graduation in this major.
[A] Students may substitute EMCH 211 and EMCH 213 or 213D for EMCH 210.
[B] Science Elective, Engineering Electives, Manufacturing Process Electives and Technical Electives - Select from Department List
[C] Prerequisites are strictly enforced; students are responsible for ensuring they are meeting prerequisite requirements during registration.
* Students may satisfy this requirement with one, 3-credit GHW course or 3 credits of ROTC upon completion of the ROTC program.

I. Required IE Courses – grouped by fields of interest

Management Systems

I E 322: *Probabilistic Models in Industrial Engineering* - three lectures per week
Prerequisite: MATH 141
Content: Graphical description of data, probability basics, discrete and continuous probability distributions, expected values and variances, reliability, sampling distributions, and estimation.

I E 405: *Deterministic Models in Operations Research* - three lectures per week
Prerequisite: MATH 220
Content: Simplex method, duality, sensitivity analysis, parametric programming, transportation models and assignment models.

I E 425: *Stochastic Models in Operations Research* - three lectures per week
Prerequisites: I E 322 and Math 220
Content: Project networks, dynamic programming, Markov processes & queuing, inventory theory, and supply chain management.

I E 453: *Simulation Modeling of Decision Support* - two lectures and one double lab per week
Prerequisites: I E 323, I E 425, CMPSC 200 or 201.

Content: Basic simulation modeling, modeling advanced system complexities, model verification and validation, experimental design and output analysis.

Manufacturing Engineering

I E 305: *Product Design, Specification and Measurement* — two lectures and one double lab per week
Prerequisites: EDSGN 100
Content: Introduction to product design, manufacturing engineering and production, part definition and qualification, computer-aided design, and product verification and conformance to specification.

I E 470: *Manufacturing System Design and Analysis* — two lectures and one double lab per week
Concurrent: A manufacturing process elective - see electives
Content: Manufacturing system organization and modes of product flow, manufacturing system metrics, lean manufacturing systems, automation/integration, and information systems for manufacturing systems.

Management Controls

I E 302: *Engineering Economy* — three lectures per week
Prerequisite: MATH 141
Content: Time value of money, basic economic analysis techniques, cost accounting, taxes, and depreciation.

I E 323: *Statistical Methods in Industrial Engineering* — three lectures per week
Prerequisite: I E 322
Content: Estimation, hypothesis testing, simple linear regression, design of experiments, control charts, process capability, and gage R & R studies.

Human Factors Engineering

I E 327: *Introduction to Work Design* — two lectures and one double lab per week
Prerequisite: MATH 141, Concurrent: E MCH 211 or E MCH 210
Content: Human information processing, basic auditory and visual displays, basic human-computer information, anthropometry and musculoskeletal principles, cumulative trauma disorders, low back problems, NIOSH lifting guidelines, work measurement, and work environment.

Analytics

I E 330: *Engineering Analytics* — three lectures per week
Prerequisites: I E 322 and CMPSC 200 or CMPSC 201
Contents: Quantitative background in data mining, predictive analytics, and the use of Big Data in analysis.

Additional

I E 480W: *Capstone Design Project*
Prerequisites: IE 302, IE 305, IE 323, IE 327, and IE 405; plus IE 330 as prerequisite or concurrent

II. Elective IE Courses

Manufacturing Process Electives

I E 306: *Machining Process Design & Analysis* - two lectures and one double lab per week
Prerequisites: I E 305, I E 322
Contents: Machining processes including milling and turning, basics of CNC machining center operations, cutting tool materials, cutting fluids and selection criteria, process parameter selection, machining forces, tool wear, work piece geometric variation, machining process design, process plan specification, and process analysis.

I E 307: *Additive Manufacturing Process and Reverse Engineering* - two lectures and one double lab per week
Prerequisite: I E 305
Rapid prototyping processes, reverse engineering, and rapid tooling.

I E 311: *Principles of Solidification Processing* - two lectures and one double lab per week
Prerequisites: I E 305
Content: Arc welding, other welding processes, sand casting, cast metal and solidification, soldering, powder, and polymer processing.

I E 428: Metal Casting – two lectures and one double lab per week

Prerequisites: I E 311 or I E 312, or METAL 408W *(*Note: Pending prerequisites change – proposed new prerequisites: I E 305 and MATSE 259*)

Content: Application of engineering principles to the design of castings; casting of ferrous and nonferrous alloys; laboratory and simulation projects.

Courses not taken to meet the 3-credit requirement can be counted as Technical Electives.

Human Factors Engineering

I E 408: *Cognitive Work Design* — two lectures and one double lab per week
Prerequisite: I E 327
Content: Project management, human factors in the design process, defining users requirements, cognitive task analysis, participatory methodologies, modeling architectures for cognitive tasks, usability design principles, information display, interface programming, usability evaluation, socio-technical systems design and application, organizational design, and contemporary issues in HCI.

I E 418: *Human/Computer Interface Design* — two lectures and one double period lab per week
Prerequisite: CMPSC 200 or 201 and I E 327
Content: Characteristics of users and usability, screen design principles, software lifecycle, and usability evaluation.

