The Grado Department of Industrial and Systems Engineering

Undergraduate Student Handbook
2016-17
# The Grado Department of Industrial and Systems Engineering

## Undergraduate Student Handbook

<table>
<thead>
<tr>
<th>Position</th>
<th>Name</th>
<th>Office Location</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interim Department Head and Professor</td>
<td>Dr. Eileen M. Van Aken</td>
<td>253 Durham Hall</td>
<td>Phone: (540) 231-6656 Email: <a href="mailto:evanaken@vt.edu">evanaken@vt.edu</a></td>
</tr>
<tr>
<td>Interim Associate Department Head, Professor, and Interim Undergraduate Program Director</td>
<td>Dr. John P. Shewchuk</td>
<td>259 Durham Hall</td>
<td>Phone: (540) 231-6656 Email: <a href="mailto:shewchuk@vt.edu">shewchuk@vt.edu</a></td>
</tr>
<tr>
<td>Assistant Department Head, H.G. Prillaman Professor, and Graduate Program Director</td>
<td>Dr. Maury A. Nussbaum</td>
<td>521 Whittemore Hall</td>
<td>Phone: (540) 231-6053 Email: <a href="mailto:nussbaum@vt.edu">nussbaum@vt.edu</a></td>
</tr>
<tr>
<td>Undergraduate Academic and Career Advisor, Co-Op Liaison</td>
<td>Ms. Joyce Vest</td>
<td>243 Durham Hall</td>
<td>Phone: (540) 231-6388 Email: <a href="mailto:vestjs@vt.edu">vestjs@vt.edu</a></td>
</tr>
<tr>
<td>Undergraduate Academic and Career Advisor, Study Abroad Liaison</td>
<td>Ms. Paula Van Curen</td>
<td>241 Durham Hall</td>
<td>Phone: (540) 231-2364 Email: <a href="mailto:pcuren@vt.edu">pcuren@vt.edu</a></td>
</tr>
<tr>
<td>Graduate Program Coordinator</td>
<td>Ms. Hannah Parks</td>
<td>233 Durham Hall</td>
<td>Phone: (540) 231 – 5586 Email: <a href="mailto:hsswiger@vt.edu">hsswiger@vt.edu</a></td>
</tr>
<tr>
<td>ISE Department Office</td>
<td></td>
<td>250 Durham Hall</td>
<td>Phone: (540) 231-6656</td>
</tr>
</tbody>
</table>

**ISE Department Office**

(8 a.m. – 5 p.m., M – F)
ISE UNDERGRADUATE ACADEMIC ADVISORY PERSONNEL
2016-2017

Interim Undergraduate Program Director
Dr. John Shewchuk 259 Durham Hall
(540) 231 – 6656 shewchuk@vt.edu

Undergraduate Academic and Career Advisors:
Ms. Paula Van Curen 241 Durham Hall
(540) 231 – 2364 pcuren@vt.edu

Ms. Joyce Vest 243 Durham Hall
(540) 231 – 6388 vestjs@vt.edu

Institute of Industrial and Systems Engineers (IISE) Student Chapter Advisor:
Dr. Eileen M. Van Aken 253 Durham Hall
(540) 231 – 6656 evanaken@vt.edu

Alpha Pi Mu (APM) ISE Honor Society Advisor:
Dr. Kimberly P. Ellis 109 Durham Hall
(540) 231 – 9073 kpellis@vt.edu

Society for Manufacturing Engineers (SME) Advisor:
Dr. Robert Sturges 103 Durham Hall
(540) 231 – 7420 sturges@vt.edu

Human Factors Engineering Society (HFES) Advisor:
Dr. Nathan Lau 546 Whittemore Hall
(540) 231-5936 nathan.lau@vt.edu

2016-17 Undergraduate Program Committee (UPC) Contact Person*:
Dr. Patrick Koelling 235 Durham Hall
(540) 231-8755 koelling@vt.edu

* 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.
# TABLE OF CONTENTS

## I. INTRODUCTION TO ISE UNDERGRADUATE PROGRAM ............................................. 6
- Mission of the ISE Department and Undergraduate Program ........................................ 6
- ISE Program Educational Objectives and Student Outcomes ........................................ 7
- Advising in ISE ................................................................................................................ 8
- Helpful Hints .................................................................................................................. 8

