The Grado Department of Industrial and Systems Engineering

Undergraduate Student Handbook
2018-2019
# The Grado Department of Industrial and Systems Engineering

## Undergraduate Student Handbook

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2018-2019

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* The UPC was established to consider all undergraduate curricular matters and any issues that pertain to the ISE Undergraduate Program. Please see an Academic Advisor for questions pertaining to the UPC or for assistance with petitions for course substitutions.
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I. **INTRODUCTION TO ISE UNDERGRADUATE PROGRAM**

This ISE Undergraduate Student Handbook, along with the Undergraduate Catalog and the Timetable of Classes (both available online), provides supplemental information about the ISE Undergraduate Program including curriculum requirements, working with an ISE Academic Advisor, etc. This Handbook is intended to assist ISE undergraduate students in successfully completing requirements for the BSISE degree. It does not supersede directives in the Undergraduate Catalog, statements from the Office of the Academic Dean of Engineering, or information from the University Registrar.

The ISE Academic Advisors provide advice and guidance to students on matters of academic, career, and professional development. **It is the student’s responsibility to ensure that he/she fulfills all BSISE program requirements specified in the appropriate checksheet.** For more information on student and advisor responsibilities, see Appendix B: for the most recent checksheet, see Appendix G. Both advisors have an open-door policy so it is not necessary to schedule an appointment. Maggie Johnson’s office hours are typically 8 a.m. to 12 p.m. and 1-5 p.m. Paula Van Curen’s office hours are typically 8 a.m. to 1 p.m. and 2-5 p.m. Remember that advisors’ commitments may require they be out of the office at certain times. You may schedule an advising appointment by contacting Ms. Johnson at 540-231-6388 or mlecos@vt.edu or Ms. Van Curen at 540-231-2364 or pcuren@vt.edu.

<table>
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<tr>
<th>Mission of the ISE Department and Undergraduate Program</th>
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<td>The Department of Industrial and Systems Engineering (ISE) has three primary objectives relating to its academic mission: 1) to provide the highest quality education for preparing undergraduate and graduate students for a life-long experience in the rapidly changing field of industrial engineering, and to further prepare these students for future leadership roles in the industrial engineering profession, in business, and in industry; 2) to conduct research toward advancing the frontiers of industrial engineering, supporting the industrial and economic growth of Virginia and the nation, and providing faculty with the latest knowledge and techniques for dissemination in the classroom; and 3) by serving the industrial engineering profession, industry, and society.</td>
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<tr>
<td>The mission of the ISE Undergraduate Program is to prepare industrial and systems engineering students to create value for organizations, the profession, and society. We achieve this mission by recruiting, retaining, and educating high quality and diverse students and by creating a rigorous and collegial environment enabling students to learn industrial engineering methods and tools, built upon a foundation of mathematical, physical, and engineering sciences, and to apply them in any global organizational setting. Students are able to achieve academic and professional success through opportunities to participate in various educational experiences, to develop capabilities as future leaders, and to embark on a lifelong journey of professional development and learning.</td>
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**ISE Program Educational Objectives and Student Outcomes**

The ISE faculty has defined the following Program Educational Objectives (PEOs) and Student Outcomes that support our Undergraduate Program mission. The Program Educational Objectives statement describes the expected accomplishments of ISE graduates within 3-5 years after graduation. The Student Outcomes describe what students are expected to know and be able to do at the time of graduation. Significant input from students, ISE Advisory Board members, and faculty are used in developing and revising our PEOs.

### Program Educational Objectives: Within 3-5 years of graduation, ISE alumni will have:

1. Created value by applying the appropriate industrial and systems engineering tools to design/redesign integrated systems/processes, solve problems, implement innovative solutions, and improve organizational outcomes.
2. Provided formal and informal project, administrative, or technical leadership.
3. Pursued professional development via graduate study and/or continuing education in industrial engineering or related areas.
4. Communicated effectively using written, oral, and visual media adapted to different audiences and stakeholders
5. Worked effectively in cross-functional team environments comprised of members with varying organizational backgrounds, positions, and geographic locations.
6. Served the profession, community, and society, as exemplified in our motto Ut Prosim.

### Student Outcomes: At the time of graduation, ISE students will have 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 strategies.

To support the ISE Undergraduate Program, the ISE Undergraduate Program Committee was established to fulfill the following mission:

*To manage the ISE Undergraduate Program by overseeing the recruitment and retention of students; monitoring, implementing, and improving the BSISE curriculum and academic policies; and serving as an advocate for the Undergraduate Program in Departmental planning and decision making.*
Advising in ISE

The ISE Department has two Academic Advisors who serve as a resource for all students. Students with interests or questions in specific technical areas are referred to the appropriate faculty in that research area. For assistance in scheduling an appointment with Dr. Shewchuk, please see an ISE Academic Advisor or the receptionist in 250 Durham Hall.

The ISE Academic Advisors are the primary contact for all students regarding questions about University, College, and Departmental policies and procedures, the ISE curriculum, program of study planning, registration procedures, course loads, course substitutions, prerequisite rules, transfer credit, changing majors, and other related matters. When appropriate, an ISE Academic Advisor will refer students to campus resources, such as Cook Counseling Center or Services for Students with Disabilities.

The Career and Professional Development Co-op Advisor assists students with the administrative details of the Cooperative Education Program. For information on participating in the Co-Op program, visit the website at www.career.vt.edu. The advisor in Career and Professional Development responsible for ISE students can be contacted at 540-231-6241. Ms. Maggie Johnson is the Co-Op liaison for ISE students enrolled in the Co-Op program.

The Global Education Office Advisors assist students with the administrative details of planning and participating in an Education Abroad Program. For information on selecting and enrolling in an abroad program, students should first visit the GEO website at www.globaleducation.vt.edu and make an appointment by email at vtabroad@vt.edu or by phone at 540-231-5888. Ms. Paula Van Curen is the Study Abroad liaison for ISE students participating in an education abroad experience.

The Undergraduate Program Director resolves questions of a unique nature: for example, discussions concerning a particular class or the procedures in the class. If you are unsure who to see about a particular question or concern, please refer to Appendix C and see an ISE Academic Advisor.

Helpful Hints

- Keep this handbook as a reference, and obtain an updated copy at the start of each academic year. Each fall semester, check the ISE Department website for copies of the relevant checksheet for your graduation year and approved electives lists. The 2020 Checksheet is the most recently-approved checksheet, and pertains to students graduating in the 2020 calendar year and is included in this handbook. The 2019 Checksheet (students graduating in calendar year 2019) can be found on the ISE Department website and the Registrar’s website.
- Take your updated Checksheet and Hokie ID with you when you meet with your Academic Advisor.
- Use the appropriate Checksheet and the approved current electives lists to guide you in your selection of courses when registering for classes. The following courses should take precedence in scheduling:
  - all required courses should be added first; then add CLE and electives
  - courses that you have failed,
  - ISE, STAT, and MATH courses in which you received less than a C- and that are prerequisites for other ISE classes (see Appendix G), and
  - courses that you missed due to internships, study abroad, etc.
- Ensure that you have the proper prerequisites before registering for an ISE course. Students not meeting prerequisite requirements for a course are dropped from the course before the semester begins.
- Submit an Overload Request form to the Dean’s office in 212 Hancock if you want to take more than 19 credits in a fall/spring semester or more than 9 credits during a summer term.
- Discuss D’s and F’s as soon as possible with an ISE Academic Advisor.
- If you make less than 2.0 for any semester, reduce your course load.
- Keep track of your degree progress by checking your Degree Audit Report (DARS) each semester. The DARS is a computer-generated report that identifies degree requirements that you’ve completed and requirements that you still need to complete for your degree.
- Regularly check your email for notices concerning course offerings, Cook Counseling Center and Career Services seminars, summer internships, permanent job opportunities, and study abroad opportunities, etc.
I. ACADEMIC POLICIES AND PROCEDURES

This section on policies and procedures is not meant to be completely exhaustive. Refer to the 2018-2019 Undergraduate Catalog for further information on these policies and procedures.

### Academic Eligibility Policy

All students must maintain a **cumulative GPA of 2.0**. Academic Performance is reviewed at the end of fall and spring semesters. Those earning less than a 2.0 are placed on academic probation until the GPA has reached a 2.0. A student placed on academic probation at the end of the academic year may enroll in the summer and/or fall semester to bring up his/her GPA. A student who does not raise their cumulative GPA to the minimum 2.0 is suspended for one (1st Suspension) or two (2nd Suspension) regular semesters. For all programs except Honors, the minimum cumulative and in-major GPA for graduation is 2.0.

### Evaluation and Examination Policies

- **Evaluation**: The instructor is solely responsible for evaluating academic performance and assigning grades. Grades are based on assignments rather than on class attendance per se. However, instructors may use attendance as part of the grading criteria. Instructors are expected to prepare a syllabus outlining course objectives, covered topics, and grading scheme, and to make the syllabus available to enrolled students by the first day of class. Justifiable modification of the syllabus may result from classroom experience during the course, but the Department Head and enrolled students are informed if changes are made.

- **Final Examination Schedule**: A final exam schedule is available through the on-line timetable each semester. Failure to take an examination without pre-approval yields a zero grade for the exam. The grade is then weighted as specified in the course syllabus (grading scheme). Examination periods for one-credit and laboratory courses are scheduled during the last regular class period; for all other courses, check the final examination schedule. Students are entitled to review their graded examination papers.

- **Rescheduling Final Examinations**: Students with conflicting exams or more than three exams within 24 hours may reschedule an examination by arrangement with the instructor and permission of the student’s Academic Dean. The final exam approval form is on the College of Engineering website. Students unable to take an exam because of illness or circumstances beyond their control may reschedule an exam with permission from the Academic Dean and Schiffert Health Center and by making arrangements with the instructor. In some cases, an “I” (incomplete) grade is assigned. An “I” will not affect your GPA unless the requirement is not made up before the end of the first subsequent semester of enrollment; i.e., failure to make up the “I” before the end of the next semester in which you are enrolled will result in an F grade.

