Industrial & Systems Engineering

Industrial and Management Engineering Advising Booklet
2011-2012
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Introduction

This document provides information and guidance to students either interested in or enrolled in Rensselaer’s Industrial and Management Engineering (IME) Bachelor’s degree in the department of Industrial and Systems Engineering (ISE). Guidance covers the four undergraduate years and the fifth year if students continue to a Master’s degree under Rensselaer’s Co-Terminal program.

Topics covered include an introduction to the profession of Industrial and Management Engineering, the engineering foundation semesters, the major semesters, cooperative education options, international experiences, continuing to a Masters degree under the Co Terminal program, academic advising, and course descriptions.

What is Industrial and Management Engineering (IME)?

The most distinctive aspect of IME is the flexibility it offers. Whether it’s shortening a rollercoaster waiting line, streamlining an operating room procedure, distributing products worldwide, or manufacturing superior automobiles, all these challenges share the common goal of saving money and increasing efficiencies which is a core focus of this discipline. Industrial engineering encompasses service industries as well as manufacturing, with IMEs employed in entertainment industries, shipping and logistics businesses, and health care organizations. The integration of people, materials, capital, equipment and energy into productive systems is the IME's main concern. An IME may be involved in scheduling crews and flights at an airline, planning production at a manufacturing plant, designing automation solutions in a distribution warehouse or building information systems to support organizational decision making.

As companies adopt management philosophies of continuous productivity and quality improvement to survive in the increasingly competitive world market, the need for IME’s is growing. IME’s are the only engineering professionals trained specifically to be productivity and quality improvement specialists. Many practitioners say that an IME education offers the best of both worlds: an engineering and business education. This is why many industrial engineers end up being promoted into management positions.

IMEs make processes better in the following ways:

- More efficient and more profitable business practices
- Better customer service and product quality
- Making work safer, faster, easier, and more rewarding
- Helping companies produce more products quickly
- Making the world safer through better designed products and processes
- Reducing costs associated with new technologies

The U.S. Bureau of Labor Statistics [BLS] has described a typical IME's function as follows: *Industrial engineers determine the most effective ways for an organization to use the basic factors of production—people, machines, materials, information, and energy—to make or process a product. They are the bridge between management and operations. They are more concerned with increasing productivity through the management of people, methods of business organization, and technology than are engineers in other specialties, who generally work more with products or processes.*
Are you a candidate for IME?

IME's are curious about how and why things work the way they do. They typically have an interest in planning, organizing and implementing worthwhile projects. Additionally, they have a strong desire to serve human needs by finding practical solutions to problems and they enjoy working with other people. Numerous professional industrial engineers have underscored the notion that IME's often help coordinate the actions of various types of engineers and managers in order to make a project successful.

Objectives of Our Undergraduate Curriculum

The IME curriculum seeks to prepare IME’s for successful careers in the 21st Century. The IME bachelor's degree program provides students with a strong technical skill base in process design and reengineering, computer information systems, data analysis, systems modeling, facility design, quality systems and management. Additionally, IME students gain experience in the use of a variety of technologies, including computer-aided design tools, simulation modeling tools, and statistical and operations research analysis packages. Three to five years after graduation, graduates of Rensselaer’s Bachelor’s program in Industrial and Management Engineering will:

Objective 1 - exhibit a total integrated systems perspective enabling: a.) thorough understanding of manufacturing systems, service systems and supply chains, b.) knowledge of engineering relationships to the planning, organization, implementation and control of human centered systems, and c.) the effective application of information through computing and other emerging technologies.

Objective 2 - be creative and innovative designers of systems, processes, facilities, services, products, organizational teams, and equipment with an understanding of the stochastic nature of management systems enabling the skillful identification, modeling, analysis, solution and management of real world problems.

Objective 3 - be effective oral and written communicators with a solid foundation for using communications media and interpersonal skills to facilitate their roles as contributors and leaders of diverse teams.

Objective 4 - be broadly educated in the humanities, social sciences and engineering professionalism which informs their socially responsible and ethical professional practice.

Objective 5 - understand the importance of lifelong learning and be capable and motivated to pursue continued growth, learning and innovation throughout the professional career.

Objective 6 - apply a solid foundation in math and science in professional practice.

Rensselaer’s IME program has an outstanding national and international reputation and has won many regional and national awards for excellence from Alpha Pi Mu, the international academic honor society for industrial engineering.
Employment

IMEs are employed by a wide variety of settings in the public and private sectors. IME's work for insurance companies, banks, hospitals, airlines, retail organizations, government agencies and as business consultants. In the past five years, our graduates have accepted positions in a wide variety of firms including Citicorp, Accenture, the U.S. Postal Service, Proctor & Gamble, IBM, General Electric, American Airlines, General Motors, Intel and many others.

Rensselaer’s Curriculum

An essential part of an IME's training is the development of modeling skills. A model is an abstraction of a real-world process such as package delivery, customer service or behavior of currency markets. Sound analysis of a model's output can help improve a company's performance.

Rensselaer’s IME program requires a minimum of 128 credit hours of coursework building on the common foundation Core program courses taken by all Rensselaer engineering disciplines. While coursework is extensive, the program provides opportunity generally in the junior year for a 9 month cooperative education experience working as an engineer at a local or national company and/or for study abroad opportunities.
ISE Department

The Industrial and Systems Engineering department is located on the 5th floor of the Low Center for Industrial Innovation, the CII. Faculty of the department, contact information, and research interests are shown below.