I E 419: *Work Design*—Productivity and Safety — three lectures per week
Prerequisite: I E 327

Contents: Productivity concepts, methods engineering, work design, work sampling, MTM-2 analysis, wage incentives and learning, accident prevention theories, decision making tools, federal regulations, safety administration, and industrial hazards.

Courses not taken to meet the 3-credit requirement can be counted as Technical Electives.

III. Technical Electives

All 6 credits must be IE courses from the Department List below. No courses outside of IE will be accepted. (***Note***: students completing the Six Sigma minor can only use one of the 400-level courses: IE 433, IE 434, or IE 436 due to the policy requiring 6 credits of a minor to be unique from the major. Students completing the Six Sigma minor will have to take one IE Technical Elective that is not required for the minor.)

I E 306:	Machining Process Design & Analysis - may be used if not being used as a Manufacturing Processing elective requirement
I E 307:	Additive Manufacturing Process and Reverse Engineering - may be used if not being used as a Manufacturing Processing elective requirement
I E 311:	Principles of Solidification Processing - may be used if not being used as a Manufacturing Processing elective requirement
I E 402:	Advanced Engineering Economy
I E 408:	Cognitive Work Design - may be used if not being used as Human Factors elective requirement
I E 418:	Human/Computer Interface Design - may be used if not being used as Human Factors elective requirement
I E 419:	Work Design - Productivity and Safety - may be used if not being used as Human Factors elective requirement
I E 428:	Metal Casting
I E 433:	Regression Analysis and Design of Experiments - only one (I E 433 or STAT 462) may be counted towards the elective requirement
I E 434:	Statistical Quality Control
I E 436:	Six Sigma Methodology
I E 454:	Applied Decision Analysis
I E 456:	Industrial Robot Applications
I E 466:	Concurrent Engineering
I E 467:	Facility Layout and Material Handling
I E 468:	Optimization Modeling and Methods
I E 477:	Computer Control of Manufacturing Machines and Processes
I E 478:	Retail Services Engineering
I E / EDSGN 479:	Human Centered Product Design and Innovation

IV. Science Electives – 3 credits required

AFR 105:	African Biodiversity and Conservation (can count as Science Elective and IL)
AGECO 134N:	Sustainable Agriculture Science and Policy (may count as Science Elective ***or*** GS/Interdomain)
AGECO 144:	Principles and Practices of Organic Agriculture
ASTRO 291:	Astronomical Methods and the Solar System
BIOL 133:	Genetics and Evolution of the Human Species
BIOL 141:	Introductory Physiology
BIOL 155:	Introduction to the Biology of Aging
BIOL 161:	Human Anatomy and Physiology
CHEM 112:	Chemical Principles II
EARTH 103N:	Earth in the Future - Predicting Climate Change and Its Impacts Over the Next Century (may count as Science Elective ***or*** GS/Interdomain)
EARTH 105N:	Environments of Africa: Geology and Climate Change (may count as Science Elective ***or*** GS/Interdomain)
EARTH 107N:	Coastal Processes, Hazards and Society (may count as Science Elective ***or*** GS/Interdomain)
ERM 210:	Environmental Factors and Their Effect on Your Food Supply
FOR 201:	Global Change and Ecosystems
GEOG 6N:	Maps and the Geospatial Revolution (may count as Science Elective ***or*** GS/Interdomain)
GEOSC 001:	Introduction to Physical Geology
GEOSC 40:	The Sea Around Us
INART 050:	The Science of Music
INART 050Z:	The Science of Music (may count as Science Elective *or* Linked)
MATH 310:	Elementary Combinatorics
MATH 311M:	Honors Concepts of Discrete Mathematics
MATH 311W:	Concepts of Discrete Mathematics
MATH 401:	Introduction to Analysis I
MATH 405:	Advanced Calculus for Engineers and Scientists I
MATH 411:	Ordinary Differential Equations
PHYS 214:	General Physics: Wave Motion and Quantum Physics

V. Engineering Electives – 6 credits required

Many of the courses may require prerequisites that are outside the degree requirements for IE students. In these cases, it is the student's responsibility to ensure that prerequisites are being met for the course of interest. Questions regarding prerequisites must be directed to the department offering the course.

Some of the courses may be enrollment controlled by the department offering the course. Please check with the specific department to determine their policy on letting students from other majors enroll in the course.

- CE 422 – requires approval of instructor
- CE 423 – requires approval of instructor
- CMPEN 270 (4 credit course; only 3 credits will count)
- EE 211 or EE 212 or EE 210 (4 credit course; only 3 credits will count)
- EMCH 212
- ENVSE 450 or ENVSE 470 (Controlled course; Contact ENVSE department for enrollment at the beginning of semester)
- IST 210 or IST 220 (Controlled course; Contact IST department for enrollment at the beginning of semester)
- MATSE 403
- ME 201
- MNG 230
- 3 credits from any combination of co-op or internship. Students *must* register for 1 credit (ENGR 195, 295, 395, 495) prior to or during *each* semester of work. Substitution for engineering elective **requires the completion of 3 credit-earned rotations**.
- 3 credits upon completion of the ROTC program

(Note: EDSGN credits from the Summer by Design program can be petitioned to count)

VI. IE Course Prerequisites

The department cannot stress enough the importance of having the proper prerequisites/co-requisites when scheduling courses. At the beginning of every semester, faculty receive a list from the College of students enrolled in their courses who do not meet the proper prerequisites/co-requisites. ***It is fully within the faculty member's right to disenroll a student from a course*** if he/she does not meet the proper criteria.