- **Reading Day**: There is at least one full day for study between the last day of classes and the first day of the examination period each semester and at least one-half day each summer term.

- **Tentative Grades for Spring Degree Candidates**: Several days before the last day of classes, faculty submit tentative grades for degree candidates to the Registrar. Classes continue as scheduled; final exams are required except as noted. Final grades are submitted to the Registrar before Commencement.

- **Grade Changes**: Once grades are submitted to the Registrar, a grade change is permitted only to correct errors. Grade changes should be made before the end of the student's first subsequent term of enrollment. Reason(s) for the grade change is given on the change-of-grade submission, which is signed by the instructor and submitted to an ISE Academic Advisor. Approval by the Department Head and Academic Dean is required before acceptance of a grade change by the University Registrar.

- **Re-examinations**: A re-examination in one course, in which the final grade is C– or below, may be authorized when a student was enrolled in that course during the final term of his/her senior year and when satisfactory performance on the re-examination qualifies the student for graduation. A re-examination request must be made and the exam must be completed by the student as soon as possible after the first exam. Re-examination must be approved by the instructor, the student's Department Head, and the student’s Academic Dean.
**Honor System**

The ISE Undergraduate Program operates within the guidelines of the University's Undergraduate Honor System. Violations of classroom, departmental, or university academic policy are dealt with as Undergraduate Honor System violations. Please understand that posted departmental information, homework solutions, homework returned through centralized mailboxes, and reserved library materials are included under the Honor Code. Please read the guidelines at [www.honorsystem.vt.edu](http://www.honorsystem.vt.edu).

**ISE Departmental Policy Regarding Term Projects**

Students submitting reports in partial fulfillment of the requirements for an ISE course are not permitted to use reports, in whole or in part, which were done to satisfy requirements in another course. Reports must be prepared solely by the student (or group of students, when applicable), with the express purpose of satisfying the requirements of a particular ISE course. Information taken from other sources (including previous reports) must be properly credited. **Use of another's report or failure to give credit constitutes a violation of the Undergraduate Honor Code.** Exceptions to this policy may be made by individual instructors. Students wishing to be exempt from the policy must discuss their intentions with each instructor involved and receive written permission.

The Industrial and Systems Engineering curriculum, through instruction in both technical matters and their presentation, is designed to educate students to enter the engineering profession. Written documents constitute a vital part of the engineering profession; therefore, students are expected to submit written documents of professional quality. Reports with spelling, punctuation, or grammatical errors, are unprofessional and evaluated accordingly. Students may request assistance through the Writing Center.

**Pass/Fail Grade System**

The P/F grading option is available to students who have completed a minimum of 30 credits and have a cumulative GPA of 2.5 or above. **No required course or course used for the Curriculum for Liberal Education may be taken on a P/F basis** (with the exception of CLE Area 6 courses that are taught P/F only). Students using electives to complete Minor requirements may be required to take all courses as an A/F option – carefully check the Minor checksheet requirements and consult with an ISE advisor.

Once credit is received for a course taken P/F, the course cannot be repeated under the A/F option. A course to be taken as P/F should be designated as such upon request for the course. Course grading options may be changed to P/F until the drop deadline and can be changed to A/F until the resignation deadline for each semester.

**Policy Memo 91/Satisfactory Progress**

**Satisfactory Progress towards Degree:** University Policy 91 outlines university-wide minimum criteria to determine if students are making satisfactory progress towards the completion of their degrees. The ISE Department fully supports this policy. Specific expectations for satisfactory progress for Industrial & Systems Engineering majors are as follows:

- Each student must meet the minimum University-wide criteria as described in Policy 91 and summarized in the Undergraduate Catalog (under Academic Policies)
- Additionally, upon completing 72 credit hours (including transfer, advanced placement, advanced standing, and credit by examination), students must:
  - have a minimum in-major GPA of 2.0 or better (in-major GPA is determined from all ISE and required STAT classes); and
- have completed ISE 2004, 2014, 2034, 2214, 2404, STAT 4105, MATH 2214, MATH 2204; and
  - be enrolled in 12 or more credits of ISE classes per year.
Transferring Credits Back to Virginia Tech

The Registrar maintains a Transfer Equivalency Database showing courses from colleges in Virginia and throughout the U.S. that have been evaluated in the past. This database is a historical list to be used as tool to help you find equivalent courses. It is NOT a guarantee that the course is still equivalent. Fill out a transfer credit request form (www.eng.vt.edu/forms) to have courses pre-approved, even if they are listed in the database. An approved form guarantees that you will receive the credits you expect.

If a course is not listed in the database, it has not been evaluated for transfer equivalency. Obtain a copy of a recent syllabus for the course you want to take, attach it to a transfer credit request form and turn it in to the Academic Dean’s office in 212 Hancock. Allow at least three weeks for approval. Upon course completion, have an official copy of your transcript showing final grade(s) mailed to the Office of the University Registrar. The mailing address can be found on the Registrar’s website.

Until the transfer credits appear on your VT transcript, they will not be recognized by the course registration software as satisfying prerequisite requirements. If you cannot add a class that requires a transfer course as a prerequisite, submit a force-add request on the ISE Undergraduate Programs website. Be prepared to provide a copy of your approved transfer credit request form and an unofficial copy of your grade to an ISE Advisor to review and add the course for you.

Course Withdrawal Policy & Procedure

Students may apply the W grade option to a maximum of 3 courses (regardless of credit hours) during their undergraduate academic tenure. This request must be submitted to the Undergraduate Academic Affairs Office in 212 Hancock Hall with your signature and your advisor’s signature no later than 5:00 p.m. on the last day of classes for courses taken during the current semester. Course(s) with a status of CW will appear on your transcript as a “W” grade and on Hokie Spa after final grades are posted but do not count in GPA hours nor in any GPA calculations.

Course Withdrawal Policy Stipulations are listed below:
- Use of this grade option may affect Reasonable Academic Policy requirements for continued receipt of federal financial aid.
- A student decision to invoke this policy is irrevocable and may not be appealed.
- The “W” grade option may not be used to remove a penalty otherwise accruing to student under the University Honor System.
- If a registration hold exists at the time of application, the student must take action to remove the hold within five working days of the application or the request will be voided.

Credit Hour Loads and Credit Overload Permission

Minimum full-time enrollment for undergraduate students is 12 credit hours during the fall and spring semesters. Audit hours are not used in establishing minimum full-time enrollments. Students who want to take more than 19 credit hours during Fall and Spring and more than 9 credit hours for each summer semester must obtain "Overload Permission" from the Academic Dean before the add deadline closes for the semester. The overload request form is available on-line at: http://www.eng.vt.edu/forms/.

The University does not require you to be a full-time student. The number of credits you take each semester is your decision. It is important, however, for you to determine if there are other considerations, such as health or car insurance, federal financial aid, scholarships, or on-campus housing that require you to be a full-time student. Any questions regarding financial aid should be addressed to your financial aid advisor. See the Scholarships & Financial Aid website at www.finaid.vt.edu.
II. **REGISTRATION AND SCHEDULING PROCEDURES**

Details of registration procedures are not provided in this handbook, as these are specified in the Timetable of Classes and the Registrar’s website for each semester. However, a few comments of importance are discussed below.

**Course Scheduling**

ISE required courses are offered in the regularly scheduled semesters as indicated on the ISE Checksheet. Almost all ISE courses are offered only once during the academic year (fall & spring) and once during the summer to accommodate students completing a co-op/internship or repeating a course in which they did not earn the minimum C-grade. However, a summer offering of a required course is not guaranteed (if enrollment does not reach a required minimum number of students, the course may be canceled). For this reason, do not assume you can take a required course in the summer. Students who leave two or more required courses for the summer also risk having time conflicts with courses outside the ISE department. Plan to take courses in the semester indicated by the appropriate checksheet.

ISE Technical Electives are typically offered once during the academic year with no offerings during the summer. Check the timetable and consult with an ISE Academic Advisor if you have a question regarding when a technical elective is offered. New courses may be added under the course number ISE 4984 (Special Study) and are announced to students via the undergraduate listserv. Independent Study (ISE 4974) and Undergraduate Research (ISE 4994) hours are arranged with a faculty member; see an advisor for the registration process for these types of courses.

**Force-Add Policy & Procedure**

If you are unable to add an ISE class or classes via add/drop (i.e. pre-requisite is not recognized or transfer credit for pre-requisite is not yet posted on transcript), submit a force-add request on-line through the ISE Undergraduate Programs Department website. Note that the department will not process force-add requests for time or professor preference. The ISE department cannot force-add classes from other departments: students must contact the department of the course they need to force-add.

**Plan of Study**

The ISE Undergraduate Program provides students with a very strong foundation in all four areas of the discipline: human factors engineering and ergonomics, management systems engineering, manufacturing systems engineering, and operations research. However, the department does not currently offer options in any particular area at the undergraduate level.

**Graduation Checksheets**

Checksheets for each class are available in 241 and 243 Durham Hall, on the ISE Department website, and on the Registrar’s website. Students must fulfill the checksheet requirements according to the calendar year of graduation, regardless of when they entered the University. Note that the Checksheet (Appendix G) indicates recommended course sequencing, based on prerequisite and co-requisite requirements.

During the sophomore year, students will apply for a degree and request a Degree Audit Report (DARS) from the University Registrar via Hokie Spa. The DARS lists all the student’s completed and future graduate requirements. Students can make changes (i.e. graduation date) to their DARS through Hokie Spa as well.
**Electives within the BSISE**

There are different types of electives in the ISE curriculum. An updated list of classes that meet CLE requirements is available online in the Curriculum for Liberal Education Guide. Please note comments under each elective type as follows:

- **Humanities/Social Science Electives (Areas 2 and 3):** The current policy requires completion of 6 credits in Area 2, *Ideas, Cultural Traditions, and Values* and 6 credits in Area 3, *Society and Human Behavior*.