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Email</th>
<th>Agent based simulation and optimization</th>
<th>Automated and autonomous storage retrieval systems</th>
<th>Data analysis, data mining, time series, and knowledge acquisition</th>
<th>Emergency and disaster management decision models</th>
<th>Enterprise systems engineering</th>
<th>Error analysis in large scale systems</th>
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<th>Information diffusion and technology evaluation</th>
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<th>Modelling ethics</th>
<th>Optimization in networks and scheduling</th>
<th>Power markets</th>
<th>Service and replacement parts inventory optimization</th>
<th>Social networks, Service networks uncertainly and optimization</th>
<th>Technology impact in systems safety and operation</th>
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<tbody>
<tr>
<td>Charles J. Malmborg</td>
<td>Professor</td>
<td><a href="mailto:malmbc@rpi.edu">malmbc@rpi.edu</a></td>
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<td>William A. Wallace</td>
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Advising Model

Academic advising is a shared responsibility and service between the student and departmental faculty. Students seeking the undergraduate IME degree are assigned an academic advisor based on graduation year, entrance as a transfer admission, and entry into the co terminal program. In addition, special advising for students in preparation and on return from study abroad is assigned in the department.

Graduation Year Advising. All entering IME degree seeking freshman and students who change to the IME degree from other departments who share the same graduation year are assigned the same faculty advisor. This faculty member remains their advisor for their four years at Rensselaer. This advisor is the primary source for academic and career counseling. The advisor is a recipient of all academic concern warnings issued through Rensselaer’s Electronic Warning System, EWS. While action steps for addressing the concern remain with the student, outreach efforts are often the consequence of such notice to the advisor and others.

Meeting with your academic advisor is required at Rensselaer. Failure to meet regularly with the advisor will result in suspension of registration privileges. Freshmen are required to meet with their advisor both in the first and second semester. After that, a meeting is required in the twelve month period prior to the registration period. In addition to general advising, the advisor also is required to approve and sign many academic program forms such as pass / no credit election, minor forms, and co-op forms. Advisor meetings are also an opportunity to discuss plans for the senior portfolio which is a graduation requirement in the senior year.

Transfer Admitted Students. All students who enter the IME degree through a transfer admission are initially assigned to the Undergraduate Program Director for course consultation. The UPD then determines the appropriate class year for the transfer student and assigns the corresponding IME class advisor who will serve as that student’s advisor until graduation. This advisor is the primary source for academic and career counseling.

Co Terminal Advising. The co terminal program enables Rensselaer undergraduates with strong academic records to study for a Master’s degree while completing their Bachelor’s degree(s) in the same or a different department or school. The co terminal advisor becomes the student advisor for the Master’s degree portion of the program. The student maintains their relationship with their undergraduate advisor. First contact with the co terminal advisor is required in the junior year as part of the application process to the program.

Study Abroad Advising. Study abroad has become an integral part of a well-rounded undergraduate experience. A period of study abroad allows students to develop a broader perspective on their academic field of study while earning credit towards a Rensselaer degree. Because of the large number of options available to students, a special advisor has been designated in ISE to work with students planning the study abroad experience and to complete the paperwork for posting study abroad courses to the Rensselaer degree. This advisor works in a consultancy role only. The student retains their academic advisor.
Advising Responsibilities.

The shared responsibility between the faculty academic advisor and the student involves the following parameters:

**Student's Responsibilities**
- To know their advisor's office hours and advising schedule.
- To make an appointment and prepare for registration advising by reviewing the Catalog, Class-Hour Schedule, and Curriculum Advising & Program Planning (CAPP) Program.
- To formulate questions regarding curriculum, course selections, career options, portfolio preparation, etc.
- To be aware of their academic and personal needs and to seek assistance when needed.
- To understand that the role of their advisor is to advise them, not to make decisions for them. Each student needs to realize that it's his or her education at stake and that they are ultimately responsible for making any final decisions.

**Advisor’s Responsibilities**
- To be accessible to students throughout the year at posted office hours. If an advisor will be away from campus for an extended period of time, he or she should post the names and office locations of alternate advisors outside their offices, so that students will have other advising resources.
- To set aside designated times for registration advising and individual discussions.
- To be knowledgeable about current curriculum requirements, academic policies and procedures, referrals and resources on campus, and career opportunities in the major field.
- To guide students through academic programs that will complement their personal, educational, and professional interests.

**IME Baccalaureate Program Curriculum**

The first two years of the IME curriculum provide a strong foundation in the basic sciences, engineering science, mathematics, and the humanities and social sciences. In years three and four, students concentrate on building expertise in statistics, operations research, manufacturing and services systems engineering, and industrial engineering methods and models.

Through the appropriate choice of electives, students can focus on areas of interest. Design projects include problems in manufacturing, services and public systems. It is advisable to develop a Plan of Study leading to the desired degree and concentration by the beginning of the third year. The department recommends that students declare their intent to major in industrial and management engineering as early as possible in their academic career.