Trying to rearrange your schedule at the beginning of a semester is not easy and a course that you need/want may not be available. ***Also, do not assume that if you are taking a prerequisite concurrently, that you will be allowed to stay in the class***. This is not, in general, acceptable. Please use the table below to ensure you meet the prerequisite/co-requisite requirements before scheduling a course.

Note: Check with the undergraduate staff assistant for a listing of electives offered under the I E 497.

Course No.	**Course Title**	**Prerequisite**	**Prerequisite/Concurrent**
I E 302	Engineering Economy	MATH 141	
I E 305	Product Design, Specification and Measurement		EDSGN 100
I E 306	Machining Process Design & Analysis	I E 305, I E 322	
I E 307	Additive Manufacturing Process and Reverse Engineering	I E 305	
I E 311	Principles of Solidification Processing	I E 305	
I E 322	Probabilistic Models in Industrial Engineering	MATH 141	
I E 323	Statistical Methods in Industrial Engineering	I E 322	
I E 327	Introduction to Work Design	MATH 141	E MCH 210 or E MCH 211
I E 330	Engineering Analytics	CMPSC 200 or CMPSC 201, I E 322	
I E 402	Advanced Engineering Economy	I E 302, I E 322, I E 405	
I E 405	Deterministic Models in Operations Research	MATH 220	
I E 408	Cognitive Work Design	I E 327	
I E 418	Human/Computer Interface Design	I E 327 and CMPSC 200 or CMPSC 201	
I E 419	Work Design - Productivity and Safety	I E 327	
I E 425	Stochastic Models in Operations Research	I E 322 and MATH 220	

Course No.	Course Title	Prerequisite	Prerequisite/Concurrent
I E 428	Metal Casting	I E 311 or I E 312, or METAL 408 (*Note: Pending prerequisites change – proposed new prerequisites: I E 305 and MATSE 259)	
I E 433	Regression Analysis and Design of Experiments	I E 323	
I E 434	Statistical Quality Control	I E 323	
I E 436	Six Sigma Methodology	I E 323	
I E 453	Simulation Modeling for Decision Support	I E 323, I E 425, CMPSC 200 or CMPSC 201	
I E 454	Applied Decision Analysis	I E 322	
I E 456/M E 456	Industrial Robot Applications	MATH 220, MATH 250, or MATH 251, I E 305 or ME 360	
I E 460	Service Systems Engineering	I E 322 and I E 405	
I E 466	Concurrent Engineering	MATH 141, MATH 220	
I E 467	Facility Layout and Material Handling	I E 322, I E 405	
I E 468	Optimization Modeling and Methods	I E 405, MATH 231	
I E 470	Manufacturing System Design and Analysis		A manufacturing process elective
I E 477	Computer Control of Manufacturing Machines and Processes	MATH 141, CMPSC 200 or CMPSC 201, I E 305	
I E 478	Retail Service Engineering	IE 322	
I E 479/EDSGN 479	Human Centered Product Design and Innovation	I E 408 or I E 419	
I E 480W	Capstone Design Project	I E 302, I E 305, I E 323, I E 327, and I E 405	I E 330

VII. C or Better Rule

In order to obtain a B.S. in Industrial Engineering at Penn State, students must receive a grade of C or better in the following courses: CAS 100; E MCH 210 (or E MCH 211 and E MCH 213); ENGL 15/30; ENGL 202C; I E 302, I E 305, I E 322, I E 323, I E 327, I E 330, and I E 405; MATH 250; and PHYS 212.

10. General Education Requirements

Category	Code	Credits Required	Required Course(s) that Satisfy Requirement	Course Description	Credits
Foundations					
Writing/Speaking (C Required)	GWS	9 cr. + W course	ENGL 015/30 or ESL 015	Rhetoric and Composition	3 cr.
			CAS 100A/100B	Effective Speech	3 cr.
			ENGL 202C*	Technical Writing	3 cr.
Quantification (C Required)	GQ	6 cr.	MATH 140	Calculus I	4 cr.
			MATH 141	Calculus II	4 cr.
Knowledge Domains					
Natural Sciences+	GN	9 cr.	PHYS 211**	Mechanics	4 cr.
			PHYS 212**	Electricity and Magnetism	4 cr.
			CHEM 110**	Chemical Principles	3 cr.
Health and Wellness+	GHW	3 cr.	Courses focus on the theory and practice of lifespan wellness and fitness activities, and on the knowledge, attitudes, habits, and skills needed to live well.		
Arts+	GA	6 cr.	Courses help students understand and appreciate some of the more important creative works, traditions, literature, and history of the arts and architecture/		
Humanities+	GH	6 cr.	Humanistic studies are divided into four categories: literature, history and culture, advanced language, and philosophy. The study of the humanities should develop competency in an interpretive understanding of the human condition and of the values inherent in it.		

