

7.1 ABOUT THE DEPARTMENT

Industrial Engineering is the application of engineering methods and principles of scientific management to industrial systems. Industrial systems take an expanded meaning here to mean not only manufacturing but service oriented operations as well such as those undertaken by hospitals, transportation companies, telecommunication, and contact centers among others. It is concerned with the design, improvement and installation of integrated systems of people, materials, information, equipment and energy. It draws 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.

The Industrial Engineering Program at the University of the Philippines is aimed at providing a sound foundation in science and engineering in preparation for future progress in a professional engineering career.

7.2 VISION

The Department of Industrial Engineering and Operations Research (DIEOR) envisions itself to be the national and an international leader in providing world-class industrial engineering education, research and development towards continuous improvement in productivity, quality and robustness in manufacturing and services.

To be the university of choice locally and internationally for world class Industrial Engineering education, research and development.

7.3 MISSION

To be the national and regional leader in providing world-class Industrial Engineering education and research and development toward continuous improvement in productivity, quality and robustness in manufacturing and services.

To maintain and exceed expectations as the Center of Excellence in Industrial Engineering Education and Research in the Philippines, the department's mission is to:

- Produce highly qualified global industrial engineering professionals
- Conduct continuous and progressive research and development outputs and publications, and
- Create productive institutional linkages and partnerships with industry, academe and government

7.4 CREED

- Consistent Academic Excellence and Leadership
- Continual and Progressive Research and Development
- Productive Institutional Linkages and Partnership

7.5 UNDERGRADUATE PROGRAM

The objective of the Bachelor of Science in Industrial Engineering program is to provide a sound foundation in science and engineering in preparation for a professional Industrial Engineering career.

Industrial Engineering is concerned with the design, improvement and installation of integrated systems of people, materials, information, equipment, and energy. It draws 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.

The main tracks of the program are: Production Systems, Operations Research, Human Factors and Ergonomics, and Information Systems.

7.5.1 Program Educational Objectives

The graduates of the B.S. IE program are envisioned to be:

1. Individuals who will be recognized as a success in their respective professional careers by assuming positions which have significant responsibility and impact
2. Individuals who will continuously strive to acquire new knowledge and competence through professional training and development or continuing education
3. Individuals who will be actively involved in contributing to the improvement of their professional communities and beyond

7.5.2 Program Outcomes

The program outcomes of the B.S. in Industrial Engineering program are given in the following minimum set:

1. Ability to apply knowledge of mathematics and science to solve industrial engineering problems
2. Ability to design and conduct experiments, as well as to analyze and interpret data

3. Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability, in accordance with standards
4. Ability to function on multidisciplinary teams
5. Ability to identify, formulate, and solve engineering problems
6. Understanding of professional and ethical responsibility
7. Ability to communicate effectively
8. Broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
9. Recognition of the need for, and an ability to engage in life-long learning
10. Knowledge of contemporary issues
11. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice
12. Knowledge and understanding of engineering and management principles as a member and leader in a team, to manage projects and in multidisciplinary environments
13. Ability to design, develop, implement, and improve integrated systems that include people, materials, information, equipment and energy

7.6 GRADUATE PROGRAMS

Master of Science in Industrial Engineering / Master of Engineering in Industrial Engineering

The DIEOR offers two graduate programs namely: Master of Science (M.S.) and a Master of Engineering (M.Eng.). A student must declare an area of specialization among the following areas: Production Systems (PS), Operations Research (OR), Information Systems (IS) or Human Factors and Ergonomics (HFE).

Admission Requirements

Applicants to the graduate program should possess a Bachelor's degree in Engineering (any discipline), or in the physical and mathematical sciences.

Program Requirements

The Master of Science (M.S.) degree is generally a research degree consisting of advanced technical coursework and a thesis in a chosen discipline while the Master of Engineering (M.Eng.) degree is a non-thesis degree that is comprised of strong technical and business coursework, usually including internship or applied research experience. While the Master of Science program is designed for students with professional interests on research or technology development in academia, industry or government, the Master of Engineering program is intended for students aiming for careers in product and process design and development, and innovation in industry.