- **Creativity and Aesthetic Experience (Area 6):** 1 credit required. With the exception of MUS 3314, which requires an audition, 1-credit Area 6 courses are no longer offered. A 3-credit Area 6 course will fulfill Area 6 and 2 credits of Free Electives.

- **Global Issues Elective (Area 7):** 3 credits required. Certain Area Seven courses may also fulfill an Area Two or Three course requirement. These courses are designated as such in the UG Catalog, the Curriculum for Liberal Education Guide, and in the timetable. If a student uses one of these courses to double-count in two areas, additional credits must be taken to maintain the required minimum of 127 credits for graduation.

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All courses taken to fulfill the Curriculum for Liberal Education must be taken on an A/F (not P/F) basis. Consult the latest issue of the Undergraduate Catalog or the Curriculum for Liberal Education Guide for course descriptions, prerequisite requirements, and restrictions.

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- **Technical Electives** (Appendix G). 6 credits required. See latest checksheet when selecting courses.

- **ISE Technical Electives** (Appendix G). 9 credits required.
  - ISE 2204 and ISE 3xxx or 4xxx level courses are used to fulfill this requirement.
  - Non-ISE courses may not be substituted for ISE Technical Electives.
  - An ISE graduate level course may be taken to fulfill this requirement if student:
    - is within one semester of graduation, and
    - has a 3.0 GPA or better, and
    - has obtained permission of the course instructor.

Students may take either **ISE 4974 (Independent Study)** or **ISE 4994 (Undergraduate Research)** to satisfy 3 credits of ISE Technical Elective. These courses are arranged on an individual basis with an ISE faculty member, and a request for approval is submitted on the appropriate form to your advisor by the deadline specified by the College of Engineering. A list of potential ISE 4994 Undergraduate Research projects is sent to the undergraduate student listserv before the start of each semester; however, students are not limited to this list. See an ISE academic advisor or faculty member about using ISE 4974 or ISE 4994 for technical elective credit. Updated lists of ISE Technical Elective offerings are available each semester from an ISE Academic Advisor. **ISE 4984 (Special Study)** courses are also on these lists. Changes affecting course offerings are sent to the undergraduate student listserv.

- **Free Electives** (Appendix G). 2-3 credits required. Can be taken P/F.

- **Engineering & Science Elective** (Appendix G). 3 credits required. Choose either ECE 3054/Electrical Theory or ESM 2304/Dynamics.

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When selecting electives, do not enroll in courses that duplicate requirements you have already taken or will be required to take later. Duplicated course credit cannot count toward degree requirements.
Minors for ISE Students

A minor is a program of study requiring some depth in a subject, but not as extensive a program as a major. A minor enhances what you are already learning with an ISE degree. It will specialize your learning while in ISE and will make you more marketable to future employers. In general, minors consist of at least 18 and no more than 22 credits of coursework. At least six credits for the minor must be advanced (300-level or 400-level courses).

Business Minor (Appendix D)

A Business Minor will enhance a student’s skill set in order to pursue a position in management or leadership. Classes such as Principles of Economics and Accounting will augment skills learned in ISE classes such as Engineering Economy and Project Management and System Design. A broader understanding of business concepts will benefit ISE graduates when entering the business world.

With proper planning, an ISE student may complete the Business Minor requirements by purposeful selection of elective courses and by taking 12 credits above and beyond the BSISE requirements. Based on an agreement between the College of Business and the ISE Department, several classes which fulfill ISE departmental requirements also fulfill Business Minor requirements. Students may select specified electives to fulfill both Business Minor and CLE requirements (e.g., ECON 2005-2006). Interested students may obtain the application/checksheet from the College of Business, an ISE Academic Advisor, or the ISE website.

Green Engineering Minor (Appendix D)

A Green Engineering Minor is desirable for ISE majors because it provides a basic understanding of environmental issues when it comes to manufacturing and industrial systems. With this understanding, industrial and systems engineers will be able to make these systems more efficient and more environmentally friendly. An increasing emphasis on making processes and systems more “green” has resulted in companies recruiting ISE graduates with a Green Engineering Minor.

With proper planning, students may complete the Green Engineering Minor requirements by taking no additional course requirements. Required Minor Core courses can satisfy 6 credits of Technical Elective credits for ISE students, and the Engineering Elective courses include required ISE courses. The Interdisciplinary Elective Course List requires 6 credits; there are several classes that double-count for Area 2 and/or Area 7 credit. Refer to the Green Engineering Minor Checksheet and see an ISE Academic Advisor for more information.

Other Minors

If there is a Minor that you are interested in pursuing, talk to an advisor for more details on requirements. A list of all available Minors can be found on the University Registrar website at www.registrar.vt.edu. Other minors that can be taken include, but are not limited to:

- Biomedical Engineering
- Computer Science
- Economics
- Math
- Psychology
- Sociology
- Statistics
- Foreign Language (Spanish, French, etc.)
IV. PROFESSIONAL DEVELOPMENT AND STUDENT ORGANIZATIONS

Students are advised to explore ways in which to develop themselves professionally, not only as engineers, but as individuals preparing for the workplace. Students are encouraged to take advantage of both work and organizational opportunities to enhance their professional competencies. Students may participate in extracurricular activities, study abroad, undergraduate research, and work experiences such as a co-op or an internship. This section provides information on the student professional societies, the Cooperative Education Program, summer internships, and study abroad. See an ISE Academic Advisor for further advice.

ISE Student Organizations

Institute of Industrial and Systems Engineers (IISE)

The primary professional society in the discipline is IISE, an organization of practicing Industrial and Systems Engineers which exists to enhance the development of the profession. The Virginia Tech student chapter is very active and has achieved the highest level of recognition possible (Gold Award) from the international organization.

Chapter activities include organizing and attending regional and national technical conferences; presentations by speakers from industry and government; industry plant tours; and professional certification workshops for students (i.e. Six Sigma Green Belt). IISE student members also participate in community service activities and sponsor annual events such as the spring departmental picnic, departmental Constructive Curriculum Review session, and various social activities to promote student and faculty interaction.

Alpha Pi Mu (APM)

Alpha Pi Mu is the national honor society for Industrial Engineering, which recognizes and promotes scholastic achievement and professional development in Industrial Engineering. There are currently 72 society chapters and national membership has reached 45,000. The VT Student Chapter has approximately 50 active members and is among the most active chapters in the nation. The student chapter’s activities support the ISE Department, the College of Engineering, and the University. Initiation into Alpha Pi Mu is by invitation and is restricted to registered students pursuing a graduate or undergraduate degree in ISE. At the undergraduate level, consideration is given to juniors in the upper one-fifth and seniors in the upper one-third of their classes who have demonstrated leadership and ethical behavior. Membership invitation is made subsequent to a chapter election held in the Fall and Spring Semesters of each academic year.

ISE Student Ambassadors

Students who serve as volunteer ISE Ambassadors support the ISE Department in a complementary way, along with IISE and APM. The ambassadors assist with Department, College, and University recruiting events for prospective students, (e.g., the Engineering Open House, University Open House weekends, etc.), and freshman engineering students at the Freshman Information Session. The Ambassadors also plan and conduct many activities for current students and alumni, including social events, Family Day, curriculum improvement, alumni relations, and community service. Ambassadors are selected through an application and interview process in the spring semester, with service as an Ambassador to begin the following fall semester. See Ms. Maggie Johnson for more information.

Human Factors and Ergonomics Society (HFES)

HFES is an interdisciplinary organization of professionals involved in the human factors field. The society promotes the discovery, exchange, and application of knowledge concerning the relationship of people to machines and the environment. HFES also support the development of working and living environments that are comfortable and safe. It encourages the appropriate education and training of those who conceive, design, develop, manufacture, test, manage, and participate in systems. The student chapter promotes human factors as an interdisciplinary profession in the University community and sponsors external and internal speakers on wide-ranging human factors concerns.
Cooperative Education & Internship Program (CEIP)

The Cooperative Education & Internship Program is an undergraduate academic program that incorporates real world work experience and learning into the student's college academic experience. Co-ops and internships enhance students’ educational experience with real-world career-related work experience as well as help students develop skills and knowledge applicable to their career fields. Participation in CEIP is an excellent way to build credentials for employment or admission into graduate school.

A “Co-Op” usually refers to a work agreement with one employer for at least three work terms alternated with school terms, resulting in a five-year degree program for what would otherwise take four years. Co-ops are full-time, paid positions. An “internship” usually refers to a one-term work assignment, most often in the summer (not always) and can be full-time or part-time. Keep in mind that not all employers use these terms consistently or with consistent meanings. Once enrolled in the CEIP program, students are required to complete a form provided by the Career and Professional Development staff. This form will require the signature of the ISE Department Co-Op Liaison, Ms. Maggie Johnson.

The Engineering Expo Career Fair, sponsored by the Student Engineers’ Council, is held in September. Students are encouraged to bring their resumes and meet with recruiters to identify potential internships or co-ops. The Connection Co-op & Internship Job Fair, held specifically for students looking for co-op and internship experience, is held in February. For a detailed explanation of Co-Op’s and internships, information on participating in the CEIP program, and other career fairs, refer to the Career and Professional Development website at [www.career.vt.edu](http://www.career.vt.edu).

ISE Study Abroad Exchange Programs

The ISE Department participates in student exchange agreements with universities in Brazil and Germany. ISE students take pre-approved ISE and other courses that transfer back to meet BSISE degree requirements. Students may also identify other courses of interest and request approval before departure from Virginia Tech. Program costs includes VT tuition & fees, travel, housing & food.