## II. ACADEMIC POLICIES AND PROCEDURES .................................................. 9
- Academic Eligibility Policy ............................................................................................ 9
- Evaluation and Examination Policies ............................................................................. 9
- Honor System ................................................................................................................. 10
- ISE Departmental Policy Regarding Term Projects ..................................................... 10
- Pass/Fail Grade System ............................................................................................... 10
- Policy Memo 91/Satisfactory Progress ........................................................................ 10
- Transferring Credits Back to Virginia Tech ............................................................... 11
- Course Withdrawal Policy & Procedure .................................................................... 11
- Credit Hour Loads and Credit Overload Permission ................................................... 11

## III. REGISTRATION AND SCHEDULING PROCEDURES ................................. 12
- Course Scheduling ...................................................................................................... 12
- Force-Add Policy & Procedure .................................................................................. 12
- Plan of Study .............................................................................................................. 12
- Graduation Checksheets ............................................................................................. 12
- Electives within the BSISE ........................................................................................ 13
- Minors for ISE Students ........................................................................................... 14
  - Business Minor (Appendix D) ............................................................................... 14
  - Green Engineering Minor (Appendix D) ............................................................... 14
  - Other Common Minors ......................................................................................... 14

## IV. PROFESSIONAL DEVELOPMENT AND STUDENT ORGANIZATIONS .......... 15
- Student Organizations ............................................................................................... 15
  - Institute of Industrial and Systems Engineers (IISE) .............................................. 15
  - Alpha Pi Mu (APM) ............................................................................................... 15
  - ISE Ambassadors ................................................................................................... 15
  - Human Factors and Ergonomics Society (HFES) ................................................. 15
- Cooperative Education & Internship Program (CEIP) .......................................... 16
- ISE Study Abroad Exchange Programs ............................................................... 16
V. ISE COURSES AND FACULTY.................................................................................................................. 17
    ISE Undergraduate Courses .................................................................................................................. 17
    ISE Faculty ......................................................................................................................................... 20
VI. APPENDICES .................................................................................................................................... 25
    Appendix A. Frequently Asked Questions ......................................................................................... 25
    Appendix B. Framework for Advising at Virginia Tech................................................................. 26
    Appendix C. Department and Advising Information Referral ......................................................... 27
    Appendix D. Common Minors for ISE Majors ................................................................................ 29
        Business Minor ............................................................................................................................. 29
        Green Engineering Minor ............................................................................................................. 29
    Appendix E. Honors Program ............................................................................................................ 30
    Appendix F. Taking Graduate Courses and Programs ..................................................................... 30
    Appendix G. ISE 2018 Checksheet Requirements .......................................................................... 31
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 they correctly complete the courses that meet the requirements for graduation. For more information on student and advisor responsibilities, see Appendix B. Both advisors have an open-door policy so it is not necessary to schedule an appointment. Ms. Joyce Vest’s office hours are typically 8 a.m. to 12 p.m. and 1-5 p.m. Ms. Paula Van Curen’s office hours are typically 8 a.m. to 1 p.m. and 2-5 p.m. Please remember that advisors’ commitments may require they be out of the office at certain times. You may schedule an advising appointment by contacting Ms. Vest at 540-231-6388 or vestjs@vt.edu or Ms. Van Curen at 540-231-2364 or pcuren@vt.edu.

---

**Mission of the ISE Department and Undergraduate Program**

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.

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.

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:**

1. Ability to apply computational and industrial engineering tools and techniques encompassing manufacturing systems, operations research, human factors and ergonomics, and management systems engineering.
2. Ability to apply knowledge of mathematics, statistics, physical and social sciences, and engineering to IE problems.
3. Ability to identify, formulate, and solve structured and unstructured IE problems.
4. Ability to model, analyze, and evaluate work systems and processes, using appropriate experimental design, measurement tools/techniques, and data.
5. Ability to generate and evaluate alternatives to design an integrated work system or process to meet requirements through a systems perspective.
6. Ability to evaluate the impact of IE solutions in the broader context of the organization and society, with an appreciation of different cultures and perspectives.
7. Knowledge of the role of industrial engineers in contemporary issues.
8. Ability to communicate effectively to a variety of audiences and using written, oral, and visual media.
9. Understanding of professionalism, good citizenship, and ethical behavior.
10. Ability to work collaboratively in multi-disciplinary teams.
11. Understanding of the need for continued professional development and ability to engage in life-long learning.