Regardless of program, the student must complete all core course requirements and all area of specialization requirements for graduation.

7.7 FACILITIES

The Department of Industrial Engineering and Operations Research maintains three laboratories for instruction and research.

IE/OR Computing Laboratory and the Information Systems Design, Education and Analytics (IDEA) Laboratory are equipped with desktop computers, multi-media equipment and selected statistical, modeling, optimization, simulation and ERP software packages.

Human Factors and Ergonomics Laboratory is equipped with audio-visual equipment and ergonomic assessment instruments such as manual dexterity tests, strength evaluation systems, Vernier data logger systems to measure sound, temperature, motion, EMG, and respiration, body analyzer, Biometric System that include an electronic goniometer, and usability testing hardware and software.

The new IE/ME building will house three new research laboratories. These are the **Integrated Product Design and Development Laboratory, Facilities Planning Laboratory** and the **Engineering Quality Systems Laboratory** These new laboratories will be equipped with multi-media equipment, computer hardware and software, and other specialized instruments.

7.8 FACULTY AND STAFF

Department Chair

Asst. Prof. Lowell L. Lorenzo

DEPARTMENT OF INDUSTRIAL ENGINEERING AND OPERATIONS RESEARCH

Professors

Edgardo G. Atanacio

M. Eng. Computer Science
University of the Philippines Diliman, 1981
M. Business Information Systems
Georgia State University, 1982
Information Systems, Engineering Education

Iris Ann G. Martinez

Ph.D. Mechanical Engineering for Production
University of Tokyo, 2009
Culture of Manufacturing, OR in Manufacturing

Aura C. Matias

Ph.D. Industrial Engineering
Purdue University, 1996
Human Factors Engineering, Operations Research

Nestor O. Rañeses

M.S. Industrial Engineering
Georgia Institute of Technology, 1981
Quality Management, Six Sigma

Virginia J. Soriano

Ph.D. Mechanical and Manufacturing Engineering
University of New South Wales, 2001
Sustainable Product Systems, Project Management and Development

Associate Professor

Eugene Rex L. Jalao

Ph.D. Industrial Engineering
Arizona State University, 2013
Data Mining, Information Systems, Systems Simulation

Assistant Professors

Lorelie C. Grepo

M.S. Industrial Engineering
University of the Philippines Diliman, 2012
Methods Engineering, Ergonomics, Applied Statistics

Erickson L. Llaguno

M.S. Industrial Engineering
University of the Philippines Diliman, 2000
Quality Engineering, Process Improvement

Lowell L. Lorenzo

M.S. Operations Research
Case Western Reserve University, 1986
Supply Chain Management, Scheduling

Adeline A. Pacia

M. Technology Management
University of the Philippines Diliman, 2010
Business Intelligence, Social Entrepreneurship

Joanna Z. Resurreccion

Ph.D. Systems Engineering
George Washington University, 2013
Risk Analysis Input-Output Modelling

Mili-Ann M. Tamayao

Ph.D. Engineering Policy
Carnegie Mellon University, 2014
Engineering and Public Policy, Sustainable Energy Systems and Policy

Instructors

Christian John Immanuel S. Boydon

B.S. Industrial Engineering
University of the Philippines Diliman, 2013
Operations Research

Amiel John U. Concepcion

B.S. Industrial Engineering
University of the Philippines Diliman, 2014
Operations Research

Benette P. Custodio

B.S. Industrial Engineering
University of the Philippines Diliman, 2010
Human Factors and Ergonomics

Lizabeth Anne D. Franco

B.S. Industrial Engineering
University of the Philippines Diliman, 2014
Production System

Raymond Freth A. Lagria

B.S. Industrial Engineering
University of the Philippines Diliman, 2011
Operations Research

Simon Anthony A. Lorenzo

B.S. Industrial Engineering
University of the Philippines Diliman, 2014
Operations Research

Ramon Miguel C. Panis

B.S. Industrial Engineering
University of the Philippines Diliman, 2013
Operations Research

Alyssa Jean A. Portus

B.S. Industrial Engineering
University of the Philippines Diliman, 2014
Production System