The university requirements of the baccalaureate degree are:
- Minimum grade point average (GPA) of 2.0.
- Course content in humanities and social sciences (H&SS) must total a minimum of 24 credit hours, including at least eight credit hours in the humanities and eight credit hours in the social sciences. Engineering students automatically take two of the 24 credit hours as professional
development in their engineering design sequence and take a two-credit H&SS professional development course in their junior year.

• To ensure depth in the H&SS core, at least two courses within a single topic code, (STSH and STSS can be counted as a single area), and at least one at an advanced level, (above 1000), must be completed. No course within the depth sequence may be taken as Pass/No Credit.
• No more than three 1000-level H&SS courses may be applied to the core requirement, no more than six credits may be taken as Pass/No credit, and at least one course (four credits) must be at the 4000 level.  

For information on additional requirements see the School of Humanities, Arts, and Social Sciences section of the course catalog.

• Every student is required to take at least two communication-intensive courses, one in the students’ major and one writing intensive course in the School of Humanities, Arts, and Social Sciences.

• The student must be registered full-time for a minimum of four semesters. Two semesters of part-time study at Rensselaer will be considered equivalent to one semester of full-time study. In addition, the student must complete a minimum of 64 credit hours towards the undergraduate degree at Rensselaer. If a transfer student elects to study abroad or enroll in the co-op program, no more than 12 such credits may apply to the credits needed for the bachelor’s degree.
• Transfer courses are limited to two courses or eight credits counting toward the student’s last 30 credits and require approval of the director of the Advising and Learning Assistance Center.

Refer to the catalogue for updates on graduation requirements.

The 128 credit hour IME curriculum requires completion of the course requirements shown in the typical four-year program presented below and submittal of a senior portfolio of academic work organized in conformance with guidance issued by ISE. Courses shown in the typical four year program are shown below.
## Typical Four Year Program

### Fall  
**First Year**  
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tr>
<td>MATH-1010</td>
<td>Calculus I</td>
<td>4</td>
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<tr>
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<td>Hum. or Soc. Sci. Elective</td>
<td>4</td>
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<tr>
<td>ENGR-1100</td>
<td>Intro. to Engineering Analysis</td>
<td>4</td>
</tr>
<tr>
<td>CHEM-1100</td>
<td>Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>ENGR-1300</td>
<td>Engineering Processes</td>
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**Spring**  
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<tr>
<td>MATH-1020</td>
<td>Calculus II</td>
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<tr>
<td>PHYS-1100</td>
<td>Physics I</td>
<td>4</td>
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<tr>
<td>ENGR-1200</td>
<td>Engineering Graphics &amp; CAD</td>
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### Fall  
**Second Year**  
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<tr>
<td>ENGR-2050</td>
<td>Intro to Engineering Design</td>
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<tr>
<td>MATH-2400</td>
<td>Intro to Differential Equations</td>
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</tr>
<tr>
<td>PHYS-1200</td>
<td>Physics II</td>
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<td>Hum. or Soc. Sci. Elective</td>
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**Spring**  
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<tr>
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<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ISYE-2210</td>
<td>Prod &amp; Ops Mgt &amp; Cost Acctg</td>
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<tr>
<td>ENGR-2600</td>
<td>Mod &amp; Analysis of Uncertainty</td>
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<td>Management Elective (2)</td>
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<tr>
<td></td>
<td>Multidisciplinary Engineering (3)</td>
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<tr>
<td></td>
<td>CSCI-1190 Intro to Programming</td>
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**Third Year**  
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<tr>
<td>ISYE-4140</td>
<td>Statistical Analysis</td>
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<tr>
<td>ISYE-4600</td>
<td>Operations Research Methods</td>
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<td>Multidisciplinary Engineering (3)</td>
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<td></td>
<td>Hum. or Soc. Sci. Elective</td>
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<tr>
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<td>Professional Development II (5)</td>
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<tr>
<td>ISYE-4290</td>
<td>Discrete Event Simulation &amp; Modeling</td>
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<td>Free Elective</td>
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**Fourth Year**  
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<td>ISYE-4530</td>
<td>Information Systems</td>
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<td>ISYE</td>
<td>Technical Elective (4)</td>
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<td>ENGR-4760</td>
<td>Engineering Economics</td>
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**Spring**  
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<tr>
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<td>ISYE-4270</td>
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<td>ENGR-4100</td>
<td>Professional Development III</td>
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### Notes.
1. Science elective cannot be taken Pass / No Credit.
2. Management Elective cannot be taken Pass / No Credit and must be selected from any course listed below. The Economics courses cannot be counted for meeting both the Social Science requirement and the Management Elective.
3. Select two courses from the list below.