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 a faculty member or 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, procedures for transferring into or out of ISE, and other related matters. When appropriate, an ISE Academic Advisor will refer students to other campus resources, such as the Cook Counseling Center or Services for Students with Disabilities.

The Career Services Co-op Advisor assists students with the administrative details of the Cooperative Education Program. The advisor responsible for ISE students can be contacted at the Smith Career Center 540-231-6241. Ms. Joyce Vest is the Co-Op liaison for ISE students participating in the Co-Op program.

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 permanent 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 associated approved electives lists as well as any additional relevant handouts. The 2018 Checksheet is the most recently approved checksheet for students graduating in the 2018 calendar year and is included in this handbook. The 2017 Checksheet can still be found on the ISE Department website and on 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 lists of approved current electives to guide you in your selection of courses when registering for classes.
- The following courses should take precedence in your 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.
- Check course prerequisites when registering for classes. You are responsible for ensuring that you have the proper prerequisites before registering for a course. The ISE Department checks prerequisites each semester – students not meeting prerequisite requirements for a class will be dropped.
- 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. The form can be found at www.eng.vt.edu/forms.
- 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 progress toward your degree 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 2016-2017 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 method 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 on grading criteria. 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 Department operates within the guidelines of the University's Honor System. Violations of classroom, departmental, or university academic policy are dealt with as an Honor System violation. 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.

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 requirement 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 Honor Code. Exceptions to this policy may be given by an individual instructor. 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 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);
  - have completed ISE 2004, 2014, 2034, 2204, 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 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, bring a copy of your approved transfer credit request form and an unofficial copy of your grade for the transfer course 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 Hokie Spa after final grades and will appear on your transcript as a “W” grade, but do not count in your 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 unappealable.
- 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

Undergraduate students must maintain a minimum of 12 credit hours to be legally considered as a full-time student. Students wanting to take more than 19 credit hours during Fall and Spring and more than 9 credit hours for each summer session must obtain "Overload Permission" from the Engineering Academic Dean before the add deadline closes for the semester. The overload request form (as well as other Dean’s Office forms) is available on-line at: http://www.eng.vt.edu/forms/. Submit your overload request to the Dean’s Office in 212 Hancock Hall.

The University does not require you to be a full-time student. The number of credits you take each semester (up to the stated maximum) is your decision. It is important, however, for you to determine if there are other considerations, such as insurance, federal financial aid, 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.
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 general 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 with a “trailer” section offered in 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. The University requires a minimum enrollment for undergraduate courses. If enrollment does not reach this minimum, 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 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), you must submit a force-add request on-line through the ISE Department website. Note that the department will not process force-add requests for time or professor preference. Requests for courses in which a student has not met the prerequisite requirement must be approved by the ISE Undergraduate Program Director (see an ISE advisor). The ISE department cannot force-add classes from other departments.

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 and on the ISE Department 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 junior year, students will apply for a degree and request a Degree Audit Report (DARS) from the University Registrar's Office via Hokie Spa. The DARS lists all the student’s completed and future graduate requirements. Students can make changes (i.e. change 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 hour required. FA 2004 is pass/fail (P/F) only and can fulfill the requirement.

- **Global Issues Elective (Area 7):** The current policy requires completion of 3 credits. 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 133 credits for graduation.

### All courses taken to fulfill the Curriculum for Liberal Education must be taken on an A/F (not P/F) basis
(with the exception of Area 6, as noted above). Consult the latest issue of the Undergraduate Catalog or the Curriculum for Liberal Education Guide for course descriptions, prerequisite requirements, and restrictions.

- **Technical Electives (Appendix G).** 6 credit hours required.
  ISE 3xxx or 4xxx level courses may be used to fulfill 3 credits of this requirement.