Professorial Lecturer

Fortunato T. dela Peña

M.S. Industrial Engineering
University of the Philippines Diliman, 1971
Dipl. Quality Control, Buowcentrum
Intl. Education, 1975
Technology Management

Senior Lecturers

Paul Eric G. Abeto

M.S. Industrial Engineering
University of the Philippines Diliman, 2010
Applied Statistics

Vincent Arnold S. Chung

M.Technology Management
University of the Philippines Diliman, 2013
*Technology Entrepreneurship, Production
Management*

Rolando Ramon C. Diaz

M.S. Industrial Engineering
University of the Philippines Diliman, 1985
Operations Research

Raymund Daniel A. Lu

M.S. Industrial Engineering,
University of the Philippines Diliman, 2012
Operations Research

Administrative Staff

Maria Gretchen S. Pusung

CONTACT INFORMATION

Mail :

Department of Industrial Engineering and
Operations Research
Rm 402 - 404, Melchor Hall
Osmeña Avenue
University of the Philippines Diliman
Quezon City 1101

Tel:

VoIP +63-2 981-8500 local 3128, 3149

Email:

ieor@upd.edu.ph

DEPARTMENT OF INDUSTRIAL ENGINEERING AND OPERATIONS RESEARCH

7.9 UNDERGRADUATE PROGRAM CURRICULUM

BACHELOR OF SCIENCE IN INDUSTRIAL ENGINEERING[†]

First Year

First Semester				Second Semester			
	Lect (hrs/wk)	Lab (hrs/wk)	Units		Lect (hrs/wk)	Lab (hrs/wk)	Units
Math 17 (Algebra & Trigonometry)	5	0	5	Math 53 (Elementary Analysis I)	5	0	5
IE 10 (Basics of Industrial Engg)	1	0	1	Chem 16 ⁷ (General Chemistry I)	3	6	5
GE (AH 1) Eng 10 (College English)	3	0	3	Physics 71 (Elementary Physics I)	4	0	4
GE (AH 2) Fil 40 ¹ (Wika, Kultura at Lip)	3	0	3	Physics 71.1 (Elementary Physics I Lab)	0	2	1
GE (SSP 1) Philo 1 (Philo Analysis)	3	0	3	GE (AH 3) Comm 3 (Pract Speech Fund)	3	0	3
GE (SSP 2) Kas 1 ¹ (Kasaysayan ng Pil)	3	0	3	PE ⁴ (Physical Education)	2	0	(2)
PE ⁴ (Physical Education)	2	0	(2)				
	20	0	18		17	8	18

Second Year

First Semester				Second Semester			
	Lect (hrs/wk)	Lab (hrs/wk)	Units		Lect (hrs/wk)	Lab (hrs/wk)	Units
Math 54 ⁷ (Elementary Analysis II)	5	0	5	Math 55 (Elementary Analysis III)	3	0	3
Physics 72 ⁷ (Elementary Physics II)	4	0	4	ES 11 (Statics of Rigid Bodies)	3	0	3
Physics 72.1 (Elem Physics II Lab)	0	2	1	ES 21 (Mathematical Methods in Engg)	3	0	3
ES 1 (Engineering Drawing)	0	6	2	ES 26 (Intro to Computer Programming)	2	3	3
GE (AH 4) Free Choice ²	3	0	3	Acctg 1 (Intro to Financial Accounting)	3	0	3
GE (MST 1) Free Choice ³	3	0	3	GE (AH 5) Free Choice ²	3	0	3
PE ⁴ (Physical Education)	2	0	(2)	PE ⁴ (Physical Education)	2	0	(2)
NSTP ⁵ (National Service Training Program)	3	0	(3)	NSTP ⁵ (National Service Training Program)	3	0	(3)
	20	8	18		22	3	18