To reach the recommended language proficiency before departure, students may take academic courses and use resources available through the VT Library’s Language Resource Center (i.e. Rosetta Stone). Free tutoring to meet students’ learning needs can also be arranged. Students may also learn about available scholarships and financial aid for study abroad through the Scholarships and Financial Aid office and the ISE study abroad advisor, Ms. Paula Van Curen.

ISE Students are not limited to these two exchange programs, however. Interested students can research all study abroad opportunities at the Global Education website [www.globaleducation.vt.edu](http://www.globaleducation.vt.edu) and at the College of Engineering website at [https://www.eng.vt.edu/international](https://www.eng.vt.edu/international). Afterwards, meet with Ms. Van Curen, to see how a study abroad experience can fit into the ISE curriculum.

Karlsruhe Institute of Technology (KIT)

KIT is one of the largest and most prestigious research and education institutions in Germany and is one of the leading universities in engineering & science in Europe. German language skills are necessary since most classes are taught in German. Completion of GER 2106 or equivalent before departure is recommended. Students arrive one month before the start of the semester to spend that time studying German in an immersion class and acclimating to the university and local community.

Pontifical Catholic University of Paraná (PUCPR)

PUC-PR is a private, not-for-profit university with a high percentage of students from different countries and a strong support infrastructure for international students. The main campus is located in Curitiba, the capital city of the State of Parana in Brazil. Completion of PORT 1106 or equivalent before departure is recommended. Students arrive approximately one month before the start of the semester to spend that time studying Portuguese in an immersion class and acclimating to the university and local community.
V. ISE Courses And Faculty

ISE undergraduate courses offered by the department are listed below, along with a course description, prerequisites, and semester typically offered: I (Fall), II (Spring), III (Summer I), and IV (Summer II). Courses in bold are required for the BSISE degree.

### ISE 2004: INTRODUCTION TO INDUSTRIAL AND SYSTEMS ENGINEERING (1H, 3L, 2C)
Pre: ENGE 1104, ENGE 1114, ENGE 1434 or ENGE 1216 (C- or better)  Offered: I, III
Introduction to the industrial and systems engineering profession through exposure to problems, principles, and practice. Integrated systems approach to problem solving. Foundation of data manipulation and preparation for problem analysis. Development of communication skills, career opportunities, importance of professionalism, ethics, contemporary issues, lifelong learning, and introduction to ISE Department.

### ISE 2014: ENGINEERING ECONOMY (2H, 2C)
Pre: ENGE 1024 or ENGE 1215 (C- or better) or BC 1224  Offered: I, II, III, IV
Concepts and techniques of analysis for evaluating the value of products/services, projects, and systems in relation to their cost. Economic and cost concepts, calculating economic equivalence, comparison of alternatives, purchase versus lease decisions, financial risk evaluation, cash flow sensitivity analysis, and after-tax analysis.

### ISE 2034: DATA MANAGEMENT FOR ISES (3H, 3C)
Pre: CS 1044 or CS 1064.  Offered: II, IV
Investigation of data modeling, storage, acquisition, and utilization in industrial and systems engineering via manual and computerized methods. Development of effective spreadsheet applications. Design and implementation of relational databases via entity-relationship modeling, relational schema, and normalization. Web-based database applications. Interface design and the system development life cycle applied to data management applications. All topics covered within the context of typical industrial and systems engineering problems.

### ISE 2204: MANUFACTURING PROCESSES (3H, 3C)
Pre: ENGE 1104, ENGE 1114, ENGE 1434 or ENGE 1216 (C- or better)  Offered: II
Survey of manufacturing processes including casting, forming, machining, welding, joining, and non-traditional processes such as laser-beam and electrical-discharge machining. Basic structure of metals, physical, and mechanical properties and their relationship to manufacturing. Process planning and the effect of plans on cost, safety, and the environment. Impact of product design on manufacturability: design for manufacture, assembly, etc. Includes topics in inspection and testing, jigs and fixtures, and numerical control.

### ISE 2214: MANUFACTURING PROCESSES LABORATORY (3L, 1C)
Pre: ENGE 1104, ENGE 1114, ENGE 1434 or ENGE 1216 (C- or better)  Offered: I, II, III
Laboratory exercises and experimentation in manufacturing processes. Emphasis on using production machines and equipment to make products using multiple manufacturing processes, coupled with inspection per engineering drawings. Processes include assembly, casting, machining, forming, welding, and non-traditional machining, performed manually and/or via computer programming. Covers shop floor operation and documents used to monitor and control part production.

### ISE 2404: DETERMINISTIC OPERATIONS RESEARCH (3H, 3C)
Pre: MATH 1114 or 2114  Offered: II, III
Deterministic operations research modeling concepts; linear programming modeling, assumptions, algorithms, modeling languages, and optimization software; duality and sensitivity analysis with economic interpretation; network models (formulations and algorithms), including transportation problems, assignment problems, shortest path problems, maximum flow problems, minimum cost network flow problems, minimal spanning tree problems.

### ISE 2994: UNDERGRADUATE RESEARCH VARIABLE CREDIT COURSE

### ISE 3004: INDUSTRIAL COST CONTROL (3H, 3C)
Pre: ISE 2014 (C- or better) or ME 2024  Offered: II
Fundamentals of general and cost accounting practices applied to manufacturing and service organizations. Cost accounting, standard cost determination, cost and budgetary control systems.

### ISE 3214: FACILITIES PLANNING AND LOGISTICS (3H, 3C)
Pre: ISE 2014, 2404, 3414 (C- or better)  Offered: II, IV
Theory, concepts, methods for designing and analyzing facilities and material flow in manufacturing, storage, distribution environments. Material handling systems, facility layout, facility location, warehousing, distribution, logistics, transportation.
**ISE 3414: PROBABILITY OPERATIONS RESEARCH**  
(3H, 3C)
Pre: ISE 2004, STAT 4105, MATH 2214, MATH 2224 or 2204, (C- or better);  
CS 1044 or 1064,
Offered: I, III
Introduces probability models used to investigate behavior and performance of manufacturing, and service systems under conditions of uncertainty. Topics include probability, conditioning, elementary counting processes, and Markov chains & processes. Emphasis on the use of these tools to model queues, inventories, process behavior, and equipment reliability.

**ISE 3424: DISCRETE-EVENT COMPUTER SIMULATION**  
(2H,3L,3C)
Pre: ISE 3414, STAT 4105 (C- or better)
Offered: II, IV
Analysis and design of work systems through static and dynamic simulation. Topics include an introduction to systems analysis and modeling, simulation optimization, model development, and testing and problem analysis through simulation.

**ISE 3434: DETERMINISTIC OPERATIONS RESEARCH I**  
(3H, 3C)
Pre: ISE 2004, 2404, MATH 2224 or MATH 2204 (C- or better)
Offered: I, III
Advanced concepts in deterministic operations research, including theory of complexity, integer programming, advanced linear programming techniques, nonlinear programming, and dynamic programming. Covers modeling languages and optimization software for integer programming and nonlinear programming problems.

**ISE 3614: INTRODUCTION TO HUMAN FACTORS ENG. & ERGONOMICS**  
(3H, 3C)
Pre: ISE 2004, Co: STAT 4105
Offered: I, II, III
Investigation of human factors, ergonomics, and work measurement engineering, with emphasis on a systems approach toward workplace and machine design. Discussion of basic human factors research and design methods, design/evaluation methods for work systems and human machine interactions, human information processing, visual and auditory processes, display and control design, and effects of environmental stressors on humans.

**ISE 3624: INDUSTRIAL ERGONOMICS & WORK MEASUREMENT**  
(3H, 3C)
Pre: ISE 3614 (C- or better), ESM 2104.
Offered: I
Introduction to ergonomics and work measurement with an emphasis on people at work. Discussion of methods for work measurement, ergonomic assessment, and evaluation, with major topics including productivity and performance, manual materials handling, work related musculoskeletal disorders, safety, training and legal issues.

**ISE 4004: THEORY OF ORGANIZATION**  
(3H, 3C)
Offered: I
A theory of cooperative behavior in formal organizations, including the structure and elements of formal organizations. The executive process and the nature of executive responsibility also are examined.

**ISE 4005-4006: PROJECT MANAGEMENT & SYSTEM DESIGN**  
4005: (3H,3C)  4006: (2H,2C)
Pre: ISE 2214, 3214, 3424, 3614, 4404 (C- or better) for 4005;
Co: 3624;  ISE 3624, 4005, 4204 (C- or better) for 4006.  
4005 Offered: I  4006 Offered: II
4005: Capstone design sequence for ISE majors. 4005: Structured systems engineering and project management methods and tools to plan, manage, and execute technical industrial and systems engineering projects. Students work in teams to apply industrial and systems engineering and project management tools to define and analyze a real-world problem.  
4006: Design, implement, and evaluate work system solutions. Communication of solutions to project stakeholders.

**ISE 4015: MANAGEMENT SYSTEMS THEORY, APPLICATIONS, AND DESIGN**  
(3H, 3C)
Offered: I
Systems approach to management, domains of responsibility, structured and synergistic management tools, management system model, contextual frameworks, information portrayal, automation objectives model, evaluation, shared information processing, information modeling. Management process for definition, measurement, evaluation & control, an organization as an information processor, corporate culture, scoping agreements, schemas, management elements, structured design.

**ISE 4204: PRODUCTION PLANNING AND INVENTORY CONTROL**  
(3H, 3C)
Pre: ISE 2404, 3414, STAT 4706 (C- or better).
Offered: I
Theory & concepts in model formulation for analysis & control of production processes. Systems for planning and controlling production & inventory: material requirements planning (MRP), just-in-time (JIT), & synchronous production systems.