- **ISE Technical Electives (Appendix G).** 6 credit hours required.
  ISE 3xxx or 4xxx level courses are used to fulfill this technical elective requirement.
  Non-ISE courses **may not be substituted** for ISE Technical Electives.
  Any ISE graduate level course may be taken for credit as an ISE Technical Elective if:
  1. the student is within one semester of graduation,
  2. has a 3.0 GPA, and
  3. has obtained permission of both an ISE Academic Advisor and the 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 of credits is submitted on the appropriate form to your advisor by the deadline specified by the College of Engineering. Potential ISE 4994 Undergraduate Research projects are sent via the ISE undergraduate student listserv before the start of each semester; however, students are not limited to those projects only. See an ISE Academic Advisor or an ISE faculty member about using Undergraduate Research or Independent Study for technical elective credit.

  Updated lists of ISE Technical Elective offerings are available each semester from an ISE Academic Advisor. Courses offered as **ISE 4984 (Special Study)** are also indicated on these lists. Changes and announcements affecting course offerings are sent via the ISE Undergraduate listserv.

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

### 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 hours of coursework. At least six hours of coursework for the minor are 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 9 credit hours 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 should obtain the application/checksheet from the College of Business or an ISE Academic Advisor.

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 hours of Technical Elective credits for ISE students, and the Engineering Elective courses include two required ISE courses. The Interdisciplinary Elective Course List requires 6 credits; there are several classes that double count as Area 2 and/or Area 7 credits. Refer to the Green Engineering Minor Checksheet and see an ISE Academic Advisor for more information.

See Appendix D for the list of classes required for the Business Minor and Green Engineering Minor and how they fit into the ISE curriculum.

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
- Psychology
- Computer Science
- Sociology
- Economics
- Statistics
- Math
- Foreign Language (Spanish, French, etc.)
III. 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. Student Chapter activities include:

1. Organizing and attending regional and national technical conferences
2. Organizing presentations by speakers from industry and government
3. Organizing plant tours
4. Offering professional certification workshops to students (e.g., Six Sigma Green Belt certification)
5. Participating in community service activities
6. Sponsoring an annual spring departmental picnic
7. Sponsoring the annual departmental Constructive Curriculum Review session
8. Sponsoring 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. Joyce Vest 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 (but 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 Services staff. This form will require the signature of the ISE Department Co-Op Liaison, Ms. Joyce Vest.

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 October and February. For a more detailed explanation of Co-Op’s and internships, information on how to participate in the CEIP program, and other career fairs, refer to the Career Services website at 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 include VT tuition & fees, travel, housing & food.

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 and at the College of Engineering website at https://www.eng.vt.edu/international. Afterwards, meet with the ISE Study Abroad advisor, 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.

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

<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 2004</td>
<td><strong>INTRODUCTION TO INDUSTRIAL AND SYSTEMS ENGINEERING</strong></td>
<td>(1H, 3L, 2C)</td>
<td>ENGE 1104, ENGE 1114, ENGE 1434 or ENGE 1216 (C- or better)</td>
<td>I, III</td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISE 2014</td>
<td><strong>ENGINEERING ECONOMY</strong></td>
<td>(2H, 2C)</td>
<td>ENGE 1024 or ENGE 1215 (C- or better) or BC 1224</td>
<td>I, II, III, IV</td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISE 2034</td>
<td><strong>DATA MANAGEMENT FOR ISES</strong></td>
<td>(3H, 3C)</td>
<td>CS 1044 or CS 1064</td>
<td>II, IV</td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISE 2204</td>
<td><strong>MANUFACTURING PROCESSES</strong></td>
<td>(3H, 3C)</td>
<td>ENGE 1104, ENGE 1114, ENGE 1434 or ENGE 1216 (C- or better)</td>
<td>II</td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISE 2214</td>
<td><strong>MANUFACTURING PROCESSES LABORATORY</strong></td>
<td>(3L, 1C)</td>
<td>ENGE 1104, ENGE 1114, ENGE 1434 or ENGE 1216 (C- or better)</td>
<td>I, II, III</td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISE 2404</td>
<td><strong>DETERMINISTIC OPERATIONS RESEARCH</strong></td>
<td>(3H, 3C)</td>
<td>MATH 1114 or 2114</td>
<td>II, III</td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISE 2994</td>
<td><strong>UNDERGRADUATE RESEARCH</strong></td>
<td>Variable credit</td>
<td></td>
<td>I, II, III</td>
</tr>
<tr>
<td>ISE 3004</td>
<td><strong>INDUSTRIAL COST CONTROL</strong></td>
<td>(3H, 3C)</td>
<td>ISE 2014 (C- or better) or ME 2024</td>
<td>II</td>
</tr>
<tr>
<td></td>
<td>Fundamentals of general and cost accounting practices applied to manufacturing and service organizations. Cost accounting, standard cost determination, cost and budgetary control systems.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISE 3214</td>
<td><strong>FACILITIES PLANNING AND LOGISTICS</strong></td>
<td>(3H, 3C)</td>
<td>ISE 2014, 2404, 3414 (C- or better)</td>
<td>II, IV</td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**ISE 3414: Probabilistic Operations Research**  
Pre: ISE 2004, STAT 4105, MATH 2214, MATH 2224 or 2204, (C- or better); CS 1044 or 1064, (3H, 3C)  
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**  
Pre: ISE 3414, STAT 4105 (C- or better)  
(2H, 3L, 3C)  
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 II**  
Pre: ISE 2004, 2404, MATH 2224 or MATH 2204 (C- or better)  
(3H, 3C)  
Offered: I, III  
Advanced concepts in deterministic operations research, including theory of complexity, integer programming, advanced linear programming techniques, nonlinear programming, dynamic programming. Covers modeling languages and optimization software for integer programming and nonlinear programming problems.

