RUTGERS

The State University of New Jersey

Undergraduate Handbook: Department of Industrial & Systems Engineering

Academic Year 2019-2020

RUTGERS

The State University of New Jersey

Department of industrial and Systems Engineering (ISE)

Welcome to ISE!

In today's complex and competitive world, industrial engineers are in great demand to design, improve, and operate integrated *systems* of people, materials, equipment, and energy. The industrial and systems engineering discipline applies fundamentals from the mathematical, physical, and engineering sciences to efficiently design and analyze large systems that serve industry and government both in manufacturing and service sectors.

The undergraduate industrial engineering program at Rutgers provides students with a broad engineering education along with specialization in the industrial engineering and manufacturing fields. We believe that a broad education is necessary to understand the impact of engineering solutions in a global/societal context. Academic strength in mathematics, physics, and basic engineering science is required. Specialization is offered in mathematical modeling, quality engineering and statistical techniques, computer-aided design, computer-aided manufacturing, simulation, manufacturing processes, engineering economics, production planning and control, design of engineering systems and information technology. Students have access to state-of-the-art laboratory facilities where hands-on instruction is emphasized in robotics, machine vision, manufacturing, automated material handling, quality engineering, electronic and sensor devices, simulation, and computer information systems.

The industrial engineering program focuses on classroom instruction fostered by learning in multi-disciplinary project-teams. These teams frequently formulate and find engineering solutions to real-world industry problems. The ability to communicate effectively is emphasized by having students provide both oral and written reports.

ISE graduates work in several areas including electronic, pharmaceutical, and other manufacturing; health services, transportation, distribution, and communication; and computers, finance, marketing, and management. Students pursue graduate studies in engineering and in management at leading institutions.

The ISE faculty is dedicated to excellence in teaching, research, and professional service. They bring experience, real-life industrial problems, and enthusiasm to the classroom, setting a standard for students to follow in their professional careers.

WELCOME TO INDUSTRIAL AND SYSTEMS ENGINEERING!

We have carefully prepared this handbook for you. It contains information about the undergraduate program in Industrial Engineering (IE) at Rutgers. Here, you will find descriptions of the IE curriculum and electives. We've also enclosed information on academic policies, department facilities, faculty advisors, and student societies.

Currently, students in the classes of 2019, 2020, and 2021 require a total of 129 credit hours with major credit hours totaling 67. Starting with the ISE Class of 2022, there is a still total of 129 credit hours with major credit hours totaling 67; however, 01:220:102 Introduction to Micro Economics has been replaced with an additional List B Departmental/Technical (D/T) elective.

The Department of Industrial and Systems Engineering (ISE) offers courses in various areas including: work design and ergonomics, optimization, simulation modeling, probability, manufacturing processes, design of engineering systems, facilities layout, production planning and control, and quality engineering and statistics.

In addition, the department gives students the opportunity to attain hands-on experiences in the ISE labs with work design, manufacturing processes; computer-controlled manufacturing systems, and quality engineering and statistics. Our labs include the Manufacturing Automation Lab, the Quality and Reliability Lab, the Microcomputer Lab, and the Manufacturing Processes Lab.

This handbook and other information about the Department of Industrial and Systems Engineering at Rutgers can be found on the web at http://ise.rutgers.edu**.** Our mailing address is Department of Industrial and Systems Engineering, Rutgers University, 96 Frelinghuysen Road, Piscataway, NJ 08854-8018; fax (732) 445-5467; telephone (848) 445-3654; email for the undergraduate director, Dr. E. A. Elsayed, is elsayed@soe.rutgers.edu.

Once again, we welcome you to the Department of Industrial and Systems Engineering. If you have any questions regarding your undergraduate study please feel free to stop by the departmental office. We are located in Room 201 of the CoRE Building. We are always available to help.

Enjoy Your Studies,

Dr. Mohsen Jafari, Chairman, CoRE 201
Dr. E. A. Elsayed,
Undergraduate Director, CoRE 226
Ms. Laura Kasica, CoRE 201

WELCOME TO ISE!

Welcome ISE Undergraduate Students! Here is some valuable information:

1. **IMPORTANT – IE Program Changes:** Starting with the ISE Class of 2019, there are IE program changes.
2. Do your best to follow the ISE Undergraduate Handbook that is online at: http://ise.rutgers.edu. As stated in the Handbook, "Each student must be aware that he or she is ultimately the person responsible for completing the BS degree requirements." Also, your official IE curriculum checklist is in a folder in B-100 that is being migrated to Degree Navigator. You should periodically check on it, especially if you are close to graduation.
3. Be careful with prerequisites. Prerequisite knowledge for a course is important to help you succeed. Prerequisite overrides are **not** automatically granted and are based on consultations with the course instructor and the ISE Undergraduate Director on a case-by-case basis.
3. **Co-Ops:** If you are planning a co-op, be sure to make an appointment to meet with Undergraduate Director.
4. **STUDY ABROAD:** If you are planning a study abroad, be sure to make an appointment with the Undergraduate Director for discussion and approval.
5. **BS/MBA:** meet with Undergraduate Director.
6. **LABS:** Labs are co-requisites in most IE courses. If you register for the course, you must register for the lab.
7. Should you require a Special Permission Number (SPN), you will need to meet with Undergraduate Director.
8. FYI - 540:343 Engineering Economics will be offered during 1st Summer Session in addition to Fall and Spring semesters.
9. **Dept/Tech (D/T) electives:** If you do not see courses on the D/T List A and/or List B that interest you, you will need to make a proposal to me for consideration of an alternative course. Before registering for the course, you will need my prior approval of your proposed course as an acceptable D/T elective.

Dr. Elsayed, ISE Undergraduate Director
Office: CoRE 226
Telephone: (848) 445-3859
E-mail: *elsayed@soe.rutgers.edu*

(Just send an e-mail to make an appointment)

What Is Industrial Engineering?

According to the Institute of Industrial Engineers (1975), the Industrial Engineering profession is described as follows:

"Industrial Engineering is concerned with the design, improvement, and installation of integrated systems of people, materials, equipment, and energy. It draws upon specialized knowledge and skill 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."

What are the Program Educational Objectives (PEOs) of the Industrial and Systems Engineering Department at Rutgers University?

The Program Educational Objectives (see http://ise.rutgers.edu) of the Industrial Engineering program are aligned with Rutgers University's mission of sustaining highest standards in teaching, research and public service and to educate exceptional leaders of the next generation. They are also aligned with the School of Engineering (SOE) mission.

The **Program Educational Objectives (PEOs)** are:

1. *Graduates will meet the expectations of employers of Industrial engineers.*
2. *Qualified graduates will pursue advanced study if they so desire.*
3. *Graduates will pursue leadership positions in their profession and/or communities.*

To meet these objectives, the department has designed its curriculum in order to insure the following Student Outcomes (SOs):

The following list of **Student Outcomes** is currently used to evaluate the IE program and is listed on the department web site. A graduate who has successfully gained all the skills, knowledge, and behaviors present in the following outcomes would have a complete knowledge and training necessary to achieve the program's objectives. Each Industrial Engineering student will have demonstrated the following:

1. *an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics*
2. *an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors*
3. *an ability to communicate effectively with a range of audiences*
4. *an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts*
5. *an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives*
6. *an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions*
7. *an ability to acquire and apply new knowledge as needed, using appropriate learning*

Table of Contents

1. INDUSTRIAL ENGINEERING CURRICULUM

1.1 CLASS OF 2018

Freshman Year	(17 cr. hrs.)		(18 cr. hrs.)
01:160:159	Gen Chem for Eng. 3	01:160:160	Gen Chem for Eng. 3
01:160:171	Intro to Experiment 1	01:640:152	Calc Math Phy Sci 4
01:355:101	Expository Writing 3	01:750:124	Analytic Physics I 2
01:640:151	Calc Math Phy Sci 4	14:440:127	Intro to Computers 3
01:750:123	Analytic Physics I 2	14:440:221	Engr Mech-Statics 3
14:440:100	Intro to Engr 1	__:___:___	Hum/Soc Elective 3
__:___:___	Hum/Soc. Elective 3		

Sophomore Year	(17 cr. hrs.)		(17 cr. hrs.)
01:640:251	Multivar Calc 4	01:220:102	Intro to Micro Econ 3
01:750:227	Analytic Phys IIA 3	01:640:244	Diff Eqns Eng & Ph 4
01:750:229	Anal Phys II Lab 1	01:750:228	Analytic Physics IIB 3
33:010:310	Account for Eng. 3M	01:750:230	Anal Physics II Lab 1
14:540:201	Work Des & Ergo 3M	14:440:222	Eng Mech-Dyn. 3
14:540:202	Work Des Lab 1M	14:540:210	Eng. Probability 3M
14:540:213	IE Lab 2M		

Junior Year	(17 cr. hrs.)		(16 cr. hrs.)
01:355:302	Sci & Tech Writing 3	14:540:303	Mfg. Processes 3M
14:180:215	Eng. Graphics 1M	14:540:304	Mfg. Processes Lab 1M
14:332:373	Elements of EE 3M	14:540:311	Deter. Models in OR 3M
14:635:407	Mech. Prop Materials 3M	14:540:343	Eng. Economics 3M
14:540:338	Prob. Models in OR 3M	14:540:384	Simulat. Models IE 3M
14:540:382	Comp. Contr Mfg Sys 3M	14:540:399	Design of Eng Syst I 3M
14:540:383	Comp. Contr Lab 1M		

Senior Year	(13 cr. hrs.)		(15 cr. hrs.)
14:540:400	Design of Eng Syst. II 3M	14:540:462	Fac Layout & MH 3M
14:540:433	Quality Eng & Stat 3M	__:___:___	Dpt/Tech Elec (List A) 3M
14:540:434	Quality Eng. Lab 1M	__:___:___	Dpt/Tech Elec (List B) 3M
14:540:453	Prod Plan & Control 3M	__:___:___	Hum/Soc Elective 3
14:332:402	Sustainable Energy 3M	__:___:___	Hum/Soc Elective 3

M - Course is included in major average.
Total credit hours: 130.
Major credit hours total 64.