Third Year

First Semester				Second Semester			
	Lect (hrs/wk)	Lab (hrs/wk)	Units		Lect (hrs/wk)	Lab (hrs/wk)	Units
IE 21 (Industrial Materials & Processes)	3	0	3	IE 28 (Statistical Analysis for IE)	3	0	3
IE 27 (Probability & Statistics for IE)	3	0	3	IE 32 (Methods Engineering)	2	3	3
IE 31 (Industrial Org & Management)	3	0	3	IE 33 (Systems & Procedures)	2	0	2
Shop 7 (General Shop Practice)	0	3	1	IE 41 (Operations Research I)	3	0	3
ES 12 (Dynamics of Rigid Bodies)	3	0	3	IE 50 (Engineering Economics for IE)	3	0	3
ES 13 (Mechanics of Deformable Bodies I)	3	0	3	Econ 100.1 (Intro to Macroecon Theory & Policy)	3	0	3
GE (MST 2) STS (Science, Tech & Society)	3	0	3				
	18	3	19		16	3	17

Fourth Year

First Semester				Second Semester			
	Lect (hrs/wk)	Lab (hrs/wk)	Units		Lect (hrs/wk)	Lab (hrs/wk)	Units
IE 135 (Industrial Quality Control)	3	0	3	IE 122 (Product Design & Development)	2	3	3
IE 142 (Operations Research II)	3	0	3	IE 144 (Systems Simulation)	2	3	3
IE 143 (Stochastic Processes in Engg)	3	0	3	IE 151 (Production Systems)	2	3	3
IE 160 (Ergonomics)	2	3	3	ChE 2 (Elementary Chemical Engineering)	3	0	3
BA 115 (Management Accounting)	3	0	3	EEE 3 (Elementary Electrical Engineering)	3	0	3
GE (SSP 3) Free Choice	3	0	3	GE (SSP 4) Free Choice	3	0	3
	17	3	18		15	9	18

Fifth Year

First Semester				Second Semester			
	Lect (hrs/wk)	Lab (hrs/wk)	Units		Lect (hrs/wk)	Lab (hrs/wk)	Units
IE 152 (Manufacturing Planning & Design)	3	0	3	IE 155 (Industrial Systems Design)	2	3	3
IE 153 (Project Devt & Management)	2	3	3	IE 156 (Information Systems II)	3	0	3
IE 154 (Information Systems I)	3	0	3	IE 198 (Special Problems)	3	0	3
IE Elective	3	0	3	PI 100 (The Life & Works of Jose Rizal)	3	0	3
GE (SSP 5) Free Choice	3	0	3	Elective ⁶	3	0	3
ME 63 (Thermodynamics)	3	0	3	GE (MST 3) Free Choice ³	3	0	3
	17	3	18		17	3	18

Total Number of Units = 180

Notes:

[†] Effective AY 2012-2013. Total Number of Units = 180

¹ Kas 1 and Fil 40 satisfy the 6-unit Philippine Studies requirement

² Nine (9) units of GE (AH) courses must be Communication in English

³ GE courses in the MST domain must NOT be under Physics, Chemistry or Mathematics (except Math 1)

⁴ For physical education (PE), the student is required to complete any 4 physical education (PE) courses

⁵ As a requirement for graduation, all students must take six (6) units in one of the National Service Training Program (NSTP) components: Civic Welfare Training Service (CWTS), Literacy Training Service (LTS), and Reserved Officer's Training Corps Military Science (ROTC Mil Sci)

⁶ Electives are to be chosen among IE or Non-IE electives

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7.10 GRADUATE PROGRAMS CURRICULA

Master of Science in Industrial Engineering (M.S. IE)

Program Checklist

Total Number of Units: 31

Course Requirements	Specialization				Units
	Operations Research	Production Systems	Ergonomics	Information Systems	
Refresher Courses	IE 201	IE 201	IE 201	IE 201	(3)
	IE 202	IE 202	IE 202	IE 202	(3)
	IE 211	IE 211	IE 211	IE 211	(3)
	IE 214	IE 214	IE 214	IE 214	(3)
Core Courses	IE 230	IE 230	IE 230	IE 230	3
	IE 231	IE 231	IE 231	IE 231	3
	IE 241	IE 241	IE 241	IE 241	3
	IE 251	IE 251	IE 251	IE 251	3
IE Track Specialization	IE 242	IE 245	IE 243	IE 253	3
IE Track Specialization	IE 252	IE 255	IE 256	IE 254	3
IE Track Specialization/Non-IE Elective	IE 281				3
Non-IE Elective					3
Seminar	IE 296	IE 296	IE 296	IE 296	1
Thesis	IE 300	IE 300	IE 300	IE 300	6
				Total	31