- ECON 2010 Managerial Economics
- MGMT 1100 Introduction to Management
- MGMT 2320 Managerial Finance
- MGMT 4510 Invention, Innovation, and Entrepreneurship
- MGMT 4520 Introduction to Technological Entrepreneurship
- MGMT 4850 Organizational Behavior in High Performance Organizations
- MGMT 4860 Human Resources in High Performance Organizations

4. Select two courses from the list below.

- ENGR 1600 Materials Science for Engineers
- ENGR 2710 General Manufacturing Processes
- ENGR 2350 Embedded Control

5. Select two courses from the list below.

- ECON 4210 Cost-Benefit Analysis
- MGMT 4530 Starting Up a New Venture
- MGMT 4430 Marketing Principles
- MGMT 4850 Organizational Behavior in High Performance Organizations
- MGMT 4860 Human Resources in High Performance Organizations

- ENGR 2090 Engineering Dynamics
- ENGR 2250 Thermal and Fluids Engineering I
- ENGR 2530 Strength of Materials
ENGR 4300 Electronic Instrumentation  
ENGR 4710 Advanced Manufacturing Lab I  
ENGR 4720 Advanced Manufacturing Laboratory II  
MANE 4050 Model & Control of Dynamic Sys  
4. Ideally, students should plan on taking 2 technical electives in the Fall and 2 in the Spring to accommodate course scheduling which includes offering courses on a 2 or 3 year cycle. In general, only 3 such electives will be offered each term. The courses that satisfy this requirement will be identified prior to registration for the upcoming term. When offered, the courses below meet the technical elective requirement.  
ISYE 4200 Design and Analysis of Work Systems  
ISYE 4220 Optimization Algorithms  
ISYE 4250 Facilities Des & Industrial Logistics  
ISYE 4280 Decision Focused Systems Engr  
ISYE 496X Topics courses that have been approved as technical electives by the ISE UAC  
The ISE Department does not offer any certificate programs or degree options within IME. However, the ISE Undergraduate Advisory Committee (UAC) has developed recommendations for allocating free elective credit for IME majors wishing to gain additional depth in certain concentration areas as shown below. These free elective course recommendations are advisory only and do not confer any formal certificate or other credential in the corresponding concentration area. All IME majors are urged to discuss all course elections with the academic advisor.  

**Information Technology:**  
CSCI-1100 Computer Science I (use restricted science elective)  
ITEC 2210 - Introduction to Human Computer Interaction (free elective)  
ITEC 2110 Web Systems Development (free elective)  

**Energy and Environment:**  
ECON 1200: Introductory Economics (free elective) and two of the following:  
ECON 4230: Environmental Economics (free elective)  
ECON 4240: Natural Resource Economics (free elective)  
ECON 4250: Ecological Economics (free elective)  

**Sustainability:**  
STSH/STSS 1110: Science, Technology, and Society (free elective)  
STSS 2300: Environment and Society (free elective)  
One of the following:  
STSS 4340: Environmental Society (free elective)  
STSS 4963: Sustainability Problems (free elective)  

**Marketing:**  
MGMT-1100 Intro to Management (use restricted management elective)  
MGMT-4430 Marketing Principles (free elective)  
MGMT-4470 Marketing Research (free elective)  
MGMT-4460 Consumer Behavior and Product Design (free elective)
Finance:
MGMT-2320 Managerial Finance (use restricted management elective)
MGMT-2300 Fundamental of Accounting for Decision Making (free elective)
Plus two of the following three:
MGMT 4320 - Investments I (free elective)
MGMT 4370 - Risk Management (free elective)
MGMT 4310 - Financial Trading and Investing (free elective)

IME Senior Portfolio. IME students are required to submit a professional portfolio as a condition of graduation. This portfolio is due in early March for spring semester graduates and early October for fall semester graduates. Although the portfolio is not a graded deliverable, students cannot receive final degree clearance until an acceptable portfolio is submitted and accepted by the department. Materials from the last two to three years of study should be retained by IME students in preparation for submitting the portfolio. Each academic year, the IME Undergraduate Program Director issues updated guidelines for portfolio preparation. Students must prepare the portfolio in accordance with these guidelines.

What is the Purpose of the Portfolio? The materials for the portfolio should document that you have achieved the eleven student learning outcomes associated with the IME undergraduate program. Packaged in a single binder issued by the ISE Department, the portfolio should contain an introduction section and eleven divided sections corresponding to the student learning outcomes listed below.

What type of material goes in the portfolio? Materials used in each of the sections must be drawn from work completed within a subset of the courses listed under that outcome. In most cases, exhibits will include items such as project reports, labs, exams and other significant course assignments. The same exhibit can serve multiple objectives. You are encouraged to supplement the exhibits for any given outcome from work done outside of the associated courses such as co-op assignments and extracurricular activities but the majority of exhibits under a given outcome must be drawn from work completed in the courses associated with that outcome. Use materials that most clearly demonstrate that you’ve achieved the highest benchmark of performance under a given outcome.

What are the criteria for demonstrating that exhibits of student work in the portfolio demonstrate outcome attainment? Different criteria are associated with each outcome in the form of an outcome performance rubric. Outcome attainment is scored on one of three levels; high, medium or low. In general, the guideline is to add the best examples of your work that demonstrate your capabilities as an Industrial and Management Engineer relative to a given outcome.