Social and Behavioral Sciences+	GS	6 cr.	Courses develop students' understanding of the diverse personal, interpersonal, and societal forces that shape people's lives. The general goal is a theoretical understanding of the interrelationships of the dominants of the organization of human behavior. Note: ECON 102 (GS) or ECON 104 (GS) is a required 3 cr. GS course for all majors in the College of Engineering.
Integrative Studies			
Integrative Studies+		6 cr.	Integrative Studies can be completed by taking Linked courses or Interdomain courses. A student must take either 6 credits of Linked or 6 credits of Interdomain, students may not take a combination of both types. Interdomain courses will count in multiple domain areas. Completing this requirement should be done in consultation with an Academic Adviser.
Cultural Requirements (Part of University Requirements)			
United States Cultures	US***	3 cr.	A course that fulfills the United States Cultures requirement must strive to increase students' understanding of contemporary United States society.
International Cultures	IL***	3 cr.	A course that fulfills the International Cultures requirement must strive to increase student knowledge of the variety of international societies. and may deal, to some extent, with U.S. culture in its international connections.
*** In the College of Engineering, students should select US and IL courses that also fulfill a Knowledge Domain requirement. A course designated as US; IL may be used to fulfill either the US or the IL requirement but NOT both.			
+ Students should plan to use their Integrative Studies courses to satisfy part of their GN, GA, GH, GS, and/or GHW (Knowledge Domains) requirements.			

Important Nuances

- In each of the five Knowledge Domains, you must have a 3-credit course that is *not* interdomain or linked.
- All engineering majors in the College of Engineering are required to take a 3-credit economics course (ECON 102 or ECON 104). Either course will satisfy a 3-credit GS requirement in all College of Engineering majors.

- US and IL courses may also fulfill a GA, GH, GS and/or Integrative Studies requirement.
- In most cases, GQ and GN requirements are met entirely through specific courses that are also major requirements (e.g., MATH 140, MATH 141, PHYS 211, PHYS 212, CHEM 110).
- The writing-intensive requirement is always met by a required course in a major (e.g., I E 480W). Such courses have a W, M, X, or Y suffix.
- Students admitted as transfer students are not required to take a first-year seminar. However, they must substitute one credit not otherwise needed for graduation to meet the required credit total.

Information on Substitutions

- **Move "3" in Knowledge Domains:** Once the minimum 3-credit requirement of a non-interdomain/linked course is met in the GN/GHW/GA/GH/GS areas, a student with extra credits in one area can request a Move 3 option via an e-petition. You should discuss this with an advisor before submitting the petition to ensure that it can be applied.
- **Language Substitution:** Once the minimum 3-credit requirement of a non-interdomain/linked course is met in the GN/GHW/GA/GH/GS areas, a language course completed at the 12^{th} credit level or higher (e.g. SPAN 3, FR 3, etc), can be substituted to complete an area. The substitution can only be made via an e-petition and a discussion with an advisor is advised before submission.
- **International Cultures Requirement:** Students may participate in a study abroad or work abroad program to fulfill the IL requirement. For Penn State formal study abroad programs, the IL requirement is automatically met. College of Engineering work abroad program courses ENGR 195I, 295I, 395I, or 495I can be used for IL via an e-petition request.
- **ROTC Credits:** Students who complete the academic ROTC program can substitute 3 credits for the GHW requirement and another 3-credit requirement that is specified by the department and indicated on the sample academic plan for that major.
- **Courses that Meet the Spirit of a General Education Requirement:** Any course not designated as General Education, but which truly meets the spirit of the requirements, whether taken at Penn State or elsewhere, may be petitioned to count in that appropriate area. An example of this type of petition might be 300- and 400-level courses for a language minor that focus on the culture or society (e.g., SPAN 353: Survey of Spanish Literature Before 1700 might be approved for GH given that the course focuses on literature, which is commonly a topic covered in the humanities).

All requests for course substitutions, exceptions, and waivers must be submitted for evaluation prior to the semester that graduation is planned. Such requests will not be considered after the start of the graduation semester. Course substitutions can be submitted via coursesub.psu.edu.

11. Undergraduate Minors (An asterisk indicates minor is offered by the I E department)

Minors offer another opportunity for industrial engineering students to tailor their education to support their future career plans. Listed below are minors that integrate well with the IE major; we encourage you to read through them to find one that best meets your interests and goals. Students are encouraged to meet with their advisers as early as possible to discuss the steps necessary to complete a minor.

Please refer to the IME website to see how credits may double count between the IE major and a minor.

According to Faculty Senate Policy 59-10 that "[...] At least six credits of the minor must be unique from the Prescribed Courses required by the student's major program(s)"**.**

A grade of C or better is required for all courses in a minor.

Any Foreign Language

Biomedical Engineering

The 18-credit minor in bioengineering enables students to develop an interest in medical engineering applications while pursuing an undergraduate degree in any area but is particularly suitable for engineering students seeking careers in health-related professions. Applicants wishing to enroll in the Biomedical Engineering minor should have completed background courses in mathematics and physics, and have evidence of excellent grades.

Business/Liberal Arts

An interdisciplinary minor providing students with a business-oriented supplement to their academic major. It is designed to introduce students to a variety of fundamental business skills while at the same time allowing a reasonable degree of flexibility in program emphasis. Only courses in which the student earns a grade of C or better may be counted toward fulfillment of the requirements for the minor.

