

# Department of Industrial & Management Systems Engineering

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## Degree Offered

- Bachelor of Science in Industrial Engineering (B.S.I.E.)

## Nature of Program

Industrial engineering is the discipline of engineering concerned with the design, improvement, and installation of integrated systems of people, material, information, equipment, and energy to assure performance, reliability, maintainability, schedule adherence, and cost control. Industrial engineers look at the “big picture” of an operation or system and bridge the gap between management and operations. They deal with and motivate people as well as determine what tools should be used and how they should be used. Industrial engineers use computers and sophisticated software as tools to solve complicated problems to design, quantify, predict, and evaluate the performance of all types of complex technologies and systems.

The mission of the B.S.I.E. program at WVU is to advance the industrial engineering profession through innovative and high-quality academic programs, relevant research, and professional services that address the needs of West Virginia, the nation, and the world. The industrial engineering students at WVU are taught to draw upon specialized knowledge and skills 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. They are introduced to state-of-the-art software in their coursework for data analysis, information management, scheduling, quality control, optimization, and other practices and procedures used by the industrial engineering profession in highly evolving industries of the 21st century.

The discipline of industrial engineering has a rich, ever-increasing diversity of applications. Traditionally, industrial engineers have been employed by manufacturing companies to do facilities and plant design, plant management, quality control, ergonomics, and production engineering. Today, however, industrial engineers are employed in almost any type of industry, business, or institution. Because of their skills, industrial engineers are more widely distributed and in greater demand among more industries than any other engineering discipline.

As an industrial engineer educated at WVU, you can expect to have employment opportunities in manufacturing companies, insurance companies, banks, hospitals, technical sales, pharmaceutical companies, retail organizations including e-business, airlines, government agencies, consulting firms, construction, transportation, public utilities, social service, electronics, digital and wireless communications, etc. The diverse orientation of industrial engineering, coupled with the skills and training you receive at WVU, make you a prime source of management talent that offers unique professional advancement opportunities.

The B.S.I.E. program at WVU devotes considerable attention to the individual needs of the student. It is committed to develop student strengths in technical abilities, personal development, problem solving, and practical experience, preparing them for careers in industry, business, government, or advanced professional degrees. One of the defining attributes in the success of the department is the dedication and talent of its faculty and staff. The aggregate careers of our faculty and staff represent over 300 years of service to students at WVU. In these 300 years of service are embodied the wisdom and experience to successfully prepare industrial engineers for the 21st century.

The faculty works extensively with nearly 300 sophomore, junior, and senior students in such areas as communication skills, personal growth and development, creation of summer internship opportunities, senior capstone project experience, and permanent job opportunities. As faculty and staff, we are committed to provide for our students:

- A friendly, open-door, collegial environment
- Personable faculty mentoring students
- Teaching concepts and techniques for today's demands
- Quality courses that are innovative and challenging
- Placement in the jobs they want
- Notable life-long successes

The industrial engineering program is accredited by the Engineering Accreditation Commission (EAC) of ABET, <http://www.abet.org>.

## Program Educational Objectives

Drawing from the University's mission, the departmental mission, the needs of our constituents, and ABET Engineering Criteria, the following educational objectives were developed. Within a few years of graduation, an IE graduate...

- Creates value by applying the appropriate industrial engineering methods and tools to organizations through critical and creative thinking, structured problem solving, analysis, evaluation, and improvement of systems and processes.
- Communicates effectively across disciplines and cultures to influence decisions and lead activities in support of organizational goals and objectives.

- On a continual basis, pursues professional development and inquiry via graduate study, continuing education and/or training and development through employer-based or industry/sector groups.
- Works collaboratively as both a member and leader of cross-functional teams comprised of members with varying experience levels, organizational backgrounds, positions, and geographic locations.
- Demonstrates ethical standards in designing and implementing innovative systems or processes taking into account social responsibility, global responsibility, and overall benefit to organizational constituents.

## Student Outcomes

Upon graduation, all Bachelor of Science students in Industrial Engineering will have acquired the:

- Ability to use modern and classical industrial engineering methodologies such as operations research, manufacturing systems, computer programming and simulation, production systems, human factors and ergonomics, engineering statistics and quality control, and engineering economics
- Ability to apply knowledge of math, science, and general engineering
- Ability to design and conduct experiments, analyze and interpret data, develop implementation strategies, and shape recommendations so that results will be achieved and findings will be communicated effectively
- Ability to work individually, on teams, and on multi-disciplinary teams to identify, formulate, and solve problems using industrial engineering knowledge, skills, and tools
- Ability to design and implement or improve integrated systems that include people, materials, information, equipment, and energy using appropriate analytical, computational, and experimental practices
- Broad education necessary to develop and maintain professional ethics and understand the comprehensive impact of their solutions on individuals and the society
- Recognition of the need for and an ability to engage in life-long learning
- Professional characteristics expected of a successful industrial engineer