The Dept/Tech electives (List A & List B) for Class are given in Section 1.2.

INDUSTRIAL ENGINEERING CURRICULUM

1.2 CLASS OF 2019/2020/2021

Freshman Year	(17 cr. hrs.)		(18 cr. hrs.)
01:160:159	Gen Chem for Eng. 3	01:160:160	Gen Chem for Eng. 3
01:160:171	Intro to Experiment 1	01:640:152	Calc Math Phy Sci 4
01:355:101	Expository Writing 3	01:750:124	Analytic Physics I 2
01:640:151	Calc Math Phy Sci 4	14:440:127	Intro to Computers 3
01:750:123	Analytic Physics I 2	14:440:221	Engr Mech-Statics 3
14:440:100	Intro to Engr 1	__:___:___	Hum/Soc Elective 3
__:___:___	Hum/Soc. Elective 3		

Sophomore Year	(17 cr. hrs.)		(16 cr. hrs.)
01:640:251	Multivar Calc 4	01:220:102	Intro to Micro Econ 3
01:750:227	Analytic Phys IIA 3	01:640:244	Diff Eqns Eng & Ph 4
01:750:229	Anal Phys II Lab 1	14:440:222	Engr Mech-Dyn. 3
33:010:310	Account for Eng. 3M	14:540:210	Eng. Probability 3M
14:540:201	Work Des & Ergo 3M	01:355:302	Sci & Tech Writing 3
14:540:202	Work Des Lab 1M		
14:540:213	IE Lab 2M		

Junior Year	(17 cr. hrs.)		(16 cr. hrs.)
14:540:320	Eng Statistics 3M	14:540:303	Mfg. Processes 3M
14:180:215	Eng. Graphics 1M	14:540:304	Mfg. Processes Lab 1M
14:332:373	Elements of EE 3M	14:540:311	Deter. Models in OR 3M
14:635:407	Mech. Prop Materials 3M	14:540:343	Eng. Economics 3M
14:540:338	Prob. Models in OR 3M	14:540:384	Simulat. Models IE 3M
14:540:382	Comp. Contr Mfg Sys 3M	14:540:399	Design of Eng Syst I 3M
14:540:383	Comp. Contr Lab 1M		

Senior Year	(13 cr. hrs.)		(15 cr. hrs.)
14:540:400	Design of Eng Syst. II 3M	14:540:462	Fac Layout & MH 3M
14:540:433	Quality Eng & Stat 3M	__:___:___	Dpt/Tech Elec (List A) 3M
14:540:434	Quality Eng. Lab 1M	__:___:___	Dpt/Tech Elec (List B) 3M
14:540:453	Prod Plan & Control 3M	__:___:___	Hum/Soc Elective 3
14:332:402	Sustainable Energy 3M	__:___:___	Hum/Soc Elective 3

M - Course is included in major average.
Total credit hours: 129
Major credit hours total: 67

INDUSTRIAL ENGINEERING CURRICULUM

CLASS OF 2022

Freshman Year	(17 cr. hrs.)		(18 cr. hrs.)
01:160:159 Gen Chem for Eng.	3	01:160:160 Gen Chem for Eng.	3
01:160:171 Intro to Experiment	1	01:640:152 Calc Math Phy Sci	4
01:355:101 Expository Writing	3	01:750:124 Analytic Physics I	2
01:640:151 Calc Math Phy Sci	4	14:440:127 Intro to Computers	3
01:750:123 Analytic Physics I	2	14:440:221 Engr Mech-Statics	3
14:440:100 Intro to Engr	1	__:___:___ Hum/Soc Elective	3
__:___:___ Hum/Soc. Elective	3		

Sophomore Year	(17 cr. hrs.)		(16 cr. hrs.)
01:640:251 Multivar Calc	4	__:___:___ Dpt/Tech Elec (List B)	3M
01:750:227 Analytic Phys IIA	3	01:640:244 Diff Eqns Eng & Ph	4
01:750:229 Anal Phys II Lab	1	14:440:222 Eng Mech-Dyn	3
33:010:310 Account for Eng.	3M	14:540:210 Eng Probability	3M
14:540:201 Work Des & Ergo	3M	01:355:302 Sci & Tech Writing	3
14:540:202 Work Des Lab	1M		
14:540:213 IE Lab	2M		

Junior Year	(17 cr. hrs.)		(16 cr. hrs.)
14:540:320 Eng Statistics	3M	14:540:303 Mfg. Processes	3M
14:180:215 Eng. Graphics	1M	14:540:304 Mfg. Processes Lab	1M
14:332:373 Elements of EE	3M	14:540:311 Deter. Models in OR	3M
14:635:407 Mech. Prop Materials	3M	14:540:343 Eng. Economics	3M
14:540:338 Prob. Models in OR	3M	14:540:384 Simulat. Models IE	3M
14:540:382 Comp. Contr Mfg Sys	3M	14:540:399 Design of Eng Syst I	3M
14:540:383 Comp. Contr Lab	1M		

Senior Year	(13 cr. hrs.)		(15 cr. hrs.)
14:540:400 Design of Eng Syst. II	3M	14:540:462 Fac Layout & MH	3M
14:540:433 Quality Eng	3M	__:___:___ Dpt/Tech Elec (List A)	3M
14:540:434 Quality Eng. Lab	1M	__:___:___ Dpt/Tech Elec (List B)	3M
14:540:453 Prod Plan & Control	3M	__:___:___ Hum/Soc Elective	3
14:332:402 Sustainable Energy	3M	__:___:___ Hum/Soc Elective	3

M - Course is included in major average.
Total credit hours: 129
Major credit hours total: 67

1.3. Departmental/Technical Electives

Students are required to take one course from the Departmental/Technical Electives List A (Design Elective) and one course from the Departmental/Technical Electives List B. These two lists are given below.

If a student has a particular interest, the advisor may approve courses not on the list. For example, a student planning to go to medical school may wish to take biology and organic chemistry. These are appropriate technical electives that can be substituted for List B electives.

ISE and other graduate courses are possible electives for students with a 3.0 major average or greater. **Students must obtain permission from the Undergraduate Director to take a graduate course.** Note: This is a good practice for many students who are interested in pursuing graduate studies.

See the Undergraduate Director if you have any questions about ISE departmental technical electives

NOTE: Course # and title may be changed by other departments without our knowledge! Please inform the Undergraduate Director of any changes you are aware of.

List A - Design Electives
10:762:315 Designing Cities
10:762:316 Physical Design & Site Planning
10:975:316 Urban Design & Site Planning
10:762:472 Transportation Planning
10:762:475 Designing for Sustainability
10:762:492 Design Studio: Plan and Design a Sustainable Small Town
11:550:301 Social and Cultural Aspects of Design
14:440:403 Safety Engineering in Packaging
14:540:485 Industrial Information Systems
14:540:486 Automated Manufacturing Systems
14:540:487 Energy Systems Modeling and Optimization
14:635:405 Solar Cell Design and Processing
14:650:342 Design of Mechanical Components
14:650:388 Computer Aided Design in Mechanical Engineering
14:650:455 Design of Mechanisms
33:799:301 Intro to Supply Chain Mgmt

List B
01:220:322 Econometrics
01:640:250 Introductory Linear Algebra
01:960:384 Intermediate Statistical Analysis
11:375:434 Principles of Industrial Hygiene
14:332:476 Virtual Reality **with** corequisite 14:332:478 Virtual Reality Laboratory
14:440:404 Innovation and Entrepreneurship for Science and Technology
14:540:485 Industrial Information Systems
14:540:486 Automated Manufacturing Systems
14:540:487 Energy Systems Modeling and Optimization
14:540:496 Co-Op Internship in ISE (upon approval of the undergrad director)
14:635:440 Electromechanical Materials and Devices
33:799:300 Global Procurement and Sourcing Strategies*
33:799:301 Intro to Supply Chain Mgmt
33;799:320 Fund of Sc Sol Sap*
33:799:380 Project Management*
33:799:460 Introduction to Six Sigma & Lean Manufacturing*
* Requires a 3.2 GPA or better.

NOTE: For students who are enrolled in the Certificate in Packaging Engineering, two of the four courses may be used for ISE electives. See Undergraduate Director for details.

2. ALL CLASSES - ACCEPTABLE HUMANITIES/SOCIAL SCIENCE ELECTIVES

List of Acceptable Humanities/Social Science Electives

For a list of the Humanities/Social Science Electives, please go the link below:

http://soe.rutgers.edu/sites/default/files/imce/pdfs/humanities_list.pdf

3. ACADEMIC STANDING

For the School of Engineering Academic Standing Policy, please go to the link below:

http://soe.rutgers.edu/oas/scholasticstanding

4. SUMMARY OF ACADEMIC PROGRAMS

4.1. Five Year Dual Degree Program

The School of Engineering in cooperation with the liberal arts colleges at Douglass, Livingston, Rutgers, Camden and Newark offers cooperative five-year programs leading to a BS in Engineering and a BA in liberal arts major. The current Rutgers University Catalog gives the details of the program. To receive both degrees, it is necessary for the student to satisfy the following three requirements: (1) take all the courses required for the ISE degree; (2) take all courses required for the liberal arts major; and (3) make sure the total number of credits is the required number of ISE credits plus 30.

Some courses may satisfy both ISE and liberal arts requirements. For example, an ISE and Economics double major can satisfy engineering and liberal arts requirements with the sequence of courses Engineering Probability and Intermediate Statistics. In fact, it may be possible to fulfill the requirements for both degrees with fewer credits than the total ISE credits plus thirty. If that occurs, the student must take additional courses to satisfy item (3) above.