I E students can substitute I E 425: Stochastic Models in Operations Research and I E 433: Regression Analysis and Design of Experiments towards the minor requirement: 6 credits of additional courses.

Economics

In order to earn a minor in Economics a student must pass ECON 102: Introductory Microeconomic Analysis and Policy, ECON 104: Introductory Macroeconomic Analysis and Policy, ECON 302: Intermediate Microeconomic Analysis, ECON 304: Intermediate Macroeconomic Analysis, and 6 additional credits in Economics courses at the 400 level. A grade of C or better must be earned in all courses that are used to fulfill the minor in Economics. Courses used in the minor may not be taken on a Satisfactory-Unsatisfactory basis. Only courses in the Economics Department may be counted. Substitutions of courses in other departments are not permitted. Students who wish to take their 400-level courses at the Behrend or Capital Campuses must obtain the approval of the undergraduate officer. A student must be enrolled in a specific degree granting major or program before applying for this minor. A minor certificate will be awarded to each graduate successfully completing this minor. A statement that a Minor in Economics has been conferred will appear on a student's transcript.

Engineering Leadership Development

An interdisciplinary minor for engineering students seeking development of critical principles and skills in leadership. Engineers must be able to deal effectively with other people, including the ability to work in teams and to interact with customers and other organizations on both national and international levels. Engineering graduates must demonstrate the ability to assume leadership roles in a competitive, technologically complex global society. Students will employ engineering case studies in active and collaborative classroom settings to develop these skills.

Entrepreneurship and Innovation (ENTI)

The ENTI minor helps students to become innovation leaders, develop entrepreneurial mindsets, and be agents of positive change. The world needs new ways to deliver products and services to meet market needs and address significant problems in all disciplines including the arts, business, engineering, science, agriculture, healthcare, and education. The interdisciplinary ENTI minor is open to students in all majors who are interested in creating a new product or service to meet a need or creating their own jobs.

The ENTI courses develop skills in problem solving, opportunity recognition, self-efficacy, leadership, communication, and learning from failure. Penn State's majors prepare students with skills and knowledge for a variety of employment options or graduate school. The ENTI minor broadens student's education and Penn State experiences, enabling them to see challenges as opportunities and thrive in a job, class or activity that includes unknowns, deadlines and ambiguities.

*Information Sciences and Technology for Industrial Engineering Minor (IST-IE) **

Collection and processing of information have increased in all sectors for solving engineering problems, including manufacturing and service-related problems. Efficient and timely analysis of data is critical for the survival of companies. There is a need for industrial engineers with a strong background in information technology and systems. The minor in Information Sciences and Technology for Industrial Engineering will augment the skills of students in the Department of Industrial and Manufacturing Engineering in the information systems area. All students pursuing a baccalaureate degree in Industrial Engineering are eligible for this minor.

Mathematics

The minor is designed to provide students with an interest in mathematics an opportunity to study a broad range of mathematical topics. The requirements allow students a great deal of flexibility in choosing courses of interest.

Nanotechnology

The nanotechnology minor is designed to help prepare students from a broad range of disciplines for careers involving nanotechnology, from medicine and catalysis to textiles and to quantum computing. The minor provides students with fundamental knowledge and skills in nanoscale simulation, design, syntheses, characterization, properties, processing, manufacturing, and applications.

Psychology

Psychology is a scholarly discipline, a scientific field, and a professional activity. Its overall focus is the scientific study of behavior and experience, and of the associated mental and physiological processes. Students in the Psychology minor are not assigned a specific adviser in psychology, but are welcome to contact the Psychology Advising Center for assistance concerning the minor.

*Service Enterprise Engineering **

The Service Enterprise Engineering minor gives students the ability to apply industrial engineering techniques to processes in hospitals, nonprofit organizations, retailers, banks, financial institutions, airlines, and more. Service Enterprise Engineering is the study, design, and implementation of new systems that improve the processes and efficiencies of the service sector, in which 80 percent of the U.S.

workforce is employed. The minor answers a critical need for operational expertise in health care and human service fields. Students completing this minor will gain an understanding of applying industrial engineering and operations research tools for modeling, analysis, design and control of service enterprises.

*Six Sigma **

The Six Sigma minor is designed for any student who is interested in the Six Sigma statistical methodology. Six Sigma is a structured, quantitative approach to improving the quality and cost of products and processes. It provides a framework for quality improvement and innovation that builds upon statistical tools to achieve results.

Statistics

The Statistics minor introduces students to the quantitative aspects of research. Understanding statistics is useful for research in many areas including agriculture, business, education, social science and sciences as well as many jobs in industry and government.

Supply Chain and Information Science and Technology

The minor in SCIST is structured to provide students not majoring in Supply Chain & Information Systems or Management Information Systems with the opportunity to develop working knowledge of information technology, supply chain management, and their interdisciplinary synergies. The joint minor is designed for professional careers in business, information systems, software development, consulting, and government. The successful minor must, at a minimum, possess basic knowledge of quantitative techniques, computer applications, and microeconomics.