How should the portfolio be organized? The introduction section of your portfolio should include an updated one page statement of career objectives and plans following graduation to the extent you know them, an up-to-date resume, a current transcript, (an unofficial transcript is acceptable), and the completed senior survey for your graduation year, (included with the portfolio binder). The courses corresponding to each outcome are listed in the portfolio guidelines that are issued annually and can be obtained at any time from the Undergraduate
Program Director. The 11 student learning outcomes for the IME program that correspond to the 11 sections of the portfolio are listed below:

1. An ability to apply knowledge of mathematics, science and engineering.
2. An ability to design and conduct experiments, as well as to analyze and interpret data.
3. An 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.
4. An ability to function on multi-disciplinary teams.
5. An ability to identify, formulate and solve engineering problems and to model the stochastic nature of management systems and engineering relationships to the planning, organization, evaluation and control of human centered systems.
6. An understanding of professional and ethical responsibility.
7. An ability to communicate effectively.
8. That you have attained the broad education necessary to understand the systems level impact of engineering solutions in both an integrated value chain and within a global, economic, environmental, and societal context.
9. That you recognize the need for, and have an ability to engage in life-long learning.
10. That you have knowledge of contemporary issues.
11. An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

Double Degree and Dual Degree Programs

Double Degrees. A student may become a candidate for a second baccalaureate degree when he or she has completed: (1) the equivalent of at least two terms (30 credit hours) of additional work beyond the requirements of a single degree, and (2) the courses in the department in which the student is registered and such other courses as are required for the second degree.

Dual Majors. Undergraduate students who fulfill all the degree requirements for two curricula and who have met the conditions below will have completed a dual major. They will receive one diploma noting both majors. The student must designate a first-named and second-named major in writing at least one semester prior to graduation, and have the appropriate department(s) approve this designation prior to filing the dual major form with the registrar. Each student will be assigned an adviser in each department who will monitor progress towards degrees in that department. The degree clearance officer in each department will certify that the student has met the degree requirements in that department.

Co-Op and Study Abroad Timing

The Co-Op and Study Abroad opportunities available at Rensselaer are excellent experiences for both professional and personal growth. But because both require significant time away from the Rensselaer campus, planning is required to minimize the impact on the graduation plans of the participant.

ISE has designed the undergraduate curriculum so that the sixth semester, the second semester of the Junior year, is the best time for either program. While the typical plan of study presented
above shows the student taking two technical electives in this semester, there are no required
courses that must be taken in this semester that cannot be taken in the senior year.

For students studying abroad, this semester could be filled with a humanities or social science
course and free electives moved from the senior year if the host university does not have courses
that might fit into the technical electives category. The technical electives listed for this semester
can be moved to the senior year in place of the free electives.

When looking at these off campus experiences, some cautionary notes on course transfer apply.
The courses easiest to find and transfer from a university that does not have engineering are:

1. Any course that RPI will accept as a free elective. These courses have to be more than 1
credit and must have some link back to a course or department at RPI. The course you want
to transfer in cannot also overlap extensively with a course you have already taken here at
RPI.

2. Humanities and Social Science (H&SS) courses which are above the 1000 level here at
RPI. Courses that the host university claims as being junior level or senior level course can
be brought in subject to the transfer maximums for H&SS courses stated in the catalogue. If
you exceed this transfer credit limit, the course gets posted to Free Electives if there is still
room to bring it in and have it count to the degree.

3. Science courses (this includes Mathematics and Computer Science) that can count as a
Science Elective. The problem here is with the credit hours of the course. The system at RPI
is based on 4 credit hour courses while the rest of the world relies principally on 3 credit
courses so one can wind up one credit short. In many cases, students end up taking 2 science
courses to fill the science credit hour requirement with the extra credits counted against 'Free
Elective' requirements.

4. Listed Mathematics courses can be brought in often as direct substitutes for RPI courses
but the credit hour problem arises here as well.

For universities with engineering programs, any exact named equivalent for Core engineering
courses, (Strengths, Dynamics, Thermo, Circuits), can be taken and transferred in. For ISE
courses, students must get approval in advance before assuming that a course will transfer. For
core courses, the credit hour question discussed above often arises.

In all cases, prior approval of transfer credits is strongly encouraged to avoid any problems. For
prior approval, the course description from the university attended, and if possible a syllabus,
makes the process work quickly and to the advantage of the student.
Selected ISE Course Descriptions

Below are course descriptions for some of the courses in the undergraduate IME program. For a complete listing and description of all Rensselaer courses see the online catalogue available under the Registrar web site.

**ISYE 2210 Production and Operations Management and Cost Accounting**
The design and analysis of production and service systems. Topics include forecasting, scheduling, inventory systems, total quality management, line balancing, and capacity planning. Introduction to cost accounting. Use of analytic techniques in accounting-based decision making. Formulation and solution of POM models practiced on computers. Students cannot obtain credit for both this course and ENGR 4700. Prerequisites: MATH 1020 or equivalent. Spring term annually. 4 credit hours

**ISYE 4140 Statistical Analysis**
Review of simple and multiple regression, selection procedures, regression diagnostics, residual analysis, stepwise regression, analysis of variance, design of experiments including factorial experiments, analysis of ordinal data and nonparametric inference, basic time series models. Extensive use of statistical software. Emphasis on statistical applications to industrial engineering. Prerequisites: ENGR 2600 and knowledge of calculus. Fall term annually. 4 credit hours

**ISYE 4200 Design and Analysis of Work Systems**
Analysis and design of work and workplace. Topics covered include human-machine systems, ergonomics, work measurement systems, methods and standards, process design, direct time study, standard time data, predetermined time systems, work sampling, work load balancing, and workplace layout. Computer-based analysis of problems in work systems. Prerequisite: ENGR 2600 or equivalent. 3 credit hours