**ISE 4214: LEAN MANUFACTURING**  
(3H, 3C)
Pre: ISE 4204 (C- or better).
Offered: II
Lean Manufacturing principles, theory, methods, and techniques in modern manufacturing enterprises. Lean manufacturing philosophy, basic concepts, master production scheduling, production smoothing, assembly line sequencing, setup time reduction, U-shaped line balancing/operation, machine arrangement, Kanban, automation, quality control. Investigation and discussion of lean manufacturing case studies.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Prerequisites</th>
<th>Offered</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISE 4264</td>
<td>INDUSTRIAL AUTOMATION</td>
<td>2H,3L,3C</td>
<td>Pre: 2204 or 2214 (C- or better)</td>
<td>I or II</td>
</tr>
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<td></td>
<td>A survey of the various technologies employed in industrial automation. This includes an emphasis on industrial applications of robotics, machine vision, and programmable controllers, as well as an investigation into problems in the area of CAD/CAM integration. Examination of the components commonly employed in automation systems, their aggregation and related production process design. Laboratory work is required.</td>
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<tr>
<td>ISE 4304</td>
<td>GLOBAL ISSUES IN INDUSTRIAL MANAGEMENT</td>
<td>3H, 3C</td>
<td>Offered: II</td>
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<td></td>
<td>Industrial management topics of current interest explored from a global perspective. Current domestic and international challenges resulting from a global marketplace and the proliferation of information and technology. Industrial management and organizational performance, total quality management, business process re-engineering, leadership, organizational change, role of communication and information, and ethics. Examination and comparison across international boundaries.</td>
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<tr>
<td>ISE 4404</td>
<td>STATISTICAL QUALITY CONTROL</td>
<td>3H, 3C</td>
<td>Pre: 3414, STAT 4105, STAT 4706 (C- or better)</td>
<td>II, IV</td>
</tr>
<tr>
<td></td>
<td>Application of statistical methods and probability models to the monitoring and control of product quality. Techniques for acceptance sampling by variables and attributes are presented. Shewhart control charts for both classes of quality characteristics are examined in depth. The motivation for each method, its theoretical development, and its application are presented. The focus is upon developing an ability to design effective quality control procedures.</td>
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<tr>
<td>ISE 4414</td>
<td>INDUSTRIAL QUALITY CONTROL</td>
<td>3H, 3C</td>
<td>Pre: 4404 (C- or better)</td>
<td>I or II</td>
</tr>
<tr>
<td></td>
<td>Implementation of statistical quality control techniques in an industrial setting. Development and analysis of cost models for use in the design of optimal quality control plans. Also included are new techniques, advanced quality control models, and an examination of the role of industrial statistics in the overall product quality assurance function.</td>
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<tr>
<td>ISE 4424</td>
<td>LOGISTICS ENGINEERING</td>
<td>3H, 3C</td>
<td>Pre: ISE 3414 (C- or better)</td>
<td>I or II</td>
</tr>
<tr>
<td></td>
<td>Introduction to key issues in the integrated support of a product of process. Synthesis of topics from earlier studies to provide a cohesive approach to their applications. Logistics engineering provides a survey of product support issues and methods of resolving them within the context of the overall production activity.</td>
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</tr>
<tr>
<td>ISE 4624</td>
<td>WORK PHYSIOLOGY</td>
<td>3H, 3C</td>
<td>Pre: ISE 3624 (C- or better)</td>
<td>I or II</td>
</tr>
<tr>
<td></td>
<td>Anthropometry, skeletal system, biomechanics, sensorimotor control, muscles, respiration, circulation, metabolism, climate. Ergonomic design of task, equipment, and environment.</td>
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<tr>
<td>ISE 4644</td>
<td>OCCUPATIONAL SAFETY AND HAZARD CONTROL</td>
<td>3H, 3C</td>
<td>Pre: ISE 3614 (C- or better)</td>
<td>I or II</td>
</tr>
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<td></td>
<td>Survey of occupational safety. Topics include: history of occupational safety; hazard sources related to humans, environment, and machines; engineering management of hazards.</td>
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<tr>
<td>ISE 4654</td>
<td>PRINCIPLES OF INDUSTRIAL HYGIENE</td>
<td>3H, 3C</td>
<td>Offered: I or II</td>
<td></td>
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<tr>
<td></td>
<td>Introduction to the foundations of the Industrial Hygiene field, the discipline devoted to the anticipation, recognition, measurement, evaluation, and control of occupational health hazards. Includes biological (microbial agents, allergens), chemical (solvents, carcinogens), and physical (radiation, temperature) hazards. Overview of health hazards control, such as protective equipment, administrative controls, and engineering controls. Lecture and participatory &quot;case-study&quot; activities provide ample opportunity for hands-on use of monitoring equipment, protective equipment and controls testing devices.</td>
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<tr>
<td>ISE 4974</td>
<td>Independent Study Variable credit course.</td>
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<tr>
<td>ISE 4984</td>
<td>Special Study Variable credit course.</td>
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<tr>
<td>ISE 4994</td>
<td>Undergraduate Research Variable credit course.</td>
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</tbody>
</table>

The ISE Department does not permit an undergraduate student to work on an independent study, undergraduate research, or a senior design project while they are simultaneously being compensated for the same work.