4.2. James J. Slade Scholar (Honors Program)

In the junior year, students with a GPA of 3.2 or better may apply for admission to this program. The program requires that you write a senior thesis. This program gives a student the opportunity to do independent research while still an undergraduate. Also, this program gives the student recognition (at graduation and with a certificate) for outstanding achievement.

4.3. Five Year BS/MBA Program

A joint program exists between The Rutgers Business School in New Brunswick and the School of Engineering. A student can receive an MBA within 12 months of receiving the BS in engineering. Students should apply early in the junior year. Careful course scheduling is required to fit several business courses in the junior and senior years. To apply, students need a GPA of 3.2 or better and a rank in the top quartile in the GMAT. See ISE Undergraduate Director for details.

4.4. Four Year and One Semester Co-Op Program

The co-op internship provides the student with the opportunity to practice and/or apply knowledge and skills in various industrial and systems engineering environments. This co-op internship is intended to provide a practical engineering experience to the student's undergraduate education by integrating prior course work into a working engineering environment. In addition to receiving compensation for their on-site job experience, students earn credits for the educational benefits of the experience. The 6 co-op credits are in addition to

the 129 credit hours required for graduation. Students may use 3 of the 6 co-op credits as Dept/Tech Elective (List B) under the approval of ISE Undergraduate Director. Students who choose the co-op internship option will complete their undergraduate degree requirements in the 9th semester. See page 12 for more details.

4.5. Study Abroad

There are several universities abroad that are suitable for engineering students. Opportunities exist for students to study at schools in Australia, the United Kingdom, Ireland, Germany, Argentina, Chile, France, China, Spain, Japan, Mexico, Israel, Turkey and South Korea. It is possible to create a program of study such that a student will not lose time in finishing ISE degree requirements. It is not a straightforward transfer of credit though. For information see Dean Prendergast and the ISE Undergraduate Director. More information is available from the Rutgers Study Abroad Office at http://studyabroad.rutgers.edu

4.6 BS in Industrial & Systems Engineering (ISE) / MBA PROGRAM

A Unique Opportunity

The Rutgers BS in Industrial Engineering/ MBA program is a customized study plan that allows you to earn both a bachelor's degree and a Master's of Business Administration degree within five years and one summer. The MBA concentration is in Supply Chain Management, a very exciting and emerging field. Normally, the sequence of degrees requires six years. This dual degree program offers you a unique opportunity to develop your engineering interest, as well as prepare yourself for a career in management or business.

If accepted into the program, during your Senior year, you could take 4 courses towards your MBA degree which will be offered at the Rutgers Business School's New Brunswick's campus. At the end of your Senior year, you must have successfully completed all undergraduate requirements for the Bachelor's Degree. Enrollment in the Graduate business program will begin the summer after graduation. During your fifth year, you will complete your graduate studies and receive your MBA degree.

Source: http://www.ise.rutgers.edu

Next Steps?

Talk with the ISE Undergraduate Director regarding the ISE undergraduate college requirements and major requirements.

- Maintain a 3.2 or better grade point average.
- Take the GMAT during your junior year.
- Apply to the program in the spring semester of your junior year by June 15.

For more information about the Rutgers ISE Department go to:

http://ise.rutgers.edu

Admissions Requirements:

GPA of 3.2 or better.

Enrollment in Graduate business courses after your Senior year requires awarding of your Bachelor's degree from the Rutgers School of Engineering.

For more information about the Rutgers Business School (RBS), go to:

http://business.rutgers.edu

BS/MBA Curriculum
In Supply Chain Management

Freshman Year		(17 cr. Hrs.)			(18 cr. Hrs.)
01:160:159	Gen Chem for Eng.	3	01:160:160	Gen Chem for Eng.	3
01:160:171	Intro to Experiment	1	01:640:152	Calc Math Phy Sci	4
01:355:101	Expository Writing	3	01:750:124	Analytic Physics I	2
01:640:151	Calc Math Phy Sci	4	14:440:127	Intro to Computers	3
01:750:123	Analytic Physics I	2	14:440:221	Engr Mech-Statics	3
14:440:100	Intro to Engr	1	__:___:___	Hum/Soc. Elective	3
__:___:___	Hum/Soc Elective	3			

Sophomore Year		(17 cr. Hrs.)			(16 cr. Hrs.)
01:640:251	Multivar Calc	4	01:220:102	Intro to Micro Econ	3
01:750:227	Analytic Phys IIA	3	01:640:244	Diff Eqns Eng & Ph	4
01:750:229	Anal Phys II Lab	1	14:440:222	Engr Mech-Dyn.	3
33:010:310	Account for Eng	3M	14:540:210	Eng Probability	3M
14:540:201	Work Des & Ergo	3M	01:355:302	Sci & Tech Writing	3
14:540:202	Work Des Lab	1M			
14:540:213	IE Lab	2M			

Junior Year		(17 cr. Hrs.)			(16 cr. Hrs.)
14:549:320	Eng. Statistics	3M	14:540:303	Mfg. Processes	3M
14:180:215	Eng. Graphics	1M	14:540:304	Mfg. Processes Lab	1M
14:332:373	Elements of EE	3M	14:540:311	Deter. Models in OR	3M
14:635:407	Mech. Prop Materials	3M	14:540:343	Eng. Economics	3M
14:540:338	Prob. Models in OR	3M	14:540:384	Simulat. Models IE	3M
14:540:382	Comp. Contr Mfg Sys	3M	14:540:399	Design of Eng Syst I	3M
14:540:383	Comp. Contr Lab	1M			

Senior Year		(16 cr. Hrs.)			(18 cr. Hrs.)
14:540:400	Design of Eng Syst. II	3M	14:540:462	Fac Layout & MH	3M
14:540:433	Quality Eng & Stat	3M	__:___:___	Dpt/Tech Elec (List A)	3M
14:540:434	Quality Eng. Lab	1M	__:___:___	Dpt/Tech Elec (List B)	3M
14:540:453	Prod Plan & Control	3M	__:___:___	Hum/Soc Elective	3
14:332:402	Sustainable Energy.	3M		RBS course	3
__:___:___	Hum/Soc Elective	3		RBS course	3

Senior Summer (12 cr. Hrs.)
RBS courses 12

Fifth Year		(15 cr. Hrs.)			(15 cr. Hrs.)
	RBS courses	15		RBS course	15

M – Course is included in major average.
RBS – Rutgers Business School
Total ISE credit hours: 129.
ISE Major credit hours total 67.

Note: Some courses in the ISE curriculum will count towards the Rutgers MBA.

4.7 Co-Op Internship Option

540:496/497 CO-OP INTERNSHIP IN INDUSTRIAL AND SYSTEMS ENGINEERING (6 CREDITS, PASS/NO CREDIT BASIS ONLY)

All ISE students interested in pursuing the ISE co-op, must schedule a meeting with the ISE Undergraduate Director.

CATALOG DESCRIPTION:

The co-op internship program is designed to provide a practical engineering experience to the student's undergraduate education by integrating prior course work into a working engineering environment. It presents a unique opportunity to the student to practice and/or apply knowledge and skills in various industrial and systems engineering environments. The credits earned are for the educational benefits of the experience. **Students may use 3 of the 6 co-op credits as Dept/Tech Elec (List B) upon approval of the ISE Undergraduate Director.**

Prerequisite: The normal prerequisite is 90 credits completed with a cumulative grade point average of at least 2.5. Students may be approved with slightly fewer credits at the discretion of the Undergraduate Director.

Course Outline: The students must satisfy the following criteria to be eligible for an internship:

The co-op internship must be with the same company for six consecutive months, normally the spring and the summer semester.

Note that the 6 credits shown on page 16 are in addition to the 129 credit hours required for graduation unless the student is approved to use 3 credits as a Dept/Tech elective. Students who choose the co-op internship option will normally complete their undergraduate degree requirements in the 9th semester.

The following are the requirements to satisfy the undergraduate activities for credit:

1. A written proposal must be submitted to the Department by the student. The proposal must be approved by the Undergraduate Director. The written proposal should include the offer letter from the company, educational benefits, engineering related responsibilities at the work site, project tasks, and the plan for evaluation.
2. A suitable level of responsibility must be proposed and carried out under the supervision of a practicing professional and a final report must be presented to the Undergraduate Director.
3. The registration is by special permission only, obtained from the Undergraduate Director.
4. Students hired as technicians within the Department cannot use this to fulfill the Co-op Internship requirement.
5. All internship work done for 3 credits of Technical elective will be documented in a weekly report to the Undergraduate Director in addition to the final report.
6. Students on co-op must be registered for co-op credit during the semesters that they are working.

ISE Curriculum (Co-op Option)

If you plan to pursue a co-op, it is important that you make an appointment with the ISE Undergraduate Director, prior to the start of your co-op to discuss implementation details. All ISE co-ops must be approved by the ISE Undergraduate Director.