**ISE 3614: Introduction to Human Factors Eng. & Ergonomics**  
Pre: ISE 2004, 2034, 2204 or 2214, STAT 4105 (C- or better)  
(3H, 3C)  
Offered: I, 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 Measurements**  
Pre: ISE 3614 (C- or better), ESM 2104.  
(3H, 3C)  
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**  
Pre: ISE 2204, 2214, 3214, 3424, 3434, 3614, 4404 (C- or better) for 4005;  
Co: 3624; ISE 3624, 4005, 4204 (C- or better) for 4006.  
4005: (3H,3C)  
4006: (2H,2C)  
Offered: I  
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**  
Pre: ISE 2404, 3414, STAT 4706 (C- or better).  
(3H, 3C)  
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**  
Pre: ISE 4204 (C- or better).  
(3H, 3C)  
Offered: II  
Lean Manufacturing principles, theory, methods, and techniques in modern manufacturing enterprises. Lean manufacturing philosophy, basic concepts, master production scheduling, production planning, 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>2204 or 2214 (C- or better)</td>
<td>I or II</td>
</tr>
<tr>
<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>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISE 4304</td>
<td>GLOBAL ISSUES IN INDUSTRIAL MANAGEMENT</td>
<td>3H, 3C</td>
<td></td>
<td>II</td>
</tr>
<tr>
<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>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISE 4404</td>
<td>STATISTICAL QUALITY CONTROL</td>
<td>3H, 3C</td>
<td>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>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISE 4414</td>
<td>INDUSTRIAL QUALITY CONTROL</td>
<td>3H, 3C</td>
<td>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>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISE 4424</td>
<td>LOGISTICS ENGINEERING</td>
<td>3H, 3C</td>
<td>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>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISE 4624</td>
<td>WORK PHYSIOLOGY</td>
<td>3H, 3C</td>
<td>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>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISE 4644</td>
<td>OCCUPATIONAL SAFETY AND HAZARD CONTROL</td>
<td>3H, 3C</td>
<td>ISE 3614 (C- or better)</td>
<td>I or II</td>
</tr>
<tr>
<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>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISE 4654</td>
<td>PRINCIPLES OF INDUSTRIAL HYGIENE</td>
<td>3H, 3C</td>
<td></td>
<td>I or II</td>
</tr>
<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>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISE 4974</td>
<td>Independent Study</td>
<td>Variable credit course</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISE 4984</td>
<td>Special Study</td>
<td>Variable credit course</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISE 4994</td>
<td>Undergraduate Research</td>
<td>Variable credit course</td>
<td></td>
<td></td>
</tr>
</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>
<tbody>
<tr>
<td>Bansal, Manish, Ph.D., (from Texas A&amp;M University, 2014), Assistant Professor.</td>
<td>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</td>
</tr>
<tr>
<td>Bish, Doug R., Ph.D., (from Virginia Tech, 2006), Associate Professor.</td>