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## FACULTY

### CHAIR

- Kenneth R Currie - Ph.D., P.E., (West Virginia University)  
Manufacturing systems design, Optimization, Automation & Controls, Healthcare Systems Engineering

### PROFESSORS

- Rashpal S. Ahluwalia - Ph.D., P.E. (Western Ontario University)  
Manufacturing systems, Quality and reliability engineering, Robotics and automation
- Jack Byrd Jr. - Ph.D., P.E. (West Virginia University)  
Operations research, Workforce development, Work design, Integrated product development
- B. Gopalakrishnan - Ph.D., P.E., CEM (Virginia Polytechnic Institute and State University)  
Manufacturing processes and systems engineering, Information systems, Artificial intelligence applications, Expert systems development, Mechatronics, Facilities planning and materials handling, Databases, Industrial energy/waste productivity management
- Steven Guffey - Ph.D., C.I.H. (North Carolina State University)  
Ventilation systems theory and design, Noise measurement and control, Exposure assessment
- Majid Jaridi - Ph.D. (University of Michigan)  
Statistics, Quality control, Forecasting and transportation research
- Gary Winn - Ph.D. (Ohio State University)  
Construction safety, Transportation safety and program evaluation, Total quality management, Theory of paradigm shifts
- David Wyrick - Ph.D., P.E., P.E.M. (University of Missouri-Rolla)  
Associate Dean for Academic Affairs, Engineering management, Engineering education, Effective management of technology in SMEs

### ASSOCIATE PROFESSORS

- Elyce Biddle - Ph.D. (West Virginia University)  
Teaching Associate Professor, Economics of safety, Risk management, Injury prevention
- Alan McKendall Jr. - Ph.D. (University of Missouri - Columbia)  
Operations research, Meta-heuristics, Facilities layout and materials handling, Project scheduling, Integrated production systems
- Ashish Nimbarte - Ph.D. (Louisiana State University)  
Occupational biomechanics, human factors engineering, Industrial ergonomics, Industrial hygiene, Occupational safety and health
- Feng Yang - Ph.D. (Northwestern University)  
Simulation, Applied statistics, Stochastic Processes

## ASSISTANT PROFESSORS

- Leily Farrokhvar - Ph.D. (Virginia Tech University)  
Logistics systems modeling and analysis, Supply chain integration, Large scale optimization, Transportation and distribution networks, Decision support development for emergency and disaster management, Applied operations research in healthcare
- Xinjian (Kevin) He - Ph.D. (University of Cincinnati)  
Respiratory protection, air purification and filtration, Aerosol measurement and characterization, Occupational exposure assessment, Underground coal mine ventilation and fire protection
- Xiaopeng Ning - Ph.D. (Iowa State University)  
Occupational safety and health, Occupational biomechanics, Human factors engineering, Industrial ergonomics
- Thorsten Wuest - Ph.D. (Dr.-Ing.; University of Bremen, Germany)  
Smart and advanced manufacturing, Intelligent manufacturing systems, Machine learning / Big data in manufacturing applications, Product lifecycle management, Smart product design, Information and knowledge management, IPPS / Servitization

## ADJUNCT AND VISITING PROFESSORS

- Lorenzo G. Cena - Ph.D. (University of Iowa)  
Occupational health and safety, Aerosol generation and characterization, Exposure assessment
- Christopher Coffey - Ph.D. (West Virginia University)  
Occupational Safety and Health, Assessment, Evaluation of Respiratory protective equipment
- Ren Dong - Ph.D. (Concordia University)  
Human Factors Engineering, Ergonomics, Safety engineering
- John R. Etherton - Ph.D. (West Virginia University)  
Safety engineering
- Martin Harper - Ph.D. (London School of Hygiene and Tropical Medicine)  
Industrial hygiene, Exposure assessment
- James Harris - Ph.D., P.E. (West Virginia University)  
Safety, Human factors
- Hongwei Hsiao - Ph.D. (University of Michigan)  
Safety, Human factors
- Kevin Michael - Ph.D. (The Pennsylvania State University)  
Acoustics, Hearing protection, Industrial hygiene
- Christopher Pan - Ph.D. (University of Cincinnati)  
Human factors engineering, Safety engineering, Ergonomics
- Ju-Hyeong Park - Sc.D., M.P.H., C.I.H. (Harvard)  
Industrial hygiene, Exposure assessment
- M. Abbas Virgi - Sc.D., C.I.H. (University of Massachusetts)  
Exposure assessment, Epidemiology, Biostatistics
- Ziqing Zhuang - Ph.D. (West Virginia University)  
Exposure assessment, Assessment and evaluation of respiratory protective equipment