Freshman Year		(17 cr. hrs.)			(18 cr. hrs.)
01:160:159	Gen Chem for Eng	3	01:160:160	Gen Chem for Eng	3
01:160:171	Intro to Experiment	1	01:640:152	Calc Math Phy Sci	4
01:355:101	Expository Writing	3	01:750:124	Analytic Physics I	2
01:640:151	Calc Math Phy Sci	4	14:440:127	Intro to Computers	3
01:750:123	Analytic Physics I	2	14:440:221	Engr Mech-Statics	3
14:440:100	Intro to Engr	1	__:___:___	Hum/Soc Elective	3
__:___:___	Hum/Soc Elective	3			

Sophomore Year		(17 cr. hrs.)			(16 cr. hrs.)
01:640:251	Multivar Calc	4	01:220:102	Intro to Micro Econ	3
01:750:227	Analytic Phys IIA	3	01:640:244	Diff Eqns Eng & Ph	4
01:750:229	Anal Phys II Lab	1	14:440:222	Engr Mech-Dyn.	3
33:010:310	Account for Eng.	3M	14:540:210	Eng Probability	3M
14:540:201	Work Des & Ergo	3M	01:355:302	Sci & Tech Writing	3
14:540:202	Work Des Lab	1M			
14:540:213	IE Lab	2M			

Junior Year		(17 cr. hrs.)	
14:540:320	Eng Statistic	3M	
14:180:215	Eng Graphics	1M	
14:332:373	Elements of EE	3M	CO-OP – 6 Credits
14:635:407	Mech Prop Materials	3M	Spring and Summer
14:540:338	Prob Models in OR	3M	
14:540:382	Comp Contr Mfg Sys	3M	
14:540:383	Comp Contr Lab	1M	

Fourth Year		(16 cr. hrs.)			(16 cr. hrs.)
14:540:343	Eng Economics	3M	14:540:303	Mfg Processes	3M
14:540:433	Quality Eng & Stat	3M	14:540:304	Mfg. Processes Lab	1M
14:540:434	Quality Eng Lab	1M	14:540:311	Deter Models in OR	3M
__:___:___	Dpt/Tech Elec (List A)	3M	14:540:384	Simulat Models IE	3M
__:___:___	Dpt/Tech Elec (List B)	3M	14:540:399	Design of Eng Sys I	3M
__:___:___	Hum/Soc Elective	3	14:540:462	Fac Layout & MH	3M

Fifth Year		(12 cr. hrs.)
14:540:400	Design of Eng Syst II	3M
14:540:453	Prod Plan & Control	3M
14:332:402	Sustainable Energy	3M
__:___:___	Hum/Soc Elective	3

M – Course is included in major average.
Total credit hours: 129.
Major credit hours total: 67.

The Dept/Tech electives (List A & List B) are given in Section 1.2 of this handbook.

5. ACADEMIC POLICIES

This handbook has been compiled for undergraduate Industrial and Systems Engineering students. The department wants you to be aware of your degree requirements and of changes in college and university rules. We welcome suggestions for new material for the handbook and clarifications of material already included.

When you declare an engineering major, a check-list of course requirements is put into your folder (now Degree Navigator). As you complete courses, the Dean's staff crosses the courses off the list. The folders are kept in the Dean's Office in the Engineering Building (Room B100). During registration periods the folders are available to the class advisor and students have the opportunity to see their folders.

Each class has a departmental faculty advisor as indicated on the list on page 30 of this handbook. Your advisor will post special office hours during registration periods. At other times during the semester, you may make an appointment with your advisor if the need arises. It is really sensible to make appointments (and appear on time) to save your own time. Faculty members are busy and have irregular schedules so it may be inefficient to just "stop by".

EACH STUDENT **MUST** BE AWARE THAT HE OR SHE IS ULTIMATELY THE PERSON RESPONSIBLE FOR COMPLETING THE BS DEGREE REQUIREMENTS.

Keep track of your own progress through the IE program and speak with your advisor when you run into academic or other problems. During registration, look at the check-list of courses in your folder to make sure your understanding of your status agrees with the view of the School of Engineering. It is especially important for graduating seniors to check their folders with their advisors to ensure that summer courses, transfer credits, and electives have been recorded as expected.

Before meeting with your advisor each student should be well informed. Please be sure to read this handbook and the current New Brunswick Undergraduate Catalog. In particular, students should be familiar with the sections regarding ISE degree requirements, ISE courses, Academic Policies and Procedures, and University Policies and Procedures.

5.1. Major Average

The courses that are included in the major average are marked "M" on the ISE curriculum. To graduate, your major average must be 2.0 or greater. If you fail a course and then repeat it, both grades are computed into your major average.

Every semester, compute your major average. Keep track of it carefully.

When you register, be sure to put an "M" next to your Dept/Tech elective on the registration card. The computer system cannot keep track of all the possible Dept/Tech electives.

5.2. Courses Included In Major Average

Please refer to this link: http://soe.rutgers.edu/oas/gpa-calculation

5.3. Withdrawal From Courses

It happens, unfortunately, that students encounter major problems during their college years. Don't wait to be dismissed from the School of Engineering to seek help. Take responsibility for your situation. If you know you are unable to do the required work, you must do what is necessary to let the college know of your difficulty. Further, there are many resources at

Rutgers that can help you with your situation - from substance abuse to the death of a parent or friend.

Here are the rules: If you fail a course, it is computed into your university and major averages. If you drop a course, it is **not** computed into these averages.

Please refer to this link: http://soe.rutgers.edu/oas/add_drop

5.4. Course Substitution

As a matter of policy, there are no course substitutions for ISE courses. If there is an excellent reason, with the permission of the Undergraduate Director, students may substitute courses from other schools for electives or for required courses not given in the ISE department.

5.5. Academic Dishonesty

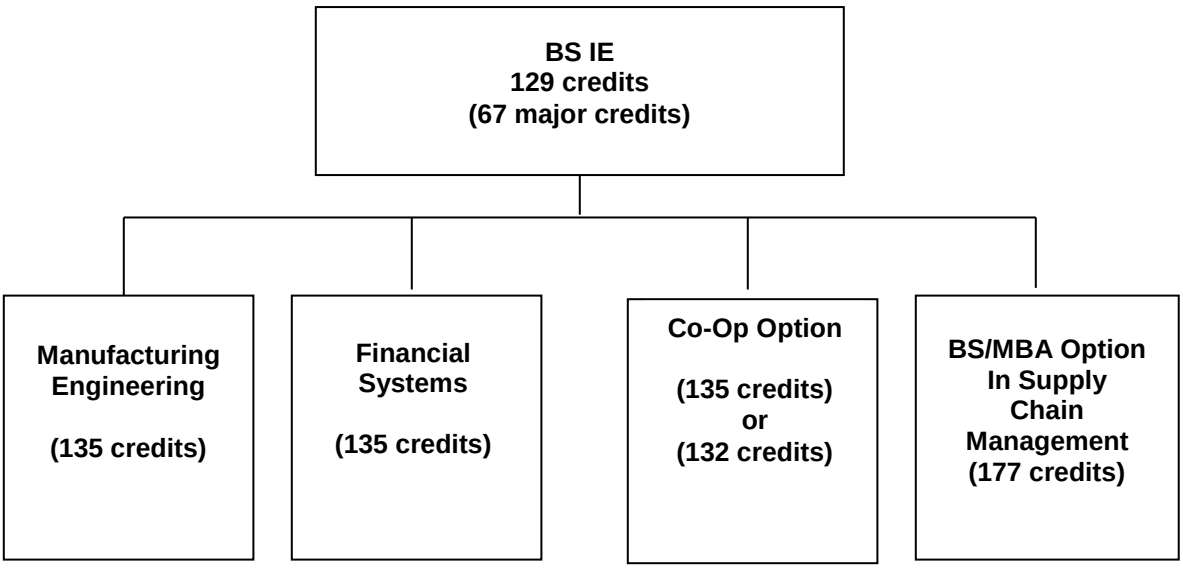
The Industrial and Systems Engineering Department expects each student to conduct him or herself in a professional manner. The policy of the ISE Department is as follows: we do not hesitate to report offenses of cheating to the college or the university. An engineer starting out a career cannot afford to have this kind of report on his or her record. A student who gives information is considered guilty as well as a student who receives information.

The University Policy on Academic Dishonesty is carefully spelled out in your catalog. Note that copying from or giving others assistance or using forbidden material on an hourly or final examination is a level three violation. The recommended sanction is suspension from the university for one or more terms with a notation of academic disciplinary suspension placed on the student's transcript.

6. UNDERGRADUATE TRACKS

The IE program provides tracks that enable students to choose a specialization area in order to emphasize specific areas of interest. The IE curriculum offers four tracks as shown and explained below:

Class of 2019/2020/2021/2022



IE Undergraduate Tracks

Financial Systems Track

Requires a total of 9 credit hours. (3 credit hours used as part of List B Dpt/Tech Elec)

Required:
33:390:300 Introduction to Financial Management (Fall, Spring, Summer)

Select two:
16:540:530 Forecasting and Time Series Analysis (Fall)
16:540:575 Advanced Engineering Economics I (Fall or Spring)
33:390:380 Investment Analysis (Spring, Summer)
33:390:400 Corporate Finance (Spring, Summer)

Note: Course substitutions are accepted with permission of the Undergraduate Director.
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IMPORTANT:

In order to complete the ISE Financial Systems Track, you must complete certain prerequisites and follow prescribed administrative processes.

NOTES:

33:390:300 Introduction to Financial Management (Fall, Spring, Summer)

The *prerequisites* for this course are calculus, economics (either 01:220:102 Intro to Micro Economics or 14:540:343 Engineering Economics), 33:010:310 Accounting for Engineers, statistics, and computer programming. The statistics prerequisite will be met when you successfully complete 14:540:210 Engineering Probability or 14:540:320 Engineering Statistics.

Note that with the ISE Financial Systems Track, you must take 33:010:310 Accounting for engineers some time before the Fall semester of your senior year. If you are following the prescribed ISE undergraduate curriculum and have completed 33:010:310 Accounting for Engineers in the Fall semester of your sophomore, then you may register for 33:390:300 Introduction to Financial Management in the Fall semester of your senior year (or Summer after your junior year).

33:390:300 Introduction to Financial Management is a prerequisite for both:

33:390:380 Investment Analysis (Spring, Summer)
33:390:400 Corporate Finance (Spring, Summer)

After completing 33:390:300 Introduction to Financial Management in the Fall semester of your senior year (or Summer after your junior year), you are then able to register for 33:390:380 Investment Analysis and 33:390:400 Corporate Finance in the Spring semester of your senior year.