Please see the Graduate Catalog for graduate course listings.
<table>
<thead>
<tr>
<th>Faculty</th>
<th>Areas of Interest</th>
</tr>
</thead>
</table>
| **Bansal, Manish, Ph.D. (Texas A&M University, 2014), Assistant Professor.** | Research Area: Operations Research  
Decision making with and without uncertainty in manufacturing (production planning), logistics (facility location), healthcare, geographical informative systems, and telerobotics. Methodologies: Mixed Integer Programming, Computational Geometry, Stochastic and Distributionally Robust Optimization |
<p>| <strong>Bish, Doug R., Ph.D. (Virginia Tech, 2006), Associate Professor.</strong> | Applied operations research; network models in transportation, logistics, and interdiction; disaster management and public health issues; revenue management; simulation of complex systems. |
| <strong>Bish, Ebru, Ph.D. (Northwestern University, 1999), Associate Professor.</strong> | Design and management of business processes that deliver goods and services; analysis of decision-making models integrating strategic operational perspectives; management and investment decision-making under uncertainty considering supply &amp; demand-side flexibility; modeling &amp; analysis of algorithms; combinatorial optimization. |
| <strong>Camelio, Jaime A. Ph.D. (University of Michigan, 2002), Rolls-Royce Commonwealth Professor of Advanced Manufacturing.</strong> | Assembly systems modeling, analysis, and control; data mining for manufacturing systems; remanufacturing; and micro-manufacturing. |
| <strong>Casali, John G., Ph.D. (Virginia Tech, 1982), John Grado Professor; Director, Auditory Systems Laboratory.</strong> | Human/machine interfacing; vehicular simulation and safety; industrial hearing protection and communications in noise. |
| <strong>Chen, Xi, Ph.D. (Northwestern University, 2012), Assistant Professor.</strong> | Stochastic modeling and simulation, applied probability, statistical methods, simulation experiment design and simulation optimization. |</p>
<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Field of Expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dickerson, Deborah E., Ph.D.</td>
<td>Associate Professor</td>
<td>Main Area: Human Factors Engineering and Ergonomics Prevention through Design; Usability; Design of tools, equipment, processes; Industrial Hygiene; Process Safety Risk-based Facility Maintenance Management</td>
</tr>
<tr>
<td>Ellis, Kimberly P., Ph.D.</td>
<td>Associate Professor</td>
<td>Design and analysis of manufacturing systems, production planning and control, applied operations research, information and systems design.</td>
</tr>
<tr>
<td>Gabbard, Joseph L., Ph.D.</td>
<td>Associate Professor</td>
<td>Usability engineering, cognitive human factors, human-computer interaction, user interface, visualization challenges for emerging technologies and domains, perception, cognition, and usability in augmented and virtual reality, empirical methods (experimental design, user-centered design and evaluation, statistical analysis)</td>
</tr>
<tr>
<td>Ghaffarzadegan, Navid, Ph.D.</td>
<td>Assistant Professor</td>
<td>Barriers for social and organizational learning in healthcare, education, and other public services, modeling the pipeline of biomedical workforce development in the U.S., potential impacts of federal organizations (such as NIH) on the medical research enterprise</td>
</tr>
<tr>
<td>Harmon, L. Kenneth, Jr., MBA</td>
<td>Associate Professor</td>
<td>Management of technology, performance improvement, and systems engineering; quality management; productivity/profitability improvement; total enterprise assessment; strategic planning and employee involvement techniques.</td>
</tr>
<tr>
<td>Name</td>
<td>Degree and Institution</td>
<td>Research Interests</td>
</tr>
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</tr>
<tr>
<td>Hildebrand, Robert</td>
<td>Ph.D. (University of California, Davis, 2013), Assistant Professor</td>
<td>Complexity and geometry of optimization problems and applications in operations research. Favorite topics of mine include linear and non-linear integer programming, geometry of numbers, convex geometry, combinatorics, operations research, machine learning, and sub modular optimization.</td>
</tr>
<tr>
<td>Hosseinichimeh, Niyousha</td>
<td>Ph.D. (State University of New York at Albany, 2012), Assistant Professor</td>
<td>Current research focuses on one of the most complex public health problem, major depressive disorder. I use systems approach to understand the complex feedback mechanisms among different drivers of the disorder. Using system dynamics method to develop simulation models which provide a lab for examining the evolution of the disorder under different conditions and treatments.</td>
</tr>
<tr>
<td>Jeon, Myoungoon (Philart)</td>
<td>Ph.D. (Georgia Tech, 2012), Associate Professor</td>
<td>Human-Computer Interaction/ Human-Robot Interaction Sound and Music Computing Affective Computing Assistive Technologies Automotive User Interfaces Aesthetic Computing</td>
</tr>
<tr>
<td>Jin, Ran</td>
<td>Ph.D. (Georgia Institute of Technology, 2011), Assistant Professor</td>
<td>Engineering-driven data fusion for complete system modeling and performance improvements; sensing, modeling, and monitoring of high definition profile data; quality engineering in manufacturing systems and scale-up.</td>
</tr>
<tr>
<td>Kannan, Hanumanthrao (Rao)</td>
<td>Ph.D. (Iowa State University, 2015), Assistant Professor</td>
<td>Main Area: Management Systems Engineering Systems Engineering Theory Preference representation and communication System architecture System design Satellite system design Data-driven decision making</td>
</tr>
<tr>
<td>Name</td>
<td>Degree</td>
<td>University</td>
</tr>
<tr>
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</tr>
<tr>
<td>Klauer, Charlie</td>
<td>Ph.D. (Virginia Tech, 2005)</td>
<td>Associate Professor.</td>
</tr>
<tr>
<td>Kleiner, Brian M.</td>
<td>Ph.D. (State University of New York at Buffalo, 1990)</td>
<td>Ralph H. Bogle Professor; Director, Macroergonomics and Group Decisions Systems Lab.</td>
</tr>
<tr>
<td>Kong, Z. “James”</td>
<td>Ph.D. (University of Wisconsin-Madison, 2004)</td>
<td>Associate Professor.</td>
</tr>
<tr>
<td>Lau, Nathan</td>
<td>Ph.D. (University of Toronto, 2012)</td>
<td>Assistant Professor.</td>
</tr>
<tr>
<td>Madigan, Michael</td>
<td>Ph.D. (Virginia Commonwealth University, 2001)</td>
<td>Professor.</td>
</tr>
<tr>
<td>Name</td>
<td>Degree Institution, Year</td>
<td>Title</td>
</tr>
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</tr>
<tr>
<td>Nussbaum, Maury A.</td>
<td>Ph.D. (University of Michigan, 1994), H.G. Prillaman Professor, Assistant Department Head, and Graduate Program Director.</td>
<td>Models of lumbar back kinetics &amp; kinematics; occupational biomechanics; artificial neural networks; industrial ergonomics and work physiology; occupational safety and health; measurement of human performance and motion; statistics and design of experiments; quality control; statics and solid mechanics.</td>
</tr>
<tr>
<td>Salado, Alejandro</td>
<td>Ph.D. (Stevens Institute of Technology, 2014), Assistant Professor.</td>
<td>Systems engineering and its application; scientific foundations of systems engineering; systems thinking; strategic perspective of systems engineering; innovative trends in systems engineering</td>
</tr>
<tr>
<td>Sarin, Subhash C.</td>
<td>Ph.D. (North Carolina State University, 1978), Paul T. Norton Professor.</td>
<td>Production planning and scheduling; applied mathematical programming; design and mathematical analysis of manufacturing systems.</td>
</tr>
<tr>
<td>Shewchuk, John P.</td>
<td>Ph.D. (Purdue University, 1995), Associate Professor, Associate Department Head, and Undergraduate Program Director.</td>
<td>Modeling and analysis of manufacturing systems; computer integrated manufacturing, production systems, simulation, scheduling in manufacturing.</td>
</tr>
<tr>
<td>Srinivasan, Divya</td>
<td>Ph.D. (University of Michigan, 2010), Assistant Professor.</td>
<td>Human factors engineering; industrial ergonomics; work physiology; human physical capabilities; human factors research design; biomechanics</td>
</tr>
<tr>
<td>Taaffe, Michael R.</td>
<td>Ph.D. (Ohio State University, 1982), Associate Professor.</td>
<td>Computational aspects of applied probability modeling and analysis, Monte Carlo simulation modeling and analysis methodology, and combined use of discrete-event simulation methods and computational probability models.</td>
</tr>
<tr>
<td>Name</td>
<td>Degree</td>
<td>Affiliation</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td><strong>Taylor, G. Donald, Ph.D.</strong></td>
<td>(University of Massachusetts, 1990), Charles O. Gordon Professor, Vice Provost for Learning Systems Innovation and Effectiveness.</td>
<td>Manufacturing, logistics, production systems, simulation and optimization.</td>
</tr>
<tr>
<td><strong>Triantis, Konstantinos P., Ph.D.</strong></td>
<td>(Columbia University, 1984), John Lawrence Professor, Northern Virginia Graduate Center.</td>
<td>Productivity measurement and analysis; distributed database systems; engineering economics; operations research.</td>
</tr>
<tr>
<td><strong>Van Aken, Eileen M., Ph.D.</strong></td>
<td>(Virginia Tech, 1995), Professor, Department Head.</td>
<td>Performance measurement and management systems; organizational assessment and improvement; collaborative work systems; and lean work systems.</td>
</tr>
<tr>
<td><strong>Xie, Weijun, Ph.D.</strong></td>
<td>(Georgia Tech, 2017), Assistant Professor.</td>
<td>Data driven distributionally robust optimization as well as stochastic programming and discrete optimization. Also has application interests in transportation/logistics, machine learning, power systems, healthcare and manufacturing.</td>
</tr>
<tr>
<td><strong>Yue, Xiaowei, Ph.D.</strong></td>
<td>(Georgia Tech, 2018), Assistant Professor.</td>
<td>Engineering-driven data mining and analytics for complex systems Surrogate modeling, uncertainty quantification and optimization of Engineering Systems Computational algorithms and information fusion for high-volume/ high-velocity data-intensive systems Predictive modeling, system informatics and automation</td>
</tr>
</tbody>
</table>
II. APPENDICES

Appendix A: Frequently Asked Questions

1. If I get a D+, D, or D- grade in a required course, do I have to repeat it?
Yes, if you receive less than a C- grade in an ISE, STAT, or MATH course that is a prerequisite for an ISE course, you must repeat the course to satisfy the prerequisite requirement. In other cases, you do not have to repeat the course, but you may do so if you are ill-prepared to take subsequent courses which build on the material from the class in which you received a “D” grade.

2. If I fail a required course, can I take it at another college or university during the summer?
Yes, with permission from the Academic Dean's office. The grade you receive in the class taken elsewhere must be a “C” or better. Only credits transfer, the grade does not factor into your GPA, nor does it replace the grade you earned at Virginia Tech.

3. Do I need prior approval to take classes at another institution?
Yes, if you want the credits to transfer to Virginia Tech to fulfill graduation requirements. Transfer courses must be approved by the College of Engineering's Associate Dean for Academic Affairs and the ISE department. A Transfer Credit Evaluation form can be found at www.eng.vt.edu/forms.

4. Can I retake a course taken at VT to raise my GPA?
Yes, if the initial grade was below “C” and the course is retaken at Virginia Tech. If you retake a course in which you earned a “C” or higher, that grade will be changed to a “P” grade, which will not count in your GPA.

5. Can I participate in May Commencement if I have not completed all required course work to graduate?
Yes, but you should be able to finish by the end of the second summer term. You must also have a 2.0 or better overall and in major GPA and the Dean's Office approval to participate. You will receive your diploma after you have finished all requirements for graduation satisfactorily.

6. If a course is not on the approved Curriculum for Liberal Education (CLE) list, can I request that it be counted toward an Area Two, Three, Six, or Seven requirement?
Yes, but only if this is a transfer course. A student may submit a request to the Academic Dean’s Office to count a course toward a CLE Area course requirement. The Dean’s office evaluates these requests according to ABET criteria. See an ISE Academic Advisor for more information.

7. What is the difference between Academic Warning and Academic Probation?
Academic Warning: Students earning less than a 2.0 term GPA, but with a cumulative GPA of 2.00 or higher, are placed on academic warning without a notation on the academic transcript. Students are required to meet with an academic advisor to fill out a contract, which is then submitted to the Academic Dean’s office.
Academic Probation is imposed when the cumulative GPA is less than 2.00 and lifted when the cumulative GPA is at least 2.00. Academic performance is reviewed at the end of each regular semester (fall and spring).

8. The Business Minor application/checksheet lists courses that aren’t listed in Appendix D in the UG Student Handbook. Do I have to complete these classes too?
No. A student who completes the ISE major requirements and takes the courses listed under the Business Minor section in Appendix D has completed requirements for the Business Minor. Ms. Johnson will substitute the required ISE classes for the additional courses listed on the Business Minor checksheet.
Appendix B. Framework for Advising at Virginia Tech

**Definition**
Advising at Virginia Tech is a collaborative process between student and advisor leading to the exchange of information that encourages the individual student to make responsible academic and career decisions.

**Statement of Student Responsibility**
The student shares the responsibility for developing an advising partnership with the advisor. Over time, the partnership results in increased responsibility for the student. This is achieved through the student:

- Communicating goals, needs, wants, concerns to the advisor in a respectful and sincere manner;
- Keeping abreast of her/his own academic progress and requirements related to their academic programs;
- Making, keeping, and being prepared for appointments with the advisor;
- Informing the advisor of changes in plans and/or circumstances that might impact academic performance;
- Bringing concerns regarding quality of advising to the attention of the advisor.

**Statement of Advisor Responsibility**
The advisor shares the responsibility for developing an advising partnership with the student. This is achieved through the advisor:

- Communicating with students and delivering individualized and accurate information in a professional and sincere manner;
- Being informed of, and providing, accurate information about current academic policies and procedures;
- Keeping appointments and being available for assistance;
- Providing appropriate referrals, contacts, and information; and
- Conducting appropriate follow-up with students; and
- Seeking out and taking advantage of opportunities for professional development.
Appendix C. Department and Advising Information Referral
This section is designed to direct students to the appropriate person for given areas of concern.