**ISYE 4210 Design and Analysis of Supply Chains**
An overview of the principles involved in the design and operation of supply chains with applications to manufacturing and service industries. Topics include dynamics of manufacturing systems and supply chains, lean manufacturing, lead time reduction in manufacturing and office operations, advanced pull systems, concurrent design of products and supply chains, rapid new product introduction, e-manufacturing and reverse supply chains, and integration of information technology in supply chain operations. The goal of the course is to enable students to synthesize models and tools and to understand how these could be applied to address emerging challenges in manufacturing and service systems and their supply chains. Prerequisites: ISYE 2210 or ENGR 4700, and ENGR 2600 or equivalent. Spring term annually. 3 credit hours

**ISYE 4220 Optimization Algorithms**
Data structures such as linear lists, arrays, stacks, queues, and heaps. Complexity analysis including asymptotic analysis and NP-Completeness. Types of algorithms including greedy, divide and conquer, dynamic programming, branch and bound, approximation algorithms, and local search. Combinatorial optimization problems such as the knapsack problem, minimum spanning trees, shortest path problems, maximum flow problems, matching problems and the traveling salesperson problem. Prerequisite: ISYE 4600 or equivalent. 3 credit hours

**ISYE 4230 Quality Control**
The statistical approach to manufacturing quality control is emphasized. Consideration is given to the managerial implications and responsibilities in implementing the statistical approach. Topical coverage includes construction and interpretation of various control charts; special control charts (e.g., CUSUM, EWMA); graphical methods; specifications, tolerance limits, process capability indices; acceptance sampling; discussion of experimental design; and Taguchi methods of quality improvement. Prerequisites: ISYE 4140 or ISYE 4760 (MATP). 3 credit hours
ISYE 4240 Engineering Project Management
Planning, controlling, and evaluating engineering projects. Use of network analysis techniques, PERT/CPM, budget control, time/cost tradeoff, time estimation, resource allocation, and resource leveling. Extensions include probabilistic models, multiple resource models, project organization, risk analysis, technical forecasting, and network theory. Students cannot obtain credit for both this course and ENGR 4750. 3 credit hours

ISYE 4250 Facilities Design and Industrial Logistics
An in-depth study of the major design issues in location and physical configuration of production and service facilities. The course emphasizes the use of mathematical models, computer modeling, and quantitative analysis as aids to the design process. Topics include plant layout and location, material handling, material flow analysis, and distribution systems. Major course concepts are developed through case studies and projects. Prerequisites: ISYE 2210 or equivalent, ISYE 4140 or equivalent, and an introductory operations research course. 3 credit hours

ISYE 4260 Industrial Safety and Hygiene
Survey of procedures and practices in industrial safety and hygiene including government regulation (OSHA), life safety, electrical safety, air contamination, noise, radiation, ventilation, illumination, toxicology, and safety engineering organization. Contemporary topics (asbestos, PCBs, AIDS) are also covered. 3 credit hours

ISYE 4270 Industrial and Management Engineering Design
This course provides a capstone and professional experience. Student teams work on independent projects in any field of industrial and management engineering approved by a faculty adviser. Typically, projects involve a manufacturing and service sector client who provides the student with an opportunity to gain an actual industrial experience. Memos, progress reports, and a final written and oral report are submitted to the project adviser and client. This is a communication-intensive course. Prerequisite: senior standing. Fall and spring terms annually. 3 credit hours

ISYE 4280 Decision Focused Systems Engineering
The objective of this course is to introduce students to systems engineering, especially from a decision focused perspective. System concepts, methodologies, models and analysis are covered in relation to a system’s design, development, test, evaluation, and operation. Decisions concerning a system’s reliability, maintainability, usability, disposability, and affordability are systematically considered. A range of systems, including service systems, is also considered. Pre- or co-requisite: ENGR 2600. 3 credit hours

ISYE 4290 Discrete Event Simulation Modeling and Analysis
Introduction to discrete-event simulation modeling and analysis techniques including; graphical simulation modeling approaches, animation techniques, modeling large-scale and complex systems, pseudorandom number and random variate generation, stochastic processes, input modeling (data collection, analysis, and fitting distribution), output analysis (initial bias and termination bias, variance reduction techniques), sensitivity analysis, design of experiments, interactive simulation-based decision support systems. Prerequisites: ISYE 4140 or equivalent and CSCI 1190 or equivalent. Spring term annually. 3 credit hours

ISYE 4530 Information Systems
This course surveys information-systems technology for the management of enterprise information as a resource. Topics include elements of system design life cycle, database concepts, and decision support. Managerial and technical dimensions of information systems are blended in a framework for IS systems. Additional topics include telecommunications, artificial intelligence (including expert systems), and structured design. The implementation, operation, and maintenance of information systems are also discussed. Projects are required. Prerequisite: CSCI 1190 or equivalent. Fall term annually. 4 credit hours
**ISYE 4600 Operations Research Methods**

An introduction to commonly used methods of deterministic and stochastic operations research. Topics include linear programming, simplex algorithms, duality, linear networks, integer programming, dynamic programming, goal programming, location models, exact and heuristic solution procedures for integer and sequencing problems, queuing theory, Markov chains, multicriteria decision making, and decision analysis. This is a communication-intensive course. Prerequisites: ENGR 2600 and Math 1020. Fall term annually. **4 credit hours**

**Registration Steps**

Registration for the spring semester generally occurs in early November. Registration for the fall semester and summer terms occurs the preceding spring, usually in early April. Exact dates are included in the Academic Calendar.