Master of Engineering in Industrial Engineering (M.Eng. IE)

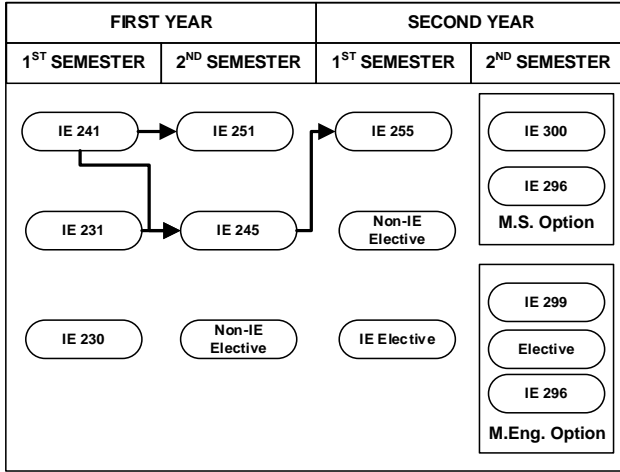
Program Checklist

Total Number of Units: 31

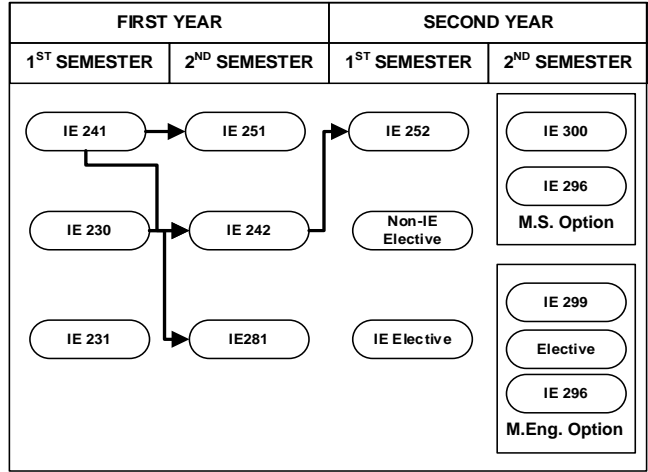
Course Requirements	Specialization				Units
	Operations Research	Production Systems	Ergonomics	Information Systems	
Refresher Courses	IE 201	IE 201	IE 201	IE 201	(3)
	IE 202	IE 202	IE 202	IE 202	(3)
	IE 211	IE 211	IE 211	IE 211	(3)
	IE 214	IE 214	IE 214	IE 214	(3)
Core Courses	IE 230	IE 230	IE 230	IE 230	3
	IE 231	IE 231	IE 231	IE 231	3
	IE 241	IE 241	IE 241	IE 241	3
	IE 251	IE 251	IE 251	IE 251	3
IE Track Specialization	IE 242	IE 245	IE 243	IE 253	3
IE Track Specialization	IE 252	IE 255	IE 256	IE 254	3
IE Track Specialization/IE Elective	IE 281				3
IE Elective					3
Elective					3
Seminar	IE 296	IE 296	IE 296	IE 296	1
Special Project	IE 299	IE 299	IE 299	IE 299	3
Comprehensive Exam					
				Total	31