Special Permission Numbers for the ISE Financial Systems Track:

The *process* for obtaining a special permission # for the Rutgers Business School courses is that the ISE Undergraduate Director will verify that the ISE students have met the prerequisites for 33:390:300 (and 33:390:380 and 33:390:400 as well) and then send a confirmation e-mail to the Undergraduate Program Coordinator at the Rutgers Business School. The ISE students will then be advised to contact the Rutgers Business School Undergraduate Program Coordinator directly for the special permission #.

Manufacturing Engineering Track

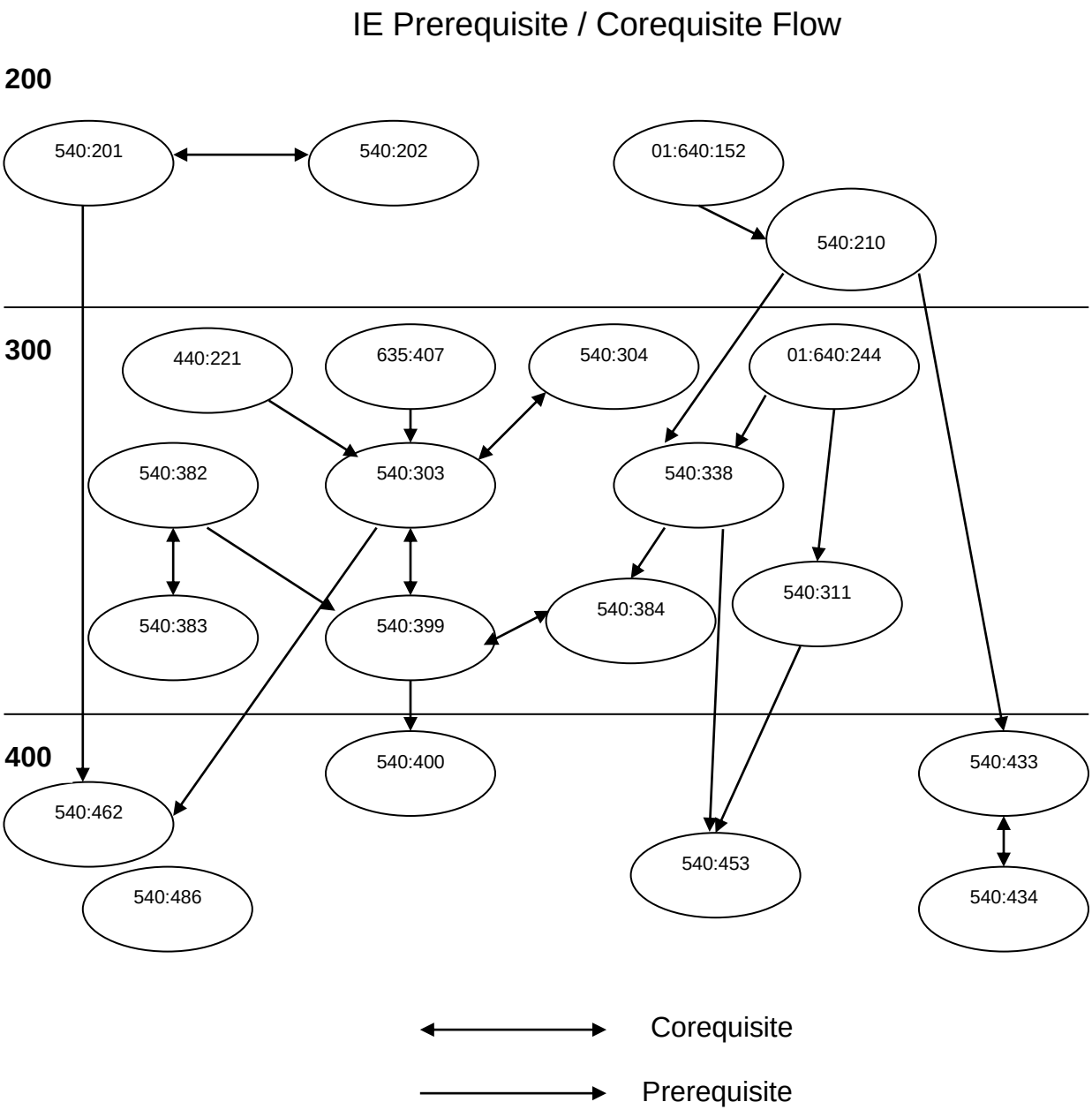
Requires a total of 9 credit hours. (3 credit hours used as part of List B Dpt/Tech Elec)

14:540:486 Automated Manufacturing Systems

Select two:
14:540:485 Industrial Information Systems
14:150:330 Introduction to Nanomaterials Science and Engineering (*open to school 14*)
16:540:520 Supply Chain and Logistics Engineering (Requires 3.0 GPA)

Note: Course substitutions are accepted with permission of the Undergraduate Director.

7. ISE PREREQUISITE/COREQUISITE



8. UNDERGRADUATE COURSE DESCRIPTIONS

Note: M denotes course is included in major average

14:540:201 Work Design and Ergonomics (3M)
Corequisite: 14:540:202, Prerequisite: 01:640:151 or 21:640:135 or 50:640:121 or 01:640:191
Man-machine analysis, motion economy, time study, predetermined time systems, work sampling; introduction to robotics, facilities layout, material handling; introduction to ergonomics and anthropometric, biomechanical, and human-machine interface models.

14:540:202 Work Design and Ergonomics Laboratory (1M)
Corequisite: 14:540:201, Prerequisite: 01:640:151 or 21:640:135 or 50:640:121 or 01:640:191
Experiments in robotics, time study, work measurement, workplace design and the human-machine interface, facilities layout.

14:540:210 Engineering Probability (3M)
School 14 Only. Prerequisite: 01:640:144 or 01:640:151, 152, 154 or 191, 192 or 21:640:135, 136 or 50:640:121, 122
Probability problems in engineering, conditional probability, discrete and continuous distributions, functions of random variables, interval estimates.

14:540:213 Industrial Engineering Laboratory (2M)
Prerequisite: 01:640:151 or 21:640:135 or 50:640:121 or 01:640:191
Introduction to programming, fundamental data types, flow control, and function; arrays, pointers, and do loops; algorithms and flow charts; GUI concepts.

14:540:303 Manufacturing Processes (3M)
Corequisite: 14:540:304, Prerequisite: 14:440:221, 14:635:407
Properties of engineering materials; metals, polymers, ceramics and composites, bulk and sheet forming, traditional and non-traditional material removal processes, polymer processing, laser and energy-beam processes, additive layered manufacturing processes and micro/nano fabrication processes. Basic and computerized machine tools. Process chains, planning and process optimization. Engineering metrology and product quality.

14:540:304 Manufacturing Process Laboratory (1M)
Corequisite: 14:540:303
Experiments on machine tools: lathes, drilling machines, milling machines, and CNC milling machines; robot workplace design and computer control of machine tools.

14:540:305,306 Honor Candidacy Problems
Prerequisite: Permission of departmental chairperson. Prerequisite for industrial engineering students who wish to be James J. Slade Scholars.
Extensive reading and study in a particular problem area of industrial engineering under the guidance of a faculty member.

14:540:311 Deterministic Models in Operations Research (3M)
Prerequisite: 01:640:244 or 21:640:314 or 50:640:314
Elements of modeling and problem solving. Use of a software package like LINDO, EXCEL to solve real life industrial engineering problems. Linear programming, duality, sensitivity analysis, integer programming, transportation and assignment problems.

14:540:320 Engineering Statistics (3M)
Prerequisite: One year of integral and differential calculus.
Statistical estimation; confidence interval; testing hypothesis; engineering applications throughout the course.

14:540:338 Probability Models in Operations Research (3M)
Prerequisite: 14:540:210, 01:640:244 or 21:640:314 or 50:640:314
Modeling and decision making under uncertainty. Markov chains, poisson processes, inventory models and queueing systems.

14:540:343 Engineering Economics (3M)
Open only to junior and senior engineering students, majors 180 Civil, 540 IE and 650 Mechanical.
Economic decisions involving engineering alternatives, annual cost, present worth, rate of return, and benefit-to-cost; before and after tax replacement economy; organizational financing; break-even charts; unit and minimum-cost public sector studies.

14:540:382 Computer Control of Manufacturing Systems (3M)
Corequisite: 14:540:383
Programmable automation applied to manufacturing. Computer architecture, sensors and automatic data acquisition, computer control of actuators, continuous and discrete control of processes, computer integration, and local area networks.

14:540:383 Computer Control of Manufacturing Systems Laboratory (1M)
Corequisite: 14:540:382
Use of microcomputers and industrial controllers in controlling machines and processes. Assembly language programming, ladder logic programming, and interfacing controllers to sensors and actuators. Experiments in manufacturing applications.

14:540:384 Simulation Models in Industrial Engineering (3M)
Prerequisite: 14:540:210, 14:540:338
Modeling and analysis of industrial and service systems using ARENA, simulation modeling prospectives, discrete event and continuous simulation, simulation languages, statistical aspects of simulation.

14:540:399 Design of Engineering Systems I (3M)
Prerequisites or Corequisites: 14:540:303, 14:540:304, 14:540:382, 14:540:384
Design principles, material selection, design for assembly, design for manufacturing, and effect of environmental issues on product design.

14:540:400 Design of Engineering Systems II (3M)
Prerequisite: 14:540:399, 14:540:384
OPEN TO 540 STUDENTS ONLY
A team approach to the redesign of a “real-life” product. Alternative engineering plans for improved designs will be developed and implemented. Both written and oral reports will be completed.

14:540:433 Quality Engineering (3M)
Prerequisite or Corequisites: 14:540:210, 540:434
Statistical methods for monitoring and improving product quality and decreasing variation. Factorial experiments, variables and attribute control charts, acceptance sampling, on- and off-line process controls.

14:540:434 Quality Engineering Laboratory (1M)
Corequisite: 14:540:433
Practical application of quality engineering methodologies, statistical software, gage studies, online process control, design of experiments to improve product design, industrial manufacturing processes, and system design.