<td>Applied operations research; network models in transportation, logistics, and interdiction; disaster management and public health issues; revenue management; simulation of complex systems.</td>
</tr>
<tr>
<td>Bish, Ebru, Ph.D., (from Northwestern University, 1999), Associate Professor.</td>
<td>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.</td>
</tr>
<tr>
<td>Camelio, Jaime A. Ph.D., (from University of Michigan, 2002), Rolls-Royce Commonwealth Professor of Advanced Manufacturing</td>
<td>Assembly systems modeling, analysis, and control; data mining for manufacturing systems; remanufacturing; and micro-manufacturing.</td>
</tr>
<tr>
<td>Casali, John G., Ph.D., (from Virginia Tech, 1982), John Grado Professor, Director, Auditory Systems Laboratory</td>
<td>Human/machine interfacing; vehicular simulation and safety; industrial hearing protection and communications in noise.</td>
</tr>
<tr>
<td>Chen, Xi, Ph.D., (from Northwestern University, 2012), Assistant Professor</td>
<td>Stochastic modeling and simulation, applied probability, statistical methods, simulation experiment design and simulation optimization.</td>
</tr>
<tr>
<td>Name</td>
<td>Title</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Ellis, Kimberly P., Ph.D.</td>
<td>(from Georgia Institute of Technology, 1996), Associate Professor</td>
</tr>
<tr>
<td>Gabbard, Joseph L., Ph.D.</td>
<td>(from Virginia Tech, 2008), Associate Professor</td>
</tr>
<tr>
<td>Ghaffarzadeh, Navid, Ph.D.</td>
<td>(from SUNY-Albany, 2011), Assistant Professor</td>
</tr>
<tr>
<td>Harmon, L. Kenneth, Jr., MBA</td>
<td>(from Wright State University, 1970), Associate Professor</td>
</tr>
<tr>
<td>Hosseinichimeh, Niyousha, Ph.D.</td>
<td>(from State University of New York at Albany, 2012), Assistant Professor</td>
</tr>
<tr>
<td>Name</td>
<td>Degree, Institution, Year</td>
</tr>
<tr>
<td>-----------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Jin, Ran</td>
<td>Ph.D., (from Georgia Institute of Technology, 2011), Assistant Professor</td>
</tr>
<tr>
<td>Kleiner, Brian M.</td>
<td>Ph.D., (from State University of New York at Buffalo, 1990), Ralph H. Bogle Professor, and Director, Macroergonomics and Group Decisions Systems Lab</td>
</tr>
<tr>
<td>Koelling, C. Patrick</td>
<td>Ph.D., (from Arizona State University, 1982), Associate Professor, Director, ISE Computational Lab</td>
</tr>
<tr>
<td>Kong, Z. “James”</td>
<td>Ph.D., (from Univ. of Wisconsin-Madison, 2004), Associate Professor</td>
</tr>
<tr>
<td>Lau, Nathan</td>
<td>Ph.D., (from University of Toronto, 2012), Assistant Professor</td>
</tr>
<tr>
<td>Name</td>
<td>Degree</td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Nussbaum, Maury A.</td>
<td>Ph.D.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Sarin, Subhash C.</td>
<td>Ph.D.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Srinivasan, Divya</td>
<td>Ph.D.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Sturges, Robert H.</td>
<td>Ph.D.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Nussbaum, Maury A.**
- Models of lumbar back kinetics & 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.