Program Flowcharts

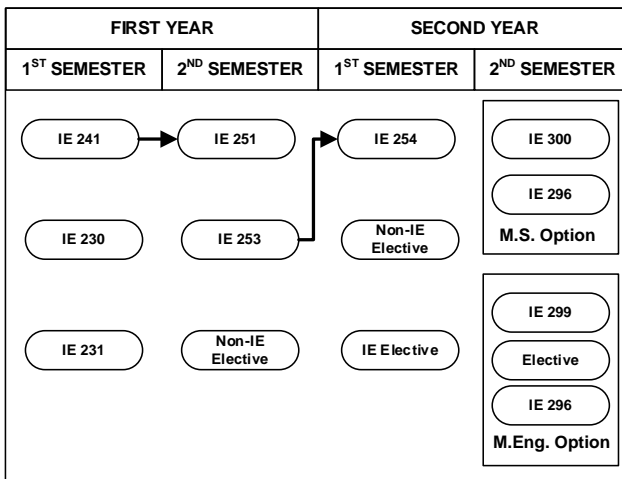
Production Systems



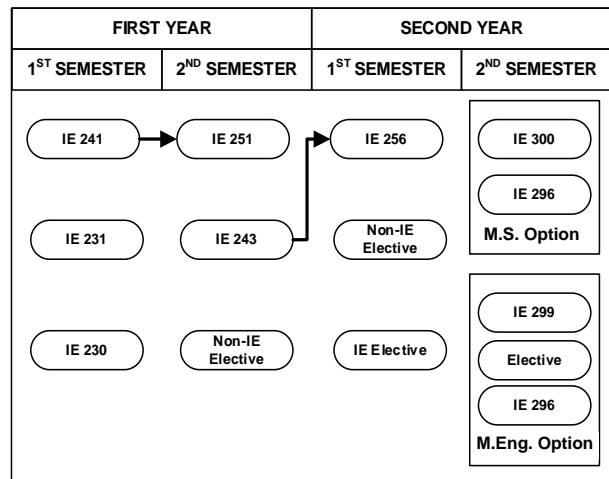
Operations Research



Information Systems



Human Factors



7.11 UNDERGRADUATE PROGRAM COURSE DESCRIPTIONS

Industrial Engineering (IE)

IE 3 Introduction to Industrial Engineering. Systems, concepts, the industrial organization and its functions, Overview of industrial engineering tools. Prereq: 3rd yr. standing. 3 u.

IE 10 Basics of Industrial Engineering. Overview of industrial engineering, its areas of specialization and the practice of Industrial Engineering profession. 1 u.

IE 21 Industrial Materials and Processes. Industrial materials and processes and their effects on production system decisions. Prereq: Chem 16, ES 1, Physics 72. 3 u.

IE 27 Probability and Statistics for Industrial Engineering. Applications of logic and probability in industrial engineering; random variables and their functions, descriptive statistics, discrete and continuous probability distributions and their applications. Sampling theory. Estimation and tests of hypotheses. Prereq: Math 54. 3 u.

IE 28 Statistical Analysis for Industrial Engineering. Regression, correlation, analysis of variance, design of experiments and their applications in Industrial Engineering. Prereq: IE 27. 3 u.

IE 31 Industrial Organization and Management. Basic features governing the organization, administration, and financing of industries. Relations between labor and management. Prereq: 3rd yr. standing. 3 u.

IE 32 Methods Engineering. Productivity concepts and techniques, methods study and work measurement; wage payment; indirect and expense labor standards; training practices. Prereq: IE 21, IE 27, IE 31. 5 h (2 lec, 3 lab) 3 u.

IE 33 Systems and Procedures. System documentation and charting; introduction to information management and related ISO standards; system and procedures best practices. Coreq: IE 32. 2 u.

IE 41 Operations Research I. Operations research methodology. Optimization models for linear systems. Linear programming: duality and sensitivity analysis, transportation, assignment and network models. Prereq: ES 21. 3 u.

IE 50 Engineering Economics for Industrial Engineering. Concepts and tools of economic analysis for decision-making. Interest and money-time relationships. Single and multiple project evaluation. After-tax economy studies. Decisions recognizing risk and uncertainty. Prereq: Acctg 1. 3 u.

IE 122 Product Design and Development. Framework for product life cycle design, integrated product and process design, development, prototyping and evaluation. Prereq: IE 21; Coreq: Shop 7. 5 h (2lec, 3 lab) 3 u.

IE 135 Industrial Quality Control. Statistical process control. Specifications and tolerances. Acceptance sampling. Reliability and life testing. Quality improvement. Prereq: IE 28, IE 32. 3 u.

IE 136 Manufacturing Systems. Primary activities of a manufacturing firm. Manufacturing practices. Prereq: 4th yr. standing. 3 u.

IE 137 Quality Systems in Manufacturing. Concepts of quality. World-class quality programs and standards. Performance measurement and competitive priorities. Benchmarking. Coreq: IE 136. 3 u.