14:540:453 Production Planning and Control (3M)
Prerequisite: 14:540:311, 338.
Coordination of activities of both manufacturing and service systems. Systems design; input and output; planning and scheduling. Decision-making problems employing mathematical techniques of linear programming. Sequencing jobs on machines and line balancing techniques.

14:540:462 Facilities Layout and Materials Handling (3M)
Prerequisites: 14:540:201, 303
Fundamentals of the design, layout, and location of industrial and nonmanufacturing facilities. Selection of machines and material handling equipment and their efficient arrangement. Emphasis on quantitative methods. Warehouse layout. Facility location theory.

14:540:486 Automated Manufacturing Systems (3M)
Introduction to computer-aided design and computer-aided manufacturing (CAD/CAM), numerical control, hardware and programming, mechatronics systems, robotics hardware and programming, and machine vision with applications in manufacturing.

14:540:487 Energy Systems Modeling and Optimization (3M)
Prerequisite: 14:540:311 Deterministic Models in OR, 14:332:402 Sustainable Energy: Choosing among Options
This course addresses the design, analysis, modeling and optimization of selected energy systems (including conventional fossil fuels and renewable wind and solar). This course will provide the basis for applying mathematical modeling and optimization techniques in energy systems. A set of projects and case studies focused on modeling and optimization of a variety of energy systems will be assigned to students and discussed in details. The course will have hands on experience with data collection, experimentation, simulation and optimization tools as they apply to energy systems.

14:540:488 Design of Decision Support Systems (3M)
Prerequisite: 14:540:485
Designing, building and testing computer systems that emulate human thinking and can draw conclusions based on incomplete and fuzzy data. Design and implementation of user interfaces. Students are required to design and build a decision support system. Students will use various test tools to validate their systems.

14:540:491, 492 Special Problems
Studies in phases of industrial engineering of special interest.

14:540:496, 497 Co-op Internship in Industrial Engineering (3,3)
Prerequisite: Permission of department, Graded Pass/No credit.
Intended to provide a capstone experience to the student's undergraduate studies by integrating prior course work into a working industrial engineering professional environment. Credits earned for the educational benefits of the experience and granted only for a continuous, six-month, full-time assignment.

9. STUDENT SOCIETIES

ALPHA PI MU

Alpha Pi Mu is the Industrial Engineering Honor Society. Both academic excellence and leadership in service activities is emphasized for membership. Scholarship opportunities are also available. Faculty Advisor: Dr. Hoang Pham

INSTITUTE OF INDUSTRIAL AND SYSTEMS ENGINEERS (IISE)

The student chapter of IISE at Rutgers University is committed to the promotion of the industrial engineering profession. Professional activities include plant tours, industry speakers, alumni night, technical paper contests, and an engineering outreach program. Social activities typically include picnics, Freshman night, and a holiday mixer. By joining this society, each student receives a complimentary copy of ISE magazine with dues payment. Faculty Advisor: Dr. Wicks

SOCIETY OF MANUFACTURING ENGINEERS (SME)

The student chapter of SME at Rutgers University is committed to the promotion of manufacturing engineering. There are plant tours, industry speakers, professional development conferences, certification and scholarship opportunities. Social activities include joint picnics with IIE student chapter and meetings. Upon joining this society, each student receives a free subscription to Manufacturing Engineering with dues payment. Faculty Advisor: Dr. Ozel

TAU BETA PI

Tau Beta Pi is the National Engineering Honor Society. Academic excellence and service to the University community are stressed. Membership is open to juniors and seniors who rank near the very top in their respective classes. Faculty Advisor: Dr. Elsayed

10. ISE FACULTY

Susan Albin is Professor in Industrial and Systems Engineering. Her areas of research are data science, quality engineering, process monitoring land stochastic modeling. Her work has been applied in areas including medical device manufacturing, semiconductor manufacturing, food processing, advanced display technology, and plastics recycling. Prof. Albin's research has been supported by NSF, FAA, DOD, the Council for Solid Waste Solutions, and industrial partners. Prof. Albin received her D. Eng.Sc in Operations Research from Columbia University and her MS and BS in Industrial Engineering from NYU. Prof. Albin was the 2010 President of INFORMS, the Institute for Operations Research and the Management Sciences, the largest professional society in the world for educators, investigators, scientists, students, managers, and consultants in the field of Operations Research. She has served as INFORMS Secretary and as a Member of the Board of Directors and was the founding chair of the INFORMS Section on Quality, Statistics and Reliability advisory board. Prof. Albin served as the Editor-in-Chief of *IIE Transactions,* the flagship journal of the Industrial Engineering profession and also as the Focus Issue Editor for Quality and Reliability Engineering. She served as Director of the Rutgers Graduate Program in Industrial and Systems Engineering for 14 years and, as a visiting professor at Peninsula Technikon in South Africa, helped establish their program in Quality Engineering. Prof. Albin is dedicated to active learning in the classroom and served as co-chair of the Rutgers University Strategic Planning Committee for Instructional Technology. Prof. Albin has been a keynote speaker at conferences in China and Brazil. She is the recipient of the Rutgers Engineering Governing Council Excellence in Teaching Award and the Exxon Education Foundation Award. She is a Fellow of IIE, the Institute of Industrial Engineers, and a recipient of the INFORMS George Kimball Medal.

Melike Baykal-Gursoy is an Associate Professor and the Director of the Laboratory for Stochastic Systems, in the department of Industrial and Systems Engineering at Rutgers University. She received her BS and MS in Electrical Engineering with a major in Control from Bogazici University, Istanbul, Turkey. She received her PhD in Systems Engineering from the University of Pennsylvania, Philadelphia. Her specific fields of interest include stochastic modeling, queueing, Markov decision processes, stochastic games, and their applications to transportation and supply chain systems. Dr. Baykal-Gursoy's research activities are in the areas of modeling, optimization and control of stochastic systems, such as transportation, telecommunication and supply chain networks. As the Director of GRIST Lab (Game Research for Infrastructure SecuriTy) she is currently focusing on using games and game theory to address physical and cyber security problems. Dr. Baykal-Gursoy teaches courses in optimization, stochastic processes, queueing theory, inventory control, supply chains and logistics, process modeling and control, and time series analysis. Her research and teaching have been supported through grants from NSF, United Nations, DOD, Rutgers Transportation Coordinating Council/Federal Transit Administration, Rutgers University Center for Disaster Preparedness and Emergency Response, and Rutgers Academic Excellence Fund. She is a member of INFORMS, and is listed in Who's Who in America. Dr. Baykal-Gursoy has received the 2008-2009 Rutgers Engineering Governing Council Excellence in Teaching Award in I&SE. She has co-authored a recent book *An Introduction to Probability and Statistics (Kendall/Hunt, 2015)*.

David W. Coit is a Professor, he received his BS in Mechanical Engineering from Cornell University, an MBA from Rensselaer Polytechnic Institute, and MS and PhD degrees in Industrial Engineering from the University of Pittsburgh. His research interests are in the areas of reliability, optimization and energy systems modeling. In 1999, he was awarded a CAREER grant from the NSF to develop reliability optimization strategies that consider reliability estimation uncertainty. Previously, he worked for twelve years at IIT Research Institute (IITRI), Rome, NY, where he was a reliability engineer and project manager, and then later, the Manager of Engineering at IITRI's Assurance Technology Center. He is a member of IIE, INFORMS.

E. A. Elsayed is Distinguished Professor of the Department of Industrial and Systems Engineering, Rutgers University. He served as Chairman of the Industrial and Systems Engineering, Rutgers University, from 1983 to 2001. He is also the Director of the NSF/ Industry/ University Co-operative Research Center for Quality and Reliability Engineering. His research interests are in the areas of quality and reliability engineering and Production Planning and Control. He is a co-author of *Quality Engineering in Production Systems*, McGraw Hill Book Company, 1989. He is also the author of *Reliability Engineering*, Addison-Wesley, 1996. These two books received the 1990 and 1997 IIE Joint Publishers Book-of-the-Year Award respectively. His recent book *Reliability Engineering 2nd Edition*, Wiley, 2012 received the *2013 Outstanding IIE Publication*.

Dr. Elsayed is also a co-author of Analysis and Control of Production Systems, Prentice-Hall, 2nd Edition, 1994. His research has been funded by the DoD, FAA, NSF, Defense Logistics Agency and many industrial companies including Lockheed Martin and Cummins Filtration. Dr. Elsayed has been a consultant for AT&T Bell Laboratories, Ingersoll-Rand, Johnson & Johnson, Personal Products, AT&T Communications, BellCore and other companies. He served as a Member of the Panel on Theory and Applications of Reliability Growth Modeling to Defense Systems, National Research Council of National Academic. He also served as the Editor-in-Chief of the *IIE Transactions* and the Editor of the *IIE Transactions on Quality and Reliability Engineering*. Dr. Elsayed is the Editor of the *International Journal of Reliability, Quality and Safety Engineering*. He serves on the editorial boards of eight journals in different capacities. He served an external evaluator for many undergraduate and graduate programs.

Dr. Elsayed is a frequent keynote speaker in National and International Conferences and is the recipient of many awards including the *Rutgers University Board of Trustees Award for Excellence in Research* for the academic year 2015-2016, *Golomski Award* for the outstanding paper, several Best Paper awards, *William Mong Distinguished Lecturers Award, David F. Baker Research Award* of the Institute of Industrial and Systems Engineering for Research Contributions to the discipline, *IISE* (Institute of Industrial and Systems Engineering) Fellow Award, ASME (American Society of Mechanical Engineers) Fellow, Senior Fulbright Award and the Recipient of 2011 Thomas Alva Edison Award for US Patent 7,115,089 B2. Most recently, Dr. Elsayed was awarded the Doctor Honoris Causes from University of Agers, France in January 2018 for his achievements in the reliability engineering field.