## LECTURERS

- Michael Carr - MSIE (West Virginia University)  
Decision support systems, Computer applications
- Kenton Colvin - MSIE (West Virginia University)  
Production planning and control, Manufacturing processes
- Shanti Hamburg - M.S. (West Virginia University)  
Prototyping, manufacturing systems, Digital manufacturing, Unmanned aerial vehicles
- Daniel Kniska - MSIE (West Virginia University)  
Engineering economy, Statistics, Production planning and control

## PROFESSOR EMERITUS

- Robert C. Creese - Ph.D., P.E. (Pennsylvania State University)  
Manufacturing processes/systems, foundry engineering, Cost engineering, Engineering economics
- Daniel E. Della-Giustina - Ph.D. (Michigan State University)  
Playground and recreation safety, Sport safety, Highway and traffic management, Safety, fire, and emergency response
- Wafik Iskander - Ph.D., P.E. (Texas Tech University)  
Operations research and optimization, Simulation modeling and analysis, Production planning and control, Applied statistics, Energy efficiency, Transportation planning

- Warren Myers - Ph.D., C.I.H. (West Virginia University)  
Industrial hygiene and safety, Worker exposure assessment and modeling, Aerosol filtration, Occupational respiratory protection design and testing
- Ralph W. Plummer - Ph.D. (West Virginia University)  
Systems safety engineering, Energy conservation, Human factors, Ergonomics

## ASSOCIATE PROFESSOR EMERITUS

- Andrew Sorine - Ph.D. (West Virginia University)  
Benchmarking, Safety and health programs, Safety management information systems

Click here to view the Suggested Plan of Study (p. 6)

## Curriculum in Industrial Engineering

### GENERAL EDUCATION FOUNDATIONS

Please use this link to view a list of courses that meet each GEF requirement. (<http://registrar.wvu.edu/gef>)

NOTE: Some major requirements will fulfill specific GEF requirements. Please see the curriculum requirements listed below for details on which GEFs you will need to select.

#### General Education Foundations

F1 - Composition & Rhetoric		3-6
ENGL 101 & ENGL 102 or ENGL 103	Introduction to Composition and Rhetoric and Composition, Rhetoric, and Research Accelerated Academic Writing	
F2A/F2B - Science & Technology		4-6
F3 - Math & Quantitative Skills		3-4
F4 - Society & Connections		3
F5 - Human Inquiry & the Past		3
F6 - The Arts & Creativity		3
F7 - Global Studies & Diversity		3
F8 - Focus (may be satisfied by completion of a minor, double major, or dual degree)		9
Total Hours		31-37

## Curriculum Requirements

To be eligible for graduation with a bachelor of science in industrial engineering, a student must meet the University's undergraduate degree requirements, take all the courses indicated below, and attain a grade point average of 2.0 or better in all industrial engineering courses. If an industrial engineering is repeated, only the last grade received is used to compute the major grade point average, and the course credit hours are counted only once. This requirement assures that the student has demonstrated overall competence in the major.

#### Freshman Engineering Requirements

ENGR 101	Engineering Problem Solving 1	2
Engineering Problem Solving:		3
CHE 102	Introduction to Chemical Engineering	
ENGR 102	Engineering Problem-Solving 2	
ENGR 103	Introduction to Nanotechnology Design	
MAE 102	Introduction to Mechanical and Aerospace Engineering Design	
ENGR 199	Orientation to Engineering	1

#### Non-Industrial Engineering Core

CHEM 115	Fundamentals of Chemistry (GEF 2B)	4
ECON 201	Principles of Microeconomics (GEF 4)	3
ECON 202	Principles of Macroeconomics	3
Calculus I (GEF 3):		4
MATH 155	Calculus 1 (Minimum grade of C- is required)	
MATH 153 & MATH 154	Calculus 1a with Precalculus and Calculus 1b with Precalculus (Minimum grade of C- is required)	
MATH 156	Calculus 2 (GEF 8 - Minimum grade of C- is required)	4
MATH 251	Multivariable Calculus (Minimum grade of C- is required)	4

MATH 261	Elementary Differential Equations	4
PHYS 111	General Physics (GEF 8)	4
Select one of the following (GEF 8):		4
BIOL 115	Principles of Biology	
CHEM 116	Fundamentals of Chemistry	
PHYS 112	General Physics	