Ms. Paula Van Curen  Ms. Maggie Johnson
Academic/Career Advisor  Academic/Career Advisor
241 Durham Hall  243 Durham Hall
Phone: (540) 231-2364  Phone: (540) 231-6388
E-mail: pcuren@vt.edu  E-mail: mlecos@vt.edu

- Academic progress toward degree and Degree Audit Report (DARS)
- Career counseling and job opportunities
- Personal counseling (problems or concerns impeding academic progress)
- Program-of-study planning
- Course scheduling and registration information
- Course substitutions and petitions for curriculum committee
- Concerns with courses, Graduate Teaching Assistants (GTAs), or instructors
- Administrative details pertaining to the Cooperative Education and Internship Program
- Transferring into or out of ISE
- General information regarding:
  o graduate study
  o study abroad or other international opportunities
  o university, college, departmental policies, procedures, resources
  o scholarships, fellowships, awards, grants
  o tutors available for selected courses
  o student organizations

Dr. John P. Shewchuk
Undergraduate Program Director and Associate Department Head
259 Durham Hall
Phone: (540) 231-6656; Email: shewchuk@vt.edu

- Undergraduate policies
- Career information and advice
- Undergraduate Program Committee petitions
- Concerns with specific courses or faculty

Dr. Maury Nussbaum
Graduate Program Director and Assistant Department Head
521 Whittemore Hall
Phone: (540) 231-6053; Email: nussbaum@vt.edu

- Information about graduate study
- Career information and advice
- Graduate program policies and procedures

Ms. Hannah Parks
Graduate Program Coordinator
233 Durham Hall
Phone: (540) 231-5586; Email: hsswiger@vt.edu

- General information and applications for graduate study in ISE
- Information about departmental and graduate school policies and procedures
Dean's Office, College of Engineering  
Dr. Bevlee Watford, Associate Dean for Academic Affairs  
Ms. Christi Boone, Enrollment Coordinator  
212 Hancock Hall; Phone: (540) 231-3244  
http://www.eng.vt.edu

- Exam time changes and approval  
- F.E. exam information and applications  
- Late drops, adds, and force-adds  
- Readmission  
- Resignations  
- Transfer course approval and transfer credit evaluation  
- Transferring into or out of the College of Engineering  
- Overload requests  
- See www.eng.vt.edu/forms for COE forms and documents referenced throughout the Handbook.

Other Campus Resources:

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<thead>
<tr>
<th>Career and Professional Development</th>
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<tbody>
<tr>
<td>Smith Career Services Bldg.</td>
<td>Lavery Hall, Suite 310</td>
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<tr>
<td><a href="http://www.career.vt.edu">www.career.vt.edu</a></td>
<td><a href="http://www.ssd.vt.edu">www.ssd.vt.edu</a></td>
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<tr>
<td>540-231-6241</td>
<td>540-231-0858</td>
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<tr>
<td><a href="http://www.ucc.vt.edu">www.ucc.vt.edu</a></td>
<td><a href="http://www.studentsuccess.vt.edu">www.studentsuccess.vt.edu</a></td>
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<tr>
<td>540-231-6657</td>
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<th>Undergraduate Honor System</th>
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<td>Hillcrest Hall, Room 104</td>
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<td><a href="http://www.dos.vt.edu">www.dos.vt.edu</a></td>
<td><a href="http://www.honorsystem.vt.edu">www.honorsystem.vt.edu</a></td>
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<tr>
<td>540-231-3787</td>
<td>540-231-9876</td>
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<td>200 Student Services Bldg.</td>
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<td><a href="http://www.honorscollege.vt.edu">www.honorscollege.vt.edu</a></td>
<td><a href="http://www.finaid.vt.edu">www.finaid.vt.edu</a></td>
</tr>
<tr>
<td>540-231-4591</td>
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<tr>
<td>142 McComas Hall</td>
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<tr>
<td><a href="http://www.recsports.vt.edu">www.recsports.vt.edu</a></td>
<td><a href="http://www.composition.english.vt.edu/writing-center">www.composition.english.vt.edu/writing-center</a></td>
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<tr>
<td>540-231-6856</td>
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<tr>
<td>McComas Hall</td>
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</tr>
<tr>
<td><a href="http://www.healthcenter.vt.edu">www.healthcenter.vt.edu</a></td>
<td><a href="http://www.globaleducation.vt.edu">www.globaleducation.vt.edu</a></td>
</tr>
<tr>
<td>540-231-5313</td>
<td>540-231-5888</td>
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Appendix D. Common Minors for ISE Majors

Business Minor

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<tr>
<th>Requirements*</th>
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<tr>
<td>ACIS 1504 Intro to Business Information Systems</td>
<td>Additional course requirement</td>
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<tr>
<td>ACIS 2115 Principles of Accounting</td>
<td>Additional course requirement</td>
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<tr>
<td>ECON 2005 Principles of Economics</td>
<td>Area 3 Elective</td>
</tr>
<tr>
<td>ECON 2006 Principles of Economics</td>
<td>Area 3 Elective</td>
</tr>
<tr>
<td>FIN 3054 Legal Environment of Business</td>
<td>Additional course requirement</td>
</tr>
<tr>
<td>Pre: Junior Standing</td>
<td></td>
</tr>
<tr>
<td>MKTG 3104 Marketing Management</td>
<td>Additional course requirement</td>
</tr>
<tr>
<td>Pre: Econ 2005, Junior Standing</td>
<td></td>
</tr>
<tr>
<td>FIN 3104 Intro to Finance Pre: ACIS 2115</td>
<td>Additional course requirement</td>
</tr>
<tr>
<td>ISE 3004 Industrial Cost Control Pre: ISE 2014</td>
<td>ISE Technical Elective; ACIS 2116 substitution</td>
</tr>
<tr>
<td>ISE 4004 Theory of Organization</td>
<td>ISE Technical Elective; MGT 3304 substitution</td>
</tr>
</tbody>
</table>

*The Business Minor requires 24 credits of coursework, but 15 credits are taken as part of the ISE curriculum. Only four courses, ACIS 1504, ACIS 2115, MKTG 3104, & FIN 3104, need to be added to the ISE degree requirements to complete the minor. Courses taken by ISE students which satisfy Business Minor requirements are: MATH 1225-1226, MATH 1114 or 2114; STAT 4105; and ISE 2404, ISE 3414, ISE 4204.

In summary, courses listed in the table above, with the BSISE requirements, fulfill Business Minor requirements. Business Minor applications are available on the Pamplin College of Business website, in 1046 Pamplin Hall, and from an ISE Academic Advisor.

Green Engineering Minor

The Green Engineering Minor can be completed with no additional courses above and beyond the ISE curriculum provided careful planning of electives.

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Course Counts As</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 3124: Introduction to Green Engineering</td>
<td>Technical Elective</td>
</tr>
<tr>
<td>ENGR 4134: Environmental Life Cycle Assessment</td>
<td>Technical Elective</td>
</tr>
<tr>
<td>*ISE 2204: Manufacturing Processes</td>
<td>ISE Technical Elective</td>
</tr>
<tr>
<td>*ISE 2214: Manufacturing Processes Lab</td>
<td>Already in ISE Undergraduate Curriculum</td>
</tr>
<tr>
<td>*ISE 4304: Global Issues in Industrial Management</td>
<td>ISE Technical Elective and Area Seven</td>
</tr>
<tr>
<td>*ISE 4644: Occupational Safety and Hazard Control</td>
<td>ISE Technical Elective</td>
</tr>
<tr>
<td>**PHIL 2304: Global Ethics</td>
<td>Areas Two and Seven</td>
</tr>
<tr>
<td>**FREC 2554: Nature and American Values</td>
<td>Area Two</td>
</tr>
<tr>
<td>**STS 4304: Contemporary Issues in Humanities, Sciences, and Technology</td>
<td>Area Two</td>
</tr>
</tbody>
</table>

* These courses fulfill the Engineering Electives requirement of the Green Engineering Minor.
** Two courses (6 credits) are needed for the Interdisciplinary Electives requirement of the minor.
Appendix E. Honors Program

The Honors College provides a combination of special sections of regular courses, honors seminars and colloquia, tutorials, independent study, and undergraduate research for students pursuing an Honors Diploma. Honors courses enable students of superior academic talent to be challenged to their full intellectual capacity. Honors represents a combination of study within departments and coursework cutting across departmental lines. The program is designed both to broaden and deepen the student's intellectual life. For more information go to: http://www.honorscollege.vt.edu/.

Appendix F. Taking Graduate Courses and Programs

Undergraduates Taking Graduate Courses

Dual Enrolled: Seniors who are within the last year of graduation, and have a GPA of 3.0 or better, may take graduate level courses to satisfy a graduate degree program as dual registrants. Such work may only be used to satisfy graduate (not undergraduate) degree requirements and with the consent of the graduate advisory committee.

Seniors: Students, who are within their last two semesters of graduation and have a 3.0 or better GPA, may enroll in 5000-level courses for undergraduate credit within their department when qualified by the course instructor and department head. Taking 5000-level courses outside the department requires Graduate School approval. These courses may not be used for graduate credit if the student is admitted into a graduate program.

Accelerated Undergraduate/Graduate Degree in ISE

The ISE Department has a strong and diverse master’s program that provides opportunities for study in specific areas in industrial and systems engineering, as well as general master's study. For qualified students in the BSISE program at Virginia Tech, the Department offers the opportunity to begin master’s degree coursework in the final year of bachelor’s studies. Both thesis and non-thesis tracks are available for all students. Students can select one of four general focus areas for their graduate study (human factors engineering and ergonomics, management systems engineering, manufacturing systems engineering, or operations research) or select the general industrial engineering area, which provides more flexibility in tailoring their study.

Admissions Requirements for the UG/G program in ISE are:

- Minimum 3.4 GPA in last 60 hours of bachelor’s coursework completed
- Official GRE scores
- Statement of purpose with career objectives
- CV/Resume
- 3 letters of reference
- Official transcripts of all undergraduate coursework

Applicants must be in the last two semesters of their undergraduate degree and accepted into the program prior to the beginning of the semester in which they enroll in courses to be used in the UG/G program. An advisor will be assigned unless there is already an informal student/faculty relationship. Students may change advisors if they identify a faculty member that is more suited to their interest than that of the initially assigned advisor.