IE 138 Manufacturing Management. Organization and financial aspects of manufacturing. Manufacturing management principles. Prereq: 4th yr. standing. 3 u.

IE 139 Reliability Engineering for Industrial Systems. Basic concepts of reliability engineering. Reliability measurement system. Reliability analysis methods. Failure mode and effects analysis. Fault tree analysis. Risk analysis. Human reliability. Life testing, Reliability testing and evaluation. Design for reliability applications. Prereq: IE 135; IE 143. 3 u.

IE 142 Operations Research II. Matrix approach to linear programming; integer programming; dynamic programming; goal programming; game theory. Prereq: ES 26, IE 41. 3 u.

IE 143 Stochastic Processes in Engineering. Elements of stochastic processes; queuing theory and decision models; Markov chains, renewal theory and its applications to engineering problems. Prereq: IE 27. 3 u.

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IE 144 Systems Simulation. Simulation of complex discrete event systems with applications in manufacturing and service organizations; random number and variate generation, input distribution modeling, statistical analysis of simulation output; case studies. Prereq: ES 26, IE 28, IE 32. 5 h (2 lec, 3 lab) 3 u.

IE 151 Production Systems. Capacity planning. Forecasting. Production planning. Scheduling and inventory control. Maintenance. Production Control. Production information system. Prereq: IE 50, IE 135, IE 41. 5 h (2 lec, 3 lab) 3 u.

IE 152 Manufacturing Planning and Design. Manufacturing process design. Location and layout of facilities. Material flow systems. Materials handling. Storage and distribution. Prereq: IE 151; Coreq: IE 144. 3 u.

IE 153 Project Development and Management. Phases of project feasibility studies. Project development, evaluation and management. Prereq: BA 115, IE 122, IE 151. 5 h (2 lec, 3 lab) 3 u.

IE 154 Information Systems I. Concepts and frameworks of information systems. Analysis and design of information systems. Prereq: ES 26; Coreq: IE 33. 3 u.

IE 155 Industrial Systems Design. Total systems design. Integration of sub-systems with concentration on optimal total systems implementation. A project and case study oriented course. Prereq: IE 153, IE 154. 5 h (2 lec, 3 lab) 3 u.

IE 156 Information Systems II. Implementation considerations in information systems design. Relational database systems. Prereq: IE 154. 3 u.

IE 157 Software Tools for Industrial Engineering. Introduction to computer software packages for Industrial Engineering applications. Prereq: ES 26, COI. 5 h (2 lec, 3 lab) 3 u.

IE 158 Supply Chain Management for Industrial and Service Systems. An overview of concepts, processes, and best practices that are used in the management of supply chains. Supply chain management, procurement, customer relationship management, finance, information technologies, logistics activities and case studies. Prereq: IE 151. 3 h lec. 3 u.

IE 159 Introduction to Technology Entrepreneurship. Fundamentals of technology entrepreneurship, intellectual property, industry creation, and technology strategy. Opportunity recognition and evaluation. Business model development. Management of ventures. Prereq: Senior standing / COI for non-IE students. 3 h lec. 3 u.

IE 160 Ergonomics. Origins and development of human factors and ergonomics; movement, cognitive and environmental factors in ergonomic workplace design and evaluation; tools and techniques of ergonomic risk assessment. Prereq: IE 32/COI. 5 h (2 class, 3 lab) 3 u.

IE 161 Safety and Health Management. Hazard analysis techniques, human error analysis, safety standards and hazard communication; application of human factors and engineering practice in accident prevention and the reduction of health hazards on living and work environments. Prereq: IE 160 / COI. 3 u.

IE 197 Special Topics. 3 u.

IE 198 Special Problems. Prereq: Senior standing. 3 u.

7.12 GRADUATE PROGRAMS COURSE DESCRIPTIONS

Industrial Engineering (IE)

IE 201 Industrial Management and Productivity. Organization theory, management principles, managerial functions, the industrial environment, functional areas of the industrial enterprise, human behavior and motivation, productivity concepts and techniques, methods engineering, systems and procedures. 3 u.

IE 202 Production Systems and Processes. Introduction to production systems and functions, production processes and engineering materials. 3 u.