Step 1 is to check your advising status on the Student Information System (SIS). Are you cleared to register by your advisor? If a freshman, did you have an academic advising meeting with your advisor this semester? For other class years, did you have such a meeting in the past 12 months? If not, schedule a meeting with your advisor and have your status updated.

Step 2 is to review your Curriculum Advising and Program Planning (CAPP) report and to compare your progress to your goals and to the plan of study you are following. You can access your CAPP report via the main menu of the Student Information System (SIS). If not on schedule, develop options to pursue and do so on paper so you have them when discussing your plans with your advisor. Update your plan of study as needed. You should also check the status of materials that you have set aside for use in your senior portfolio and plan to update your advisor on the status of these materials to ask his or her opinion of your decision to include them for a specific student learning outcome.

Step 3 can be done prior to 4 or following 4 depending on the timing in the semester. Step 3 is drafting a schedule of courses and sections based on the course offerings for the upcoming semester. Registration is by sections so develop some options to use when registering in the event you find sections closed or class times changed.

Step 4 is to schedule a visit with your advisor to discuss your plans. This visit is almost mandatory if you plan on completing a co-op assignment or to study abroad.

Step 5 is the physical act of registering for classes. A quick primer on class registration is below.

**How:** Use the Student Information System (SIS) to register for your courses.

**Where:** There are no assigned rooms for registration. You can register for your classes using any computer with Internet access.

**Time tickets:** You are issued a "time ticket," which assigns you a specific window of time during which you may register for the next semester. Your time ticket will be sent to your RPI email address, 2 - 3 weeks before registration. This e-mail message will also notify you of any existing holds which may prevent you from registering if you do not resolve them.
Adjusting Your Class Schedule

All adjustments to your class schedule are done using the Student Information System (SIS). Adjustments can include switching sections, dropping a class, or adding a class. The academic calendar contains cutoff dates for each of these actions. You do not need to wait until classes start to adjust your schedule of classes. The catalogue describes class schedule adjustment procedures that fall outside of the windows given on the Academic calendar such as late add and late drop. Consult the catalogue for the procedure.

Undergraduate Research Program (URP)

Rensselaer has a very strong Undergraduate Research Program. This is a program that allows students to work in a professor’s laboratory for credit, cash, or experience. Details on the program and application forms are available from the website of the Office of Undergraduate Education.

How to find a project. Most URP projects are found through direct contact with the faculty member supervising the research. Most undergraduates find projects from faculty members from whom they have taken classes. Check their website to investigate their field of research. If it sounds interesting, approach directly them about a possible URP project.

What if I have my own idea for a project? You may work with a faculty member on an existing research project or on a project based on your own ideas. If you want to pursue your own project, you will need to find a faculty advisor who may be interested in your topic since you will be required to have a project advisor.

For credit, funding or the experience? You can earn from one to four credit hours per semester for your participation in the URP. If you choose this option you and your sponsor need to:

• Determine how many credit hours you will earn
• Decide exactly what is expected of you, such as your time commitment, the type of work to be submitted, etc.
• Agree on how your grade will be determined

URP funding comes from two sources:

• Your sponsoring faculty member
• The Office of Undergraduate Education

The faculty sponsor is responsible for the financial support of your research. In addition, the Office of Undergraduate Education pays URP participants a maximum of $400 per semester in the form of matching funds.

If the motivation is for experience, the process is simple just between you and the researcher. No deadline specified.
Co-Terminal B.S. / M.S. or M.E. Program

The Co Terminal Graduate Degree Program enables Rensselaer undergraduates with strong academic records to study for a Master’s degree while completing their bachelor’s degree(s) in the same or a different department or school. Co terminal applications must be submitted before the end of the applicant's junior year. The application form and instructions are available from the website of the Office of Graduate Education.

ISE offers both thesis and non thesis options at the Master’s level. The application and admission requirements in the ISE department for this program are:
1. All applicants must take the Graduate Record Exam (GRE) and submit the scores to Rensselaer and include a paper copy of the scores with the completed application.
2. The minimum undergraduate GPA for admission is 3.3. Applicants with a GPA above 3.0 but below 3.3 may be considered for admission if the GRE scores exceed 550 verbal and 650 quantitative.
3. The application form must be signed by the undergraduate advisor who attests to the GPA stated on the application.
4. The applicant must schedule an appointment with the ISE Co-Terminal advisor bringing the completed application including GRE score report. During this meeting, a graduate plan of study will be drafted listing the courses that must be completed and the semester the course will be completed for the master’s degree segment. The requirements will be based on the published requirements in the university catalogue. At a minimum, 30 credits beyond the Bachelor requirement must be completed. The draft plan must be typed by the student on the Graduate School Plan of Study form.
5. The applicant must submit the completed application package to the ISE Co-Terminal advisor who will direct its review within the ISE department.

The final admission decision rests with the Graduate School. Notice of the decision on admission will be forwarded to the applicant soon after the ISE department is notified of the final decision.