Weihong "Grace" Guo is an Assistant Professor in the Department of Industrial and Systems Engineering. She earned her B.S. degree in Industrial Engineering from Tsinghua University, China, in 2010 and her Ph.D. in Industrial & Operations Engineering from the University of Michigan, Ann Arbor, in 2015. At Rutgers ISE, Dr. Guo is the founding co-director of the Data Analytics & Process Insights Laboratory. Her research interests are in the areas of statistical quality control and process monitoring, data mining for manufacturing and healthcare systems modeling and improvement, and quality-oriented design and modeling of complex manufacturing systems. Her current research focuses on data fusion methods in the interface between applied statistics and system control/optimization. Her research has been funded by DOT, NJOHSP, and industry. Dr. Guo received the Outstanding Young Manufacturing Engineer Award from the Society of Manufacturing Engineers. She received the 1st place Best Paper Award at the 2018 ASME Manufacturing Science and Engineering Conference (MSEC), a 2nd place Best Paper Award at MSEC 2016, the Best Paper Award at the 11th International Conference on Frontiers of Design and Manufacturing, and the Wilson Prize for the Best Student Paper in Manufacturing from the University of Michigan. She was a finalist in IISE and INFORMS Best Paper Competitions. Her teaching interests include quality engineering, data analytics, and manufacturing systems. She is a member of IISE, INFORMS, and ASME.

Mohsen A. Jafari is a professor of Industrial & Systems Engineering at Rutgers University. He has directed or co-directed a total of over $15.5M funding from various government agencies and industry, in areas of automation, system optimization, data modeling, information systems, and risk analysis. His research application areas include energy systems, manufacturing, transportation, and healthcare. His work has led to major technological advances and product development including, multi-material deposition in solid free form fabrication; decision support system for traffic safety (Plan4Safety); integrated closed loop approach to planning, operation and investment of energy systems; cyber risk assessment of power networks; building energy asset management (BEAM); and Berth Planning. He actively collaborates with universities and research institutes in the US and

abroad. He has advised thirteen Ph.D. theses and nine post doctoral & research fellows. Presently, he is advising additional ten Ph.D. theses focusing on energy systems, zero-net communities, risk analysis and process improvement in healthcare. He is a member of IEEE and was recipient of the IEEE excellence award in service and research. He has been consultant to several fortune 500 companies, and national and international government agencies.

Dr. Myong K. (MK) Jeong is a Professor and Graduate Director in the Department of Industrial and Systems Engineering, RUTCOR (Rutgers Center for Operations Research), and DIMACS (Center for Discrete Mathematics and Theoretical Computer Science) at Rutgers University. Currently, he is the Director of Laboratory for Data Analytics and Process Insights. He received his BS in Industrial Engineering from Han Yang University, Seoul, Korea, in 1991, MS in Industrial Engineering from Korea Advanced Institute of Science and Technology, Taejon, Korea, in 1993, MS in Statistics from Georgia Institute of Technology, Atlanta, Georgia, in 2002, and Ph.D. in Industrial and Systems Engineering from Georgia Institute of Technology, Atlanta, Georgia, in 2004. He was formerly an Assistant Professor in the Department of Industrial and Information Engineering, the University of Tennessee, Knoxville. He worked as a senior researcher from 1993 to 1999 at the Electronics and Telecommunications Research Institute (ETRI).

He has focused on developing data mining and machine learning techniques for process monitoring and improvement. The applications include various industries such as gas/oil, semiconductor, transportation, bio-energy, computing, electronics, and automobile. He has published over 100 journal papers including *Technometrics, IEEE Transaction on Semiconductor Manufacturing, IEEE Transactions on Systems, Man, Cybernetics, Pattern Recognition Letters*, and *IIE Transaction on Quality and Reliability*. He received the Freund International Scholarship and the National Science Foundation (NSF) CAREER Award in 2002 and in 2007, respectively. His research has been supported by the National Science Foundation, National Transportation Research Center, United States Department of Agriculture, Qatar National Research Fund, Electronics and Telecommunications Research Institute, and various industries. He has been a consultant for Samsung Electronics, Intel, IBM Watson Research Lab., ETRI, KISTI, and other companies. He served as the President of Data Mining Society of INFORMS (Institute for Operations Research and Management Science). He served as an Associate Editor and Advisory Board Member of various journals including IEEE Transactions on Automation Science and Engineering, International Journal of Quality, Statistics and Reliability, and International Journal of Advanced Manufacturing Technology. He is a senior member of IEEE.

Eric Rosenberg is a Visiting Professor in the Industrial and Systems Engineering Department. His areas of interest include network design and analysis, the theory and application of fractals, routing in networks, telecommunications networks, nonlinear and convex optimization, capacity planning, and facility location. Dr. Rosenberg received a B.A. in Mathematics from Oberlin College and a Ph.D. in Operations Research from Stanford University. He has worked at Bell Labs, where he received the Distinguished Technical Staff Award for Sustained Achievement, and at AT&T Labs, where he received the AT&T Labs President's Excellence Award. Dr. Rosenberg is the author or co-author of 17 patents and many published papers. He is the author of the book A Primer of Multicast Routing and the book A Survey of Fractal Dimensions of Networks. Dr. Rosenberg is a member of INFORMS, and serves on the editorial board of the journal Recent Patents in Engineering. He has taught full-time at Princeton University, and has taught as an adjunct at Brookdale Community College and at New Jersey Institute of Technology. Dr. Rosenberg has mentored several summer interns at Bell Labs and AT&T Labs, and many undergraduate and graduate students as part of the MentorNet program.

Dr. Tuğrul Özel is an Associate Professor and Director of Manufacturing & Automation Research Laboratory in the Department of Industrial and Systems Engineering at Rutgers. He received his Ph.D. degree from Ohio State University in 1998. He previously worked at NSF funded Engineering Research Center for Net Shape Manufacturing at Ohio State and was a summer faculty fellow at NASA Glenn Research Center. His research interest includes advanced manufacturing including laser processing and additive manufacturing, modeling and optimization of manufacturing processes, physics-based process simulations, mechatronics, automation and control, micro/nano manufacturing systems. His research has been well funded by National Science Foundation, US

Department of Commerce - NIST, NASA/New Jersey Space Grant Consortium, Rutgers Research Council and automotive, aerospace, machine tool, and medical device industry. He is the Editor-in-Chief of the *International Journal of Mechatronics and Manufacturing Systems* and has been serving as associate editor, guest editor or editorial board member for several international journals including *International Journal of Machine Tools and Manufacture, Production Engineering Research and Development, International Journal of Manufacturing Engineering, International Journal of Manufacturing Research*. He is the co-author of four edited books "Intelligent Machining", (ISTE-Wiley, 2009), "Micro-Manufacturing: Design and Manufacturing of Micro-Products", (Wiley, 2010); "Modern Manufacturing Processes", (Wiley forthcoming in 2017); and "Biomedical Devices: Design, Prototyping, and Manufacturing", (Wiley, forthcoming in 2017). He has published over 65 peer-reviewed articles in engineering journals such as *ASME Journal of Manufacturing Science and Engineering*, *International Journal of Machine Tools and Manufacture, Journal of Materials Processing Technology*, *Materials and Manufacturing Processes*, and *International Journal of Advanced Manufacturing Technology* and authored over 60 peer-reviewed conference publications. He has been member of scientific or program committee over 30 international conferences. Dr. Özel has advised numerous undergraduate students, 6 Ph.D. and 14 Masters' graduates and supervised 10 visiting students, 1 post-doctoral trainee, and hosted 4 visiting professors. He is member of SME, ASME, North American Manufacturing Research Institute and CIRP- International Academy for Production Engineering. He is listed in The Marquis Who's Who in the World, Who's Who in America, and Who's Who in Science and Engineering.

Hoang Pham is Distinguished Professor in the Department of Industrial and Systems Engineering at Rutgers University. Before joining Rutgers, he was a Senior Engineering Specialist with the Idaho National Engineering Laboratory and Boeing Company. He received his Ph.D. from the State University of New York at Buffalo. His research areas include reliability modeling of systems with competing risks and random environments, software reliability, and statistical inference. He is the editor-in-chief of the International Journal of Reliability, Quality and Safety Engineering and an associate editor and editorial board member of several journals, and the editor of Springer Series in Reliability Engineering. His several awards include the 2009 IEEE Reliability Society *Engineer of the Year Award.* Dr. Pham is the author/coauthor of 6 books, edited 12 books and has published over 170 journal articles. He is a Fellow of IEEE and IISE.

Elin M. Wicks is an Assistant Professor in the Department of Industrial and Systems Engineering. She earned a B.S. and M.S. in Industrial Engineering from Rutgers University where her masters research focused on a method for quantifying non-economic factors in monetary terms. She went on to earn her Ph.D. in Industrial and Systems Engineering from Virginia Tech focusing on the design of cellular manufacturing systems. She then joined the faculty of the University of Missouri, Columbia in the Industrial and Manufacturing Systems Department. After taking some time off to raise her children, she supplemented her education in the field of accounting and became the Senior Accountant of Glenn B. Cohen, CPA - an accounting and financial management firm. She is an author of the well-known textbook, *Engineering Economy*, currently in its 17th Edition. She has been a contributing co-author of this text since the publication of the 10th edition.

Zhimin Xi is an Assistant Professor in the Department of Industrial and Systems Engineering at the Rutgers University – New Brunswick. He received his B.S. and M.S. degree in Mechanical Engineering at the University of Science and Technology Beijing in 2001 and 2004, respectively. He obtained his Ph.D. in Reliability Engineering at the University of Maryland – College Park in 2010. His research interests include reliability and safety for energy storage systems, design for reliable energy systems, prognostics and health management for engineering systems, model validation under uncertainty, and system reliability analysis. He has published more than 60 papers in prestigious journals and peer-reviewed conference proceedings. He is the recipient of 2016 DARPA (Defense Advanced Research Projects Agency) - Young Faculty Award. He is the winners of multiple (including twice Top 10) Best Paper Awards from ASME – Design Automation Conference in 2008, 2011, 2013, and 2015 respectively. He received research funding support from National Science Foundation, DARPA, Department of Energy, Ford Motor Company, Denso North American Foundation, and The Woodbridge Group.