IE 211 Quantitative Methods in Industrial Engineering. Estimation and tests of hypothesis in industrial engineering problems, regression and correlation, statistical control charts, acceptance sampling plans, specifications and tolerances, reliability and life-testing. Prereq: Math 54/equiv. 3 u.

DEPARTMENT OF INDUSTRIAL ENGINEERING AND OPERATIONS RESEARCH

IE 214 Introductory Operations Research. Operations research methodology, basic linear programming, network analysis, dynamic programming, integer programming, and queuing theory. Prereq: Math 54/equiv. 3 u.

IE 230 Statistical Design and Analysis for Industrial Engineering. Sampling and sampling distributions, estimation and hypothesis testing, analysis of variance, factorial designs, randomized blocks, latin squares and related designs, fractional replication and confounding, nested or hierarchical designs, regression analysis, response surface methodology, analysis of covariance. Prereq: IE 28 or equiv. 3 u.

IE 231 Analysis of Production Systems. Mathematical and statistical decision models for the design, operation and control of production systems. Forecasting, inventory, capacity, aggregate planning, scheduling, maintenance and cost control methods. Coreq: IE 241. 3 u.

IE 241 Operations Research I. Fundamental models in operations research. Advanced topics in linear and integer programming, dynamic programming and game theory, elementary queuing models. Prereq: IE 214 or COI. 3 u.

IE 242 Operations Research II. Intermediate models in operations research: advanced queuing models, stochastic processes including discrete and continuous Markov chains, Markov decision processes and renewal theory, non-linear programming. Prereq: IE 230. 3u.

IE 243 Advanced Methods and Standards. Advanced work in motion and time study, wage analysis and payment systems, speed and effort rating, and job evaluation. Prereq: COI. 3 u.

IE 245 Advances in Production Systems. Current and emerging trends in the analysis and design of production systems. Prereq: IE 231, IE 241. 3 u.

IE 251 Engineering Economic Analysis. Economic Evaluation methods for industrial projects, deterministic and stochastic methods, deterministic investment analysis, application of algebraic, linear and non-linear programming models, comparison of multiple projects under singular or multiple constraints. Prereq: IE 241. 3 u.

IE 252 Advanced Operations Research. Advanced topics in non-linear programming and applications, modelling of large-scale systems, interior point algorithms, project work on applications involving analytical operations research models. Prereq: IE 241, IE 242. 3 u.

IE 253 Information Systems I. Concepts and frameworks for information systems. Analysis and design of information systems. Systems analysis and design tools and techniques. Prereq: ES 26 or equiv. 3 u.

IE 254 Information Systems II. Implementation considerations in computer-based information systems design. Database systems. Security and privacy issues in information systems. Information systems management. Prereq: IE 253. 3 u.

IE 255 Facilities Systems Design. Design of complex industrial systems involving physical facilities for the production of goods and services. Facilities planning and materials handling. Prereq: IE 245 or COI. 3 u.

IE 256 Human Factors Engineering. Application of engineering, psychological principles to the analysis and design of human work systems. Prereq: IE 243 or COI. 3 u.

IE 281 Systems Simulation. Simulation of complex discrete-event systems with application in manufacturing and service organizations, random number and variate generation, input distribution modelling, statistical analysis of simulation output and variance reduction techniques, project work using a high level simulation language or a general high-level programming language, continuous simulation. Prereq: IE 230, ES 26 or equiv. 3 u.

IE 296 Graduate Seminar. 1 u.

IE 298 Special Problems. Topical courses not offered in regular course rotation--e.g., new courses not in the catalogue, courses by visiting faculty, courses on timely topics, highly specialized courses responding to unique student demand. May be taken twice. Prereq: COI. 3 u.

Past and Current Offerings:

- **Business Intelligence and Data Mining:** Introduction to Decision Support Systems, Data Warehousing, Introduction to Data Mining, Classification, Clustering and Association Analysis
- **Entrepreneurship**

- **Quantitative Business Models**

IE 299 Special Project. Independent study on topics in the area of specialization. Prereq: IE 296. 3 u.

IE 300 Thesis. Maximum of 6 u.