12. Study Abroad

Industrial and manufacturing engineers can be found around the world. No matter where our students end up, or what international clients and partners they may work with during their careers, the education we provide in the industrial engineering program at Penn State provides them with the tools they need to become globally minded engineering leaders.

A study abroad experience is a tremendous opportunity for our students to immerse themselves in a new culture, adapt to new styles of communication, interact with international peers, and gain a worldwide perspective on some of the challenges that exist in industry, all while earning credit toward their degrees.

We have built partnerships with a number of international schools to offer study abroad experiences to our industrial engineering students, including:

- Jonkoping University – Sweden
- National University of Singapore in Singapore
- Pforzheim University in Pforzheim, Germany
- Shanghai Jiao Tong University
- Technion – Israel Institute of Technology in Haifa, Israel
- Tecnun – The University of Navarra in San Sebastian, Spain
- The University of Auckland in Auckland, New Zealand
- The University of New South Wales in Sydney, Australia
- The University of Sydney in Sydney, Australia
- The University of Limerick in Limerick, Ireland

IE students are not limited to these schools. For a complete listing of possible study abroad opportunities for Penn State students, visit global.psu.edu.

For more information on IE study abroad opportunities, contact Elena Joshi, undergraduate program coordinator.

13. Co-ops and Internships

Industrial engineering (IE) students are strongly encouraged to gain relevant, career-related work experience before graduation. These paid experiences can aid in molding future career goals and paths.

IE students can earn credit for work experiences, whether they be through a co-op or an internship. For each work experience/rotation, a student can earn one credit. If a student accumulates a total of three credits from these experiences, the credits can substitute in place of one engineering elective (listed in the Semester 4 of the academic plan). *Students <u>must</u> register for 1 credit (ENGR 195, 295, 395, 495) prior to or during <u>each</u> semester of work. Substitution for engineering elective **<u>requires the completion of 3 credit-earned rotations</u>**.*

A co-op typically involves taking a fall or spring semester off from course work in order to work full time at a company. Although this may delay a student's graduation date, graduates find the work experience to be well worth the extra time. Participants of the co-op program find that working for a longer period of time, at the same company, allows them to delve deeper into their assigned projects and many times, see them to completion and directly witness the impact the project has on the company. Graduates of the co-op program are also often offered a higher starting salary.

An internship is a short-term work experience for a company, typically lasting twelve to fifteen weeks over the summer (although internships can also occur during the fall or spring semester).

The Marcus department maintains a list of some available co-op and internship opportunities specifically for industrial engineering students. The list can be found via the IME Intranet. However, students are encouraged to visit the Engineering Co-op & Internship Program website for more information on opportunities, as well as to gain access to many resources that can help in writing resumes and preparing for interviews.

14. Student Organizations

Alpha Pi Mu

Alpha Pi Mu is the national industrial engineering honor society. Students who are in the top one-fifth of their junior class and with at least a 3.2 GPA or in the top one-third of their senior class and with at least 3.0 GPA are eligible to be invited to join. Faculty adviser: *Catherine Harmonosky*

American Foundry Society (AFS)

The AFS chapter is for students in industrial engineering, metal science and engineering, and other departments who are interested in metal casting. The chapter sponsors a summer internship job fair, provides scholarship support for students interested in metal casting, and provides many opportunities for students to interact with industry engineers and executives. First- and second-year students are encouraged to participate. Faculty adviser: *Robert Voigt*

American Society for Quality (ASQ)

Since 1946, ASQ has been a leader in identifying, communicating, and promoting the use of quality concepts, principles, and technologies. ASQ is an excellent source for information on topics ranging from total quality management and statistical process control to benchmarking and leadership. Faculty adviser: *Hui Yang*

Human Factors and Ergonomics Society (HFES)

HFES is an interdisciplinary organization of professionals involved in the human factors field. The society promotes the discovery and exchange of knowledge concerning the characteristics of human beings that are applicable to the design of systems and devices of all kinds. Faculty adviser: *Andris Freivalds*

Industrial Engineering Graduate Association (IEGA)

IEGA was founded to serve the academic and social needs of graduate students in the Harold and Inge Marcus Department of Industrial and Manufacturing Engineering at Penn State. Members organize and sponsor several social events during the year and are active in helping the department's graduate student recruitment efforts. All current graduate students in the department are automatically members of IEGA. Faculty adviser: *Ling Rothrock*

Institute of Industrial and Systems Engineers (IISE)

IISE is the professional society devoted to serving the needs of industrial and systems engineering professionals. Membership in the Penn State IISE student chapter includes a free magazine, special programs, career fairs, spring banquet, broomball tournament, and the opportunity to attend the national conference. Faculty adviser: *Srinivas Tamvada*

Institute for Operations Research and the Management Sciences (INFORMS)

INFORMS serves the scientific and professional needs of operations research and management science (OR/MS) investigators, scientists, students, educators, and managers, as well as the institutions they serve, by such services as publishing a variety of journals that describe the latest OR/MS methods and applications and by organizing professional conferences. Faculty adviser: *Qiushi Chen*

National Organization for Business and Engineering (NOBE)

NOBE is comprised of undergraduate engineering students interested in complementing their engineering knowledge with important aspects of business including: investment portfolios, stocks and bonds, corporate finance, financial statements, business planning, and analyzing economic decisions from an engineering perspective. The group also seeks to help students build professional relationships with corporate employers by hosting panel discussions and other social events. Faculty representative: *Charles Purdum*

Society of Manufacturing Engineers (SME)

SME is an international professional society dedicated to serving its members and the manufacturing community through the advancement of professionalism, knowledge, and learning. Its membership is comprised of manufacturing, research, and design engineers and practitioners as well as corporate executives and students. Faculty representative: *Jingjing Li*

15. Faculty – Areas of Expertise

Necdet Serhat AYBAT**,** Associate Professor (814-867-1284; nsa10@psu.edu)

First Order Methods for Large-Scale Convex Optimization, Compressive Sensing, Matrix Rank Minimization, Robust and Stable PCA, Distributed Algorithms.