### Major in Industrial Engineering Requirements

A minimum GPA of 2.0 is required in all IENG courses

EE 221	Introduction to Electrical Engineering	3
EE 222	Introduction to Electrical Engineering Laboratory	1
IENG 200	Fundamentals of Industrial Engineering	1
IENG 213	Engineering Statistics	3
IENG 220	Re-Engineering Management Systems	3
IENG 301	Materials and Costing	1
IENG 302	Manufacturing Processes	2
IENG 303	Manufacturing Processes Laboratory	1
IENG 305	Introduction to Systems Engineering	2
IENG 314	Advanced Analysis of Engineering Data	3
IENG 316	Industrial Quality Control	3
IENG 331	Computer Applications in Industrial Engineering	3
IENG 343	Production Planning and Control	3
IENG 350	Introduction to Operations Research	3
IENG 360	Human Factors Engineering	3
IENG 377	Engineering Economy	3
IENG 445	Project Management for Engineers	3
IENG 446	Plant Layout/Material Handling	3
IENG 455	Simulation by Digital Methods	3
IENG 471	Design of Productive Systems 1 (Fulfills Writing and Communications Skills Requirement)	3
IENG 472	Design of Productive Systems 2	3
MAE 241	Statics	3
MAE 243	Mechanics of Materials	3
IENG Technical Electives (Any 400 and 500 level IENG courses)		6
MAE Elective - Choose one of the following:		3
MAE 242	Dynamics	
MAE 320	Thermodynamics	
MAE 331	Fluid Mechanics	
Additional Technical Electives - Choose two of the following:		6
CE 347	Introduction to Environmental Engineering	
CE 414	Construction Engineering	
CS 430	Advanced Software Engineering	
CS 440	Database Design and Theory	
EE 425	Bioengineering	
EE 426	Biometric Systems	
GEOG 350	Geographic Information Systems and Science	
IENG 400 level courses		
IENG 500 level courses		
IH&S 500 level courses		
MAE 242	Dynamics	
MAE 320	Thermodynamics	
MAE 331	Fluid Mechanics	
MAE 427	Heating, Ventilating, and Air Conditioning	
MATH 343	Introduction to Linear Algebra	

MATH 420	Numerical Analysis 1	
MATH 441	Applied Linear Algebra	
SAFM 470	Managing Construction Safety	
STAT 421	Statistical Analysis System (SAS)	
STAT 541	Applied Multivariate Analysis	

GEF Electives 1, 5, 6, 7 15

Total Hours 129

## Suggested Plan of Study

It is important for students to take courses in the order specified as much as possible; all prerequisites and concurrent requirements must be observed. A typical B.S.I.E. degree program that completes degree requirements in four years is as follows.

### First Year

Fall	Hours Spring	Hours
MATH 155 (GEF 3)	4 MATH 156 (GEF 8)	4
ENGR 101	2 ENGR 102	3
ENGR 199	1 PHYS 111 (GEF 8)	4
CHEM 115 (GEF 2B)	4 GEF Elective 6	3
ENGL 101 (GEF 1)	3 GEF Elective 7	3
GEF Elective 5	3	
	17	17

### Second Year

Fall	Hours Spring	Hours
MATH 251	4 MATH 261	4
CHEM 116 or PHYS 112 (GEF 8)	4 MAE 243	3
MAE 241	3 IENG 213	3
ENGL 102 (GEF 1)	3 IENG 377	3
IENG 200	1 EE 221	3
IENG 220	3 EE 222	1
	18	17

### Third Year

Fall	Hours Spring	Hours
ECON 201 (GEF 4)	3 ECON 202	3
IENG 301	1 IENG 302	2
IENG 314	3 IENG 303	1
IENG 305	2 IENG 316	3
IENG 350	3 IENG 331	3
IENG 360	3 IENG 343	3
	15	15

### Fourth Year

Fall	Hours Spring	Hours
IENG Technical Elective	3 IENG 472	3
IENG 445	3 IENG Technical Elective	3
IENG 455	3 IENG 446	3
IENG 471	3 MAE Elective	3
Technical Elective	3 Technical Elective	3
	15	15

Total credit hours: 129

## Major Learning Goals

### INDUSTRIAL ENGINEERING

Upon graduation, all Bachelor of Science students in Industrial Engineering will have acquired the:

**Learning Goal #1.** Ability to use modern and classical industrial engineering methodologies such as operations research, manufacturing systems, computer programming and simulation, production systems, human factors and ergonomics, engineering statistics and quality control, and engineering economics.

**Learning Goal #2.** Ability to apply knowledge of math, science, and general engineering.

**Learning Goal #3.** Ability to design and conduct experiments, analyze and interpret data, develop implementation strategies, and shape recommendations so that results will be achieved and findings will be communicated effectively.

**Learning Goal #4.** Ability to work individually, on teams, and on multi-disciplinary teams to identify, formulate, and solve problems using industrial engineering knowledge, skills, and tools.

**Learning Goal #5.** Ability to design and implement or improve integrated systems that include people, materials, information, equipment, and energy using appropriate analytical, computational, and experimental practices.

**Learning Goal #6.** Broad education necessary to develop and maintain professional ethics and understand the comprehensive impact of their solutions on individuals and the society.

**Learning Goal #7.** Recognition of the need for and an ability to engage in life-long learning.

**Learning Goal #8.** Professional characteristics expected of a successful industrial engineer.