Ezzat, Ahmed Aziz is an Assistant Professor in the Department of Industrial and Systems Engineering. He received his Ph.D. in Industrial and Systems Engineering from Texas A&M University in 2019, and his M.Sc. and B.Sc. degrees in Industrial and Management Engineering from

the Arab Academy for Science, Technology, and Maritime Transport in Alexandria, Egypt, in 2016 and 2013, respectively. His broad research interests are in the areas of engineering data analytics, statistical and machine learning and stochastic modeling, with particular focus on renewable energy analytics, advanced manufacturing and materials. Dr. Ezzat's work has been published in journals such as The Annals of Applied Statistics, Technometrics, IEEE Transactions on Sustainable Energy, among others. His awards include the 2019 ISEN Outstanding Graduate Student at Texas A&M, INFORMS Outstanding Member of the Year at Texas A&M in 2018, First Place at the QSR Student Poster and Interaction Competition at the 2017 INFORMS Annual Meeting, Best Oral Presentation at the 2016 Texas A&M Conference on Energy, and the IISE Sierleja Memorial Fellowship in 2014. He has been nominated as a finalist for the Texas A&M 3 Minute Thesis (3MT) Competition in 2018 for his presentation titled: Wind Energy, A New Solution to a 5000 Year Old Problem. His teaching interests include quality engineering, applied statistics and experimental design, industrial data analytics, and energy analytics. He is a member of IISE and INFORMS.

11. FACULTY ADVISORS

CLASS	ADVISOR	E-MAIL ADDRESS
2023	Dr. E. Elsayed	elsayed@soe.rutgers.edu
2022	Dr. E. Wicks	elm52@soe.rutgers.edu
2021	Dr. W. Guo	wg152@soe.rutgers.edu
2020	Dr. E. Elsayed	elsayed@soe.rutgers.edu

12. DEPARTMENTAL FACILITIES

Automation Laboratory. The laboratory is equipped with two CNC milling machines, a CNC lathe, an automated storage and retrieval system, testing equipment and devices that support undergraduate courses (e.g., Manufacturing Processes and Design I and II). There are also two ROS stations for robot to robot communication and control applications. This lab is also home to a number of machines and systems that were developed in the prior student design projects (including two autonomous tennis ball collectors, a soccer ball collector). This equipment is used for departmental tours and for lecturing Design I classes. The laboratory has a prototype sheet-folding machine capable of folding creative patterns for different applications.

Manufacturing Processes Laboratory. Basic machine tools such as turning, milling, drilling, grinding, and measuring machines are available to help the student become familiar with metal-processing operations. In AY 2016-2017 the Department of Industrial and Systems Engineering acquired two CNC machines: conversational milling and turning machines. It also acquired an array of 3-D printing machines that are frequently used in undergraduate courses and design projects. The equipment is also used to perform laboratory experiments in heat treatment, chip formation, tool life, cutting forces, temperature, chip metallurgy, and power consumption.

Advanced Simulation Laboratory. This laboratory is intended to serve student term projects in the areas of simulation, design, statistical modeling and machine learning. With access to large screens, fast computers and different media tools the students are able to analyze and simulate large volume of data and build models using R, Phyton, MATLAB, ARENA, LINDO, and other commercial tools. The lab also includes 3D modeling tools such as Solid-Works and FactoryTalk for student projects. There is also an PLC server that can be connected to remote devices and robots for real time motion and supervisory controls, and for cyber-physical systems controls. This PLC is usually used in two or three student design projects every year.

Quality and Reliability Engineering Laboratory. This laboratory allows students to have hands-on experience in actual methods of quality control and reliability engineering. Software for control charts (the ISE Department acquired licenses for statistical software such as JMP sampling plans, and design of experiments is available. The laboratory has a wide array of materials testing equipment, roundness measurement equipment, temperature chambers, vibration tests, and power programmable controller equipment.

Computer Control and Mechatronics Laboratory. This laboratory provides students with hands on experience in motion and supervisory controls. With WiFi connection to the ISE remote PLC and host of PLCs and instructional kits (with motors, sensors, I/O boards) in the lab where students are able to work on hands -on projects that involve control of devices, motors, actuators, and higher level supervisory controls. This lab is used primarily for the Computer Control course and its lab. The lab also includes a small scale physical simulation of IOT sensors and devices for student projects.

Design Laboratory. The ISE Department has shared space for ISE and MAE design projects. The shared space is intended to promote interdisciplinary design activities and will include primary tools that can be used for system assembly and testing, with remote access to other department resources. This lab is located in Richard Weeks Hall building (second floor).

13. GENERAL INFORMATION

IMPORTANT OFFICES:

School of Engineering

Peng Song is Associate Dean for Undergraduate Education, Room B-100, Engineering Building, 445-2212

Ilene Rosen is Associate Dean for Student Services, Room B-110, Engineering Building, 445-2687

Lydia Prendergast is Assistant Dean for Academic Services, Room B-100, Engineering Building, 445-2212

Cecilia Vargas is Assistant Dean for First Year Students

Robert Ciervo: Assistant Dean for Transfer Students

Undergraduate Registrar - Room 200F, Administrative Service Building, Davidson Road, Busch Campus, 445-3557

Career Services - 56 College Avenue, College Avenue Campus, 932-7997

Financial Aid Room - 140 Records Hall, College Avenue Campus, 932-7057

Housing - On-Campus - Taylor Road, Busch Campus General Information, 445-2992; **Off-Campus** - 445-7766

International Student Center - 180 College Avenue, College Avenue Campus, **Counselor to International Students** - 932-7015

Student Accounting Records Hall, College Avenue Campus, Room 138, 932-7581

Undergraduate Course Periods: Undergraduate courses mostly meet during the day. The time periods are as follows:

Period	1	2	3	4	5	6	7
Starts	8:40 AM	10:20 AM	12:00 AM	1:40 PM	3:20 PM	5:00 PM	6:40 PM
Ends	10:00	11:40	1:20	3:00	4:40	6:20	8:00

Class Periods - Start and End Times

14. ADDITIONAL INFORMATION

Departmental Office: The Department of Industrial and Systems Engineering office is located on the second floor of the CORE Building (Room 201). The office has copies of most forms you might need and the staff working there can answer many questions. Office hours are 8:30-4:30 PM, Monday through Friday. Closed for lunch between 12:00 - 1:00 PM.

Electronic Mail: All Rutgers students may obtain a computer account in order to send and receive electronic mail. Go to the Micrographic Center in the basement of the Hill Center, Room 17, and the counselor there will show you how to create your account. The phone number is (848) 445-2296 and they are open 10-6 PM Monday through Saturday.

Employment Opportunities: Job announcements are posted on the ISE bulletin boards. Students are encouraged to make use of the Career Development and Placement Office on Busch campus.

Bulletin Boards: In the hallways on the 1st and 2nd floors, there are bulletin boards, which list course changes, seminars, fellowships, and other miscellaneous notices.

The Telephone Number for the Department of Industrial and Systems Engineering is (848) 445-3654 and the fax number is (848) 445-5467. The area code and prefix is (848) 445 for all telephones - the extensions are given below.

NAME	EXT	CORE	EMAIL
Albin, Susan	2238	206	salbin@rutgers.edu
Coit, David	2033	214	coit@soe.rutgers.edu
Elsayed, Elsayed A.	3859	226	elsayed@soe.rutgers.edu
Ezzat, Ahmed Aziz	3625	228	
Guo, Weihong	8556	220	wg152@rutgers.edu
Gursoy, Melike B.	5465	218	gursoy@soe.rutgers.edu
Jafari, Mohsen A.	3627	201	jafari@soe.rutgers.edu
Jeong, Myong K.	4858	222	mjeong@soe.rutgers.edu
Ozel, Tugrul	1099	208	ozel@soe.rutgers.edu
Pham, Hoang	5471	216	hopham@soe.rutgers.edu
Rosenberg, Eric	5469	212	erer635@soe.rutgers.edu
Wicks, Elin	8787	210	elm52@soe.rutgers.edu
Xi, Zhimin	3657	224	zhimin.xi@soe.rutgers.edu
Alden, Brian	5480	114	brian.alden@rutgers.edu
Kasica, Laura	8506/3654	201	lk405@soe.rutgers.edu
Ponnuraj, Barthi	8507/3654	204	barthi@soe.rutgers.edu
Manufacturing Automation Lab	5480	116	
Manufacturing Processes Lab	5480	112	
Advanced Simulation Lab	3671	106	
Quality & RelibilityLab	5480	114	
Comp. Contl & Mechatronics Lab	602		
Design Lab		Richard Weeks Hall	
IE Conference Room	8555	203	

15. SECURITY AND SAFETY

Providing a secure and safe environment for all is a top priority.

Emergency Phone Number: The number is 932-7111 for university police and emergency.

CORE Building Access: The door is open weekdays from 8 AM to 6 PM.

Access to First Floor IE Corridor: The door is open weekdays from 9-12 and 1-4:30 PM For your safety, the corridor is under camera surveillance.

Access to Labs: The labs are open from 8:30 AM to 4:30 PM.

DON'T LET STRANGERS IN: Don’t open the door for people who have no entry keys. Don't keep any door ajar by placing an object in front of it.

Laboratory Rules:

- No food or beverages.
- Know the hazards of the material and equipment you are using.
- Use goggles in manufacturing laboratories.

Obtain permission of the lab director to use power.