Russel R. BARTON**,** Professor (814-863-7289; rbarton@psu.edu)

Simulation, applied statistics, and optimization, product design and manufacturing, concurrent engineering and web application security.

Saurabh BASU**,** Assistant Professor (814-863-2447; sxb514@psu.edu)

Advanced manufacturing, manufacturing processing, and additive manufacturing

Prakash CHAKRABORTY**,** Assistant Professor (814-865-7601; pzc217@psu.edu)

Applied probability, stochastic modelling, rough path theory and applications, stochastic control, queuing systems, mathematical finance.

Qiushi CHEN**,** Assistant Professor (814-863-4562; qxc35@psu.edu)

Stochastic dynamic modeling, simulation, system dynamics models, with applications in health analytics, cost-effectiveness analysis, medical decision making, health policy modeling

Christopher DANCY, Assistant Professor

Human-AI interaction; Cognitive Systems; Computational Cognitive Modeling; Socio-technical systems

Edward DE METER**,** Professor (814-863-7291; ecd3@psu.edu)

Mechanical restraint analysis, fixture design and analysis, mechanical assembly system design and analysis

Enrique DEL CASTILLO**,** Distinguished Professor and Professor of Statistics (814-863-6408; exd13@psu.edu)

Statistics: Process Optimization and Experimental Design, Time Series Analysis and Control, Bayesian Statistics. Data Analytics: large-scale spatial and functional data modeling, statistical learning theory and manifold learning.

Andris FREIVALDS**,** Lucas Professor (814-863-2361; axf@psu.edu)

Ergonomics, biomechanics, occupational health and safety, human factors.

Terry FRIESZ, Harold & Inge Marcus Chaired Professor (814-863-2445; tlf13@psu.edu)

Dynamic optimization and differential games applied to networks, transportation, pricing, revenue management, E-commerce and supply chains.

Paul GRIFFIN**,** Professor (pmg14@psu.edu)

Health systems engineering, health analytics, cost/comparative effectiveness analysis, health policy analysis, supply chain management

Catherine M. HARMONOSKY**,** Associate Professor and Associate Department Head (814-863-2107; cmhie@engr.psu.edu)

Manufacturing and service systems analysis, production planning and control, healthcare delivery systems analysis, scheduling, computer simulation applications

Elena M. JOSHI, Associate Teaching Professor & Undergraduate Program Coordinator (814-863-3395; ejoshi@psu.edu)

Computer simulation, statistics

Sanjay JOSHI, Professor (814-865-2108; sjoshi@psu.edu)

Computer-Aided Process Planning, CAD/CAM, Control of Manufacturing Systems, Additive Manufacturing

Ilya KOVALENKO, Assistant Professor

Control and Automation, Smart Manufacturing, Robotics, Dynamic Systems, and Artificial Intelligence

Soundar KUMARA, Allen E. Pearce and Allen M. Pearce Professor of Industrial Engineering (814-863-2359; skumara@psu.edu)

Sensing and sensor data fusion, process monitoring and diagnostics, complex systems analysis, intelligent systems, software agents, enterprise integration, supply chain logistics.

Steven LANDRY, Professor and Department Head (814-863-6407; slandry@psu.edu)

Human-integrated systems, human factors, air transportation systems

El-Amine LEHTIHET, Professor (814-863-2350; lvo@psu.edu)

Machining, process planning, tolerancing, metrology, electronic assembly

Jingjing LI, William & Wendy Korb Early Career Associate Professor, (814-863-1300; jul572@psu.edu)

Novel methodologies for multi-scale material characterization, mechanical behavior, failure analysis, and the effect of microstructure on macroscopic properties

Scarlett MILLER, Associate Professor (814-863-4143; shm13@psu.edu)

Ergonomic product design, design cognition and human-computer interaction

Vittaldas PRABHU, Professor (814-863-3212; prabhu@engr.psu.edu)

Distributed control systems with a focus on manufacturing and service enterprises

Charles PURDUM, Assistant Teaching Professor & Director of Industry Relations (814-865-5345; clp73@psu.edu)

Sarah E. ROOT, Associate Teaching Professor & Academic Adviser (814-865-8025; ser41@psu.edu)

Operations Research, logistics, probability and statistics, productivity improvement, engineering education

Ling ROTHROCK, Professor (814-865-7241; lxr28@engr.psu.edu)

Human-machine systems, Human factors in engineering

Uday V. SHANBHAG, Gary and Sheila Bello Chair Professor (814-865-7266; vvs3@psu.edu)