Additional Program Requirements:

- Maximum of 9 hours may double-count toward the undergraduate and graduate degree, none of which can include required undergraduate classes.
- No more than six credits double counted may be at the 4xxx level.
- Conjoint classes, to double count, must be taken at the 5xxx level.
- A grade of “B” or better must be earned in each course to count.
- Courses may not be taken pass-fail if a graded option is available.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
<th>Course Code</th>
<th>Course Name</th>
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<td>First-Year Writing</td>
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<td>ENGE 1215</td>
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<tr>
<td>CS 1044</td>
<td>Intro to Programming in C or CS 1064 Intro to Programming in Python</td>
<td>3</td>
<td>MATH 2214</td>
<td>Introduction to Differential Equations (C-)</td>
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<tr>
<td>MATH 1114</td>
<td>Elementary Linear Algebra (C-)</td>
<td>2-3</td>
<td>ESM 2104</td>
<td>Statics</td>
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<tr>
<td>MATH 2114</td>
<td>Introduction to Linear Algebra (C-)</td>
<td>3</td>
<td>STAT 4105</td>
<td>Theoretical Statistics (C-)</td>
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<tr>
<td>PHYS 2306</td>
<td>Foundations of Physics I w/lab (C-)</td>
<td>4</td>
<td>ISE 2034</td>
<td>Data Management for Industrial and Systems Engineers (C-)</td>
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<td>ISE 2004</td>
<td>Introduction to Industrial and Systems Engineering (C-)</td>
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<td>ISE 2404</td>
<td>Deterministic Operations Research I (C-)</td>
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<td>ISE 2014</td>
<td>Engineering Economy (C-)</td>
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<td>ISE 3614</td>
<td>Human Factors Engineering and Ergonomics (C-)</td>
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<td>Engineering Science Elective</td>
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<td>ISE 3214</td>
<td>Facilities Planning &amp; Logistics (C-)</td>
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<tr>
<td>STAT 4706</td>
<td>Statistics for Engineers (C-)</td>
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<td>ISE 3424</td>
<td>Discrete-Event Computer Simulation (C-)</td>
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<td>Probabilistic Operations Research (C-)</td>
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<td>ISE 4404</td>
<td>Statistical Quality Control (C-)</td>
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<td>Project Management and System Design (C-)</td>
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General Information about Checksheet: Superscripted annotation [F, S, Sl, Sch] in Credits column indicates terms when a course is expected to be offered. Course offerings are subject to change and the availability of sufficient resources. Students should confirm course offerings in advance with the department.

Curriculum for Liberal Education (CLE)
Consult the CLE Alphabetical Listing at: http://www.cle.prov.vt.edu/guides/alpha.html. CLE courses need to be completed prior to graduation.

| CLE Area 1: Writing and Discourse (6 hrs) | ENGL 1105 | (3) | ENGL 1106 | (3) |
| CLE Area 2: Ideas, Cultural Traditions, Values Electives (6 hrs) | (3) | (3) |
| CLE Area 3: Society & Human Behavior electives (6 hrs) | (3) | (3) |
| CLE Area 4: Scientific Reasoning and Discovery (8 hrs) | PHYS 2305 | (4) | PHYS 2306 | (4) |
| CLE Area 5: Quantitative and Symbolic Reasoning (8 hrs) | MATH 1225 | (4) | MATH 1226 | (4) |
| CLE Area 6: Creativity & Aesthetic Experience elective (1 hr) | (1) |
| CLE Area 7: Global Issues Elective (3 hrs) | (3) |

If a CLE course is double-counted to satisfy an Area 2 or an Area 3 requirement and the Area 7 requirement, additional credits must be taken to maintain the required minimum of 127 credits.

A total of 6 credit hours of Area 2 and 6 credit hours of Area 3 courses must be completed. Only selected courses can simultaneously satisfy both Area 2/3 & 7 requirements (use extra care when selecting this course).

Electives
The ISE degree requires:
- 9 credits of ISE Technical Electives from a list,
- 6 credits of Technical Electives,
- 3 credits of Engineering Science Electives from a list, and
- 2-3 credits of Free Electives (2 credits required if MATH 2114 is taken, 3 credits required if MATH 1114 taken).

Only Free electives or Area 6 courses that are offered only on a P/F basis (e.g., FA 2004) may be taken under the P/F grading option.

Change of Major Requirements: Please see: http://www.enge.vt.edu/undergraduate-changing-majors.html

Foreign Language Requirements: Students must have had 2 years of a foreign language in high school or one year at the college level (6 credits) of the same language. College-level credits used to meet this requirement do not count towards the degree.

Satisfactory Progress Towards Degree: University Policy 91 outlines university-wide minimum criteria to determine if students are making satisfactory progress towards the completion of their degrees. The ISE Department fully supports this policy. Specific expectations for satisfactory progress for Industrial & Systems Engineering majors are as follows:
- Each student must meet the minimum University-wide criteria as described in Policy 91 and summarized in the Undergraduate Catalog (under Academic Policies)
- Additionally, upon completing 72 credit hours (including transfer, advanced placement, advanced standing, and credit by examination), students must:
  - Have a minimum in-major GPA of 2.0 or better (in-major GPA is determined from all ISE and required STAT classes);
  - Have completed ISE 2004, 2014, 2034, 2214, 2404, STAT 4105, MATH 2214, MATH 2204; and
  - Be enrolled in 12 or more credits of ISE classes per year,

Statement of Hidden Prerequisites: Prerequisites for each course are listed after the course title. Students must earn a C- or better in ISE, STAT, and MATH courses which are pre-requisites for subsequent ISE courses. Prerequisites may change from what is indicated. Be sure to consult the University Catalog or check with your advisor for the most current requirements. There are no hidden prerequisites in this program of study.

Course Availability: Course offerings are subject to change; students should consult an ISE academic advisor or the University Timetable for course offerings each semester.

Graduation Requirements: Each student must complete at least 127 semester credit hours with a minimum overall GPA of 2.00 and a minimum in-major GPA of 2.00. (In-major GPA is determined from ISE and required STAT classes).
INDUSTRIAL AND SYSTEMS ENGINEERING ELECTIVE REQUIREMENTS
For students graduating in calendar year 2020

In selecting electives, students should carefully note that:
- Some courses may not be available to all students due to prerequisite requirements and/or major restrictions.
- Courses with substantial duplication of courses required for the BSIE will not qualify for credit.
- Students pursuing a Minor may need to select specific courses as ISE Technical Electives, Technical Electives, Engineering Science Electives, or Free Electives to satisfy the Minor requirements.

ISE Technical Electives (9 credits required)
The purpose of this requirement is to enable students to develop expertise in a particular area of the ISE discipline.
- Courses must be selected from the list below.
- A maximum of 3 credits of ISE 4974 or ISE 4994 is allowed without prior approval from the ISE Undergraduate Program Director.

ISE 2204  Manufacturing Processes (Pre: ENGE 1104 or 1114 or 1216 or 1414)
ISE 3004  Industrial Cost Control (Pre: ISE 2014 or ME 2024)
ISE 3434  Deterministic Operations Research II (Pre: ISE 2004, 2404, (MATH 2204 or 2224))
ISE 4004  Theory of Organization
ISE 4015  Management Systems Theory, Applications, and Design I
ISE 4264  Industrial Automation (Requires Laboratory Work) (Pre: ISE 2204 or 2214)
ISE 4304  Global Issues in Industrial Management
ISE 4414  Industrial Quality Control (Pre: ISE 4404)
ISE 4424  Logistics Engineering (Pre: ISE 3414)
ISE 4624  Work Physiology (Pre: ISE 3624)
ISE 4644  Occupational Safety and Hazard Control (Pre: ISE 3614)
ISE 4654  Principles of Industrial Hygiene
ISE 4974  Independent Study (Hours and credits established by faculty supervising work)
ISE 4984  Special Study (Hours and credits established when course is proposed/offered)
ISE 4994  Undergraduate Research (Hours and credits established by faculty supervising work)

Technical Electives (6 credits required)
The purpose of this requirement is for students to further develop technical skills and to provide the opportunity to focus on a particular technical area by taking electives with significant technical content.
- The courses must be on an A-F basis, unless prior approval (for P/F basis) has been obtained from the ISE Undergraduate Program Director.
- Up to 3 credits can be obtained via ISE Technical Elective courses not being used for ISE Technical Elective credit.
- Courses in the College of Engineering or Science allowed as Technical Electives:
  - Any 3000 or 4000 level course from AOE, BMES, BSE, CEE, CHE, CHEM, CMDA, CS, ECE, ESM, MATH, ME, MSE, MINE, NSEG, PHYS, STAT (note: if there is a course of interest in a department/program other than those listed here, students may request approval from the ISE Undergraduate Program Director)
  - ENGR 3124 and ENGR 4134
- Courses not allowed: CEE 4804, CHEM 4014, CS 3604, CS 4214, MATH 4044, MATH 4625-6, MATH 4644, MATH 4664, ME 4454, MINE 4524, MINE 4554, STAT 3005, STAT 3006, STAT 3604, STAT 3615, STAT 3704, STAT 4604, STAT 4705, STAT 4714.

Engineering Science Electives (3 credits required)
The purpose of this requirement is for students to broaden their knowledge of engineering science outside of ISE.
- Courses must be selected from the list below.
ESM 2304  Dynamics
ECE 3054  Electrical Theory

Free Electives (2 credits required if MATH 2114 is taken, 3 credits required if MATH 1114 taken)
The purpose of this requirement is to enable students to enhance or complement knowledge and skills by providing breadth in areas outside of ISE.
- Students may not use a given course to satisfy both Free Elective and CLE requirements: any given course can satisfy one requirement only.