FAQs

Accelerating Courses
1. If I have advanced placement credit, what course should I take in place of the listed course? For many topics, the first years are sequences of 2 or 3 courses that are taken in order. Advanced placement credit will be posted by the Rensselaer course name so the action by you might be to take the next topic course in the sequence. The Mathematics sequence is a prime example of this. A second option is to delay taking the next course in the sequence and to substitute in its place another future semester course provided all the prerequisites for the course are met.
2. Can I take senior level courses as a sophomore when I meet the course prerequisites? The general guidance provided in course level numbering is that 1000 level courses are freshman level, 2000 are sophomore, and 4000 are junior – senior level. The recommendation is to respect this guidance especially when looking at 4000 level courses.
Pass No Credit Usage
1. Can pass - no credit be used for courses selected from a list?
All courses listed by name as degree requirements (including ones that are selected from a list of restricted electives such as the science elective) cannot be applied to the named degree requirement if taken pass – no credit.
2. Can pass – no credit be used for the science elective?
The science elective cannot be taken pass – no credit and be applied to this stated requirement.
3. Who signs the pass – no credit election form?
Your advisor must sign the form. The purpose of this signature is to force a meeting between you and your advisor so that the consequences of your election are fully understood. No signature is required to remove the designation.

Humanities and Social Science Requirements
1. Can pass – no credit be used for H&SS courses?
Pass – no credit can be used for H&SS courses with restrictions. The catalogue lists the current restrictions so refer to the latest issue of the catalogue to get the current policy. No course used for the depth sequence in a topic can be graded pass – no credit.
2. Are there limits on transfer courses for the requirement?
There are limits on the number of courses that can be transferred from another university and be applied to the H&SS requirement. The catalogue has the most up to date policies. The restriction does account for students who enter as transfer students.

Technical Electives
1. What are the technical electives?
Courses that apply to the degree as technical electives are announced before the registration period opens. This document lists several courses that are technical electives but the list expands as scheduling allows.
2. Can I take all 4 technical electives in one semester?
The current scheduling policy typically offers 3 technical electives each semester so it is usually not feasible to complete this requirement in one semester. The guidance directs students to split technical electives between the fall and spring term because some courses are repeated each semester so there may not be 4 different technical electives offered in the same semester in two adjacent years.

Co-Terminal FAQ's
1. When do I apply?
Co-terminal applications must be submitted before the end of applicants’ junior year. Applicants must have 90 credits (in progress or earned) of coursework towards their undergraduate degree (101 credits for Architecture students).
2. Where do I find a Plan of Study?
The Plan of Study is available on-line at the Office of Graduate Education website.
3. What if the courses I list on the Plan of Study change?
If the courses listed change, an updated plan must be filed with your Department, the Office of Graduate Education, and the Office of the Registrar.
4. Do I have to file a FAFSA for my 5th year to get the Undergraduate aid?
Yes - you must file a FAFSA, if you receive need based aid
5. When/how does a student get assigned a graduate adviser?
Co-terminal students will continue to work with their undergraduate adviser until completion of the 8th semester and will have a graduate advisor assigned in the 8th semester.
6. How many credits will I be eligible to register for?
Since the primary degree you will be pursuing is your bachelor's degree, you will be eligible to register for up to 21 credits but the regular full time load for graduate work is usually no more than 15 credits.
7. Can I become a part-time student in the Co-Terminal Program?
Co-terminal student must remain as full time students and cannot shift to part-time status.
8. Should I apply for my undergraduate degree if I will be registered into an 11th semester?
If you are continuing into an 11th semester, you will no longer be eligible for undergraduate aid. You should apply for your bachelor's degree at that point.
9. When do I receive my BS degree? I was supposed to graduate in May 2010 but I will be completing 2 more semesters to receive my Master's degree under the co-terminal program?
You will receive both degrees at the end of your 10th semester. You should file a degree application with the Office of the Registrar for each degree at the beginning of the semester in which you will actually graduate with both degrees. See the academic calendar for deadline information.
10. Can I use a course for both my undergraduate and graduate degree?
No - credits applied toward satisfying requirements of the undergraduate degree cannot be used to satisfy the requirements for the master's degree.
11. I finished my 9th semester but decided not to continue in the Master's program. How do I receive my BS degree?
You must first, formally withdraw from the co-terminal program. This is done using the Graduate Student Request for Change of Status form. You must then file a Degree Application for the next graduation date. Rensselaer has three official graduation dates - the end of August, the end of December, and mid-May. Check the academic calendar for application submission deadlines.
12. Can I still designate courses as Pass/No Credit?
Co-terminal students are subject to graduate degree program guidelines after they've earned the minimum number of credits required for their bachelor’s degree, 128 credits. Any courses taken after a student has reached the minimum will be subject to graduate level policies, and graduate policies prohibit designating a graduate course as Pass/No Credit.
13. Can I participate in the Commencement ceremony with my class?
You must meet the criteria for participation and file a petition, available in the Registrar's Office.

Registration
1. What do I do if a class I want to register for is full?
Core Engineering has a formal wait list for full courses. Contact the Core Engineering office to complete the paperwork for this list. For many courses, the class size listed on SIS is the room size so no additional students can be added to the room. Meet with the instructor of the course and request to be admitted to the course. If there is physical space to accommodate you, your request is very often honored. If this is an elective course you may be asked to take it in a subsequent semester.