Theory and algorithms for optimization and equilibrium problems, analysis and solution of stochastic optimization and variational inequality problems, and design and operation of power systems and markets

Timothy W. SIMPSON, Interim Department Head, School of Engineering Design, Technology, and Professional Programs; Paul Morrow Professor in Engineering Design and Manufacturing (814-863-7136; tws8@psu.edu)

Engineering design and design methodology, statistical approximations and design of experiments, and product family and product platform design

Anirudh SUBRAMANYAN, Charles and Enid Schneider Early Career Assistant Professor (814-865-4210; azs7266@psu.edu)

Optimization under uncertainty, robust and stochastic optimization, distributed optimization and control, high-performance computing, power and energy systems, transportation and distribution logistics, infrastructure systems

Hongtao SUN, Assistant Professor (814-865-1489; hzs5373@psu.edu)

Nanomanufacturing, additive manufacturing, field-assisted sintering, nanocomposites, smart/functional materials, structural materials, metamaterials, energy storage, thermal management, sensing and detection

Srinivas TAMVADA, Assistant Professor (814-865-9505; sst119@psu.edu)

Service enterprise Engineering; Less-than-truckload freight transportation; Big-data driven optimization

Jose A. VENTURA, Professor and Dean's Fellow and Coordinator, Operations Research graduate program (814-865-3841; jav1@psu.edu)

Mathematical programming, network design and optimization, production scheduling, inventory control, supply chain management, facility layout and material handling

Robert C. VOIGT, Professor and Graduate Program Coordinator (814-863-7390; rcv2@psu.edu)

Metal casting, manufacturing processes, pollution prevention, welding, heat treatment, physical metallurgy, dimensional control

Hui YANG, Harold and Inge Marcus Career Associate Professor (814-865-7397; huy25@psu.edu)

Sensor-based modeling and analysis of complex systems for process monitoring, fault diagnostic/prognostics, quality improvement and performance optimization

Yiqi ZHANG, Assistant Professor (814-865-3529; yuz450@psu.edu)

Intelligent transportation systems, human performance modeling, and warning system design

16. Staff – Areas of Responsibilities

Chris ANDERSON, Facilities Representative 3 (814-865-6977; csa15@psu.edu)
Facilities Coordinator, Lab Manager, Safety Officer, and Access Coordinator

VACANT, Communications Strategist (814-863-2357; mjb6463@psu.edu)
Communications liaison, maintain department web page and social media

Olga COVASA**,** Administrative Support Coordinator (814-863-6404; oxc10@psu.edu)
Accounting, budgets, financial forecasts, departmental HR

Mary Ann FOLNSBEE**,** Financial Assistant (814-863-6743; mxf54@psu.edu)
Process all departmental purchases, travel reimbursement and wage payroll.

Lisa FUOSS**,** Graduate Programs Staff Coordinator (814-863-1269; lkf1@psu.edu)
Provide graduate students with information on degree requirements, procedures, and policies. Assist with scheduling of research credits, processing of drop/add requests, and registration problems. Manage the IME Summer Tuition Assistance program. Assist with management of IME funding offers, TA/RA assignments, and fellowship nominations. Act as liaison between IME Graduate students and Graduate Enrollment Services.

Scott HECKMAN**,** Systems Administrator (814-863-2399; swh1@psu.edu)
Install and maintain department computers and computer systems, maintain student computer labs and PC classroom, computer networking

Jennifer HOUSER**,** Graduate Records Specialist (814-863-2371; jjh2@psu.edu)
Graduate Admissions, M ENG Program, and Graduate student information

Brent JOHNSTON, Technician A – Manufacturing Systems Lab (814-867-1285: bjj118@psu.edu)
CNC setup, Welding, Foundry, Additive Manufacturing

Cindy MOCK, Records Specialist/Graduate Program (cxm901@psu.edu)
Assist with Graduate Program Admissions, SARI, and Graduate student information

Travis RICHNER**,** Technician A – Manufacturing Systems Lab (814-867-4860; tcr10@psu.edu)
CNC programming, Welding, Foundry

Sarah SILVA, Administrative Support Assistant (814-863-6407; sms9669@psu.edu)
Provide direct support to the Department Head, maintain calendar, arrange travel for DH, faculty and visitor, Coordinate alumni and other professional visits/activities and scholarships

James WYLAND**,** Administrative Support Assistant and Travel Coordinator (814-865-7603; jtw108@psu.edu)
Department receptionist, greet and assist students, faculty, and visitors at the front desk, arrange travel accommodations, Key custodian, sort and distribute mail, textbook orders, coordinate OR 590 seminar arrangements, faculty support for typing, copying, designing presentations, name tags, brochures, etc., point of contact for Leonhard Building 3rd floor conference room scheduling

Kelly SCHIFFER**,** Education Program Specialist (814-865-0972, knk5138@psu.edu)
Assist with ABET, Course/Program Proposals; Coordinate Learning Assistant Program, Undergraduate Research Program, and IME Ambassador Program; Student Scholarships

Vacant, Academic Program Assistant

Undergraduate student information, class scheduling, drop/add classes, print unofficial transcripts, room scheduling, liaison for department's student chapters