**Salado, Alejandro**
- Systems engineering and its application; scientific foundations of systems engineering; systems thinking; strategic perspective of systems engineering; innovative trends in systems engineering.

**Sarin, Subhash C.**
- Production planning and scheduling; applied mathematical programming; design and mathematical analysis of manufacturing systems.

**Shewchuk, John P.**
- Modeling and analysis of manufacturing systems; computer integrated manufacturing, production systems, simulation, scheduling in manufacturing.

**Srinivasan, Divya**
- Human factors engineering; industrial ergonomics; work physiology; human physical capabilities; human factors research design; biomechanics.

**Sturges, Robert H.**
- Design theory and methodology, product and process design, manufacturing and assembly processes, robotics, flexible manufacturing systems.
<table>
<thead>
<tr>
<th>Name</th>
<th>Degree</th>
<th>Affiliations and Areas of Expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taaffe, Michael R.</td>
<td>Ph.D., (from Ohio State</td>
<td>Computational aspects of applied probability modeling and analysis, Monte Carlo simulation modeling</td>
</tr>
<tr>
<td></td>
<td>University, 1982),</td>
<td>and analysis methodology, and combined use of discrete-event simulation methods and computational</td>
</tr>
<tr>
<td></td>
<td>Associate Professor.</td>
<td>probability models.</td>
</tr>
<tr>
<td>Taylor, G. Donald</td>
<td>Ph.D., (from University of</td>
<td>Manufacturing, logistics, production systems, simulation and optimization.</td>
</tr>
<tr>
<td></td>
<td>Massachusetts, 1990),</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Charles O. Gordon Professor, Interim Dean for College of Engineering</td>
<td></td>
</tr>
<tr>
<td>Triantis, Konstantinos P.</td>
<td>Ph.D., (from Columbia</td>
<td>Productivity measurement and analysis; distributed database systems; engineering economics; operations research.</td>
</tr>
<tr>
<td></td>
<td>University, 1984), John Lawrence Professor, Northern Virginia Graduate Center</td>
<td></td>
</tr>
<tr>
<td>Van Aken, Eileen M.</td>
<td>Ph.D., (from Virginia Tech,</td>
<td>Performance measurement and management systems; organizational assessment and improvement; collaborative work systems; and lean work systems.</td>
</tr>
<tr>
<td></td>
<td>1995), Professor, Interim Department Head.</td>
<td></td>
</tr>
<tr>
<td>Wernz, Christian</td>
<td>Ph.D., (from University of</td>
<td>Quantitative and behavioral decision theory; game theory; applied operations research; modeling; manufacturing/service organizations.</td>
</tr>
<tr>
<td></td>
<td>Massachusetts-Amherst, 2008), Assistant Professor.</td>
<td></td>
</tr>
</tbody>
</table>
II. APPENDICIES

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?
   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 the credits transfer; the grade does not affect your GPA.

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.

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. What is a DARS?
   The Degree Audit Reporting System (DARS) is a computer generated report for undergraduate students that identifies graduation requirements that are completed as well as requirements that still need to be completed. To access your DARS, submit an Application for Degree on Hokie Spa. Consult with an ISE Academic Advisor if you think there are errors in your DARS.

7. 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?
   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.

8. 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 in 212 Hancock. 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).

9. 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. Vest 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
Academic/Career Advisor
241 Durham Hall
Phone: (540) 231-2364
E-mail: pcuren@vt.edu

Ms. Joyce Vest
Academic/Career Advisor
243 Durham Hall
Phone: (540) 231-6388
E-mail: vestjs@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:
  - graduate study
  - study abroad or other international opportunities
  - university, college, departmental policies, procedures, resources
  - scholarships, fellowships, awards, grants
  - tutors available for selected courses
  - student organizations

Dr. John Shewchuk
Interim 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:

<table>
<thead>
<tr>
<th>Career Services</th>
<th>Services for Students with Disabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smith Career Services Bldg.</td>
<td>Lavery Hall, Suite 310</td>
</tr>
<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>
</tr>
<tr>
<td>540-231-6241</td>
<td>540-231-0858</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cook Counseling Center</th>
<th>Student Success Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>McComas Hall, Room 240</td>
<td>110 Femoyer Hall</td>
</tr>
<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>
</tr>
<tr>
<td>540-231-6657</td>
<td>540-231-5499</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dean of Students</th>
<th>Undergraduate Honor System</th>
</tr>
</thead>
<tbody>
<tr>
<td>109 East Eggleston Hall</td>
<td>Hillcrest Hall, Room 104</td>
</tr>
<tr>
<td><a href="http://www.dos.vn">www.dos.vn</a></td>
<td><a href="http://www.honorsystem.vt.edu">www.honorsystem.vt.edu</a></td>
</tr>
<tr>
<td>540-231-3787</td>
<td>540-231-9876</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Honors College</th>
<th>University Scholarships and Financial Aid</th>
</tr>
</thead>
<tbody>
<tr>
<td>137 Hillcrest</td>
<td>200 Student Services Bldg.</td>
</tr>
<tr>
<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>
<td>540-231-5179</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recreational Sports</th>
<th>Writing Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>142 McComas Hall</td>
<td>Newman Library, 2nd Floor</td>
</tr>
<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>
</tr>
<tr>
<td>540-231-6856</td>
<td>540-231-5436</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Schiffert Health Center</th>
<th>Global Education Office</th>
</tr>
</thead>
<tbody>
<tr>
<td>McComas Hall</td>
<td>526 Prices Fork Road, Room 131</td>
</tr>
<tr>
<td><a href="http://www.healthcenter.vn">www.healthcenter.vn</a></td>
<td><a href="http://www.globaleducation.vn">www.globaleducation.vn</a></td>
</tr>
<tr>
<td>540-231-5313</td>
<td>540-231-5888</td>
</tr>
</tbody>
</table>
Appendix D. Common Minors for ISE Majors

Business Minor

<table>
<thead>
<tr>
<th>Requirements*</th>
<th>Course Counts As</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACIS 2115 Principles of Accounting</td>
<td>Additional course requirement</td>
</tr>
<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>Free Elective</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</td>
<td>Additional course requirement</td>
</tr>
<tr>
<td>Pre: ACIS 2115</td>
<td></td>
</tr>
<tr>
<td>ISE 3004 Industrial Cost Control</td>
<td>ISE Technical Elective; ACIS 2116 substitution</td>
</tr>
<tr>
<td>Pre: ISE 2014</td>
<td></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 three courses, 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; ENGE 1215-1216; STAT 4105; and ISE 2404, ISE 3414, ISE 4204.

In summary, courses listed in the table above, along with the BSISE requirements, fulfill the 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>Already in ISE Undergraduate Curriculum</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 course work cutting across departmental lines. The program is designed both to broaden and deepen the student's intellectual life.

Incoming freshmen are invited to apply for University Honors on the basis of their standardized test scores and high school records. Transfer students and continuing Virginia Tech students who achieve a GPA of 3.60 or greater are invited to apply. Students remain in the program on the basis of their continued high academic performance and the pursuit of one of six honors diplomas. Course selection is not necessarily tied to the student's major field of study.

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 the 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 be double counted.
- Courses must not be taken pass-fail if a graded option is available.

See the ISE Graduate Program Office in 233 Durham for more information on ISE graduate programs.
# Appendix G. ISE 2018 Checksheet Requirements

## 133 Credits Required for Graduation

<table>
<thead>
<tr>
<th></th>
<th>FRESHMAN FALL SEMESTER 2014</th>
<th></th>
<th>FRESHMAN SPRING SEMESTER 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Credits</td>
<td></td>
<td>Credits</td>
</tr>
<tr>
<td>CHEM 1035 General Chemistry</td>
<td>3</td>
<td>ENGL 1106 First-Year Writing</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 1045 General Chemistry Lab</td>
<td>1</td>
<td>Pre: ENGL 1105</td>
<td></td>
</tr>
<tr>
<td>ENGL 1105 First-Year Writing</td>
<td>3</td>
<td>MATH 1226 Calculus of a Single Variable</td>
<td>4</td>
</tr>
<tr>
<td>MATH 1225 Calculus of a Single Variable (C-) Pre: Math Ready</td>
<td>4</td>
<td>PHYS 2305 Found of Physics I w/lab</td>
<td>4</td>
</tr>
<tr>
<td>ENGE 1215 Foundations of Engineering (C-) Co: MATH 1225</td>
<td>2</td>
<td>ENGE 1216 Foundations of Engineering (C-) Pre: ENGE 1215</td>
<td>2</td>
</tr>
<tr>
<td>CLE (Area 2, 3, or 7)</td>
<td>3</td>
<td>CLE (Area 2, 3, or 7)</td>
<td>3</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>16</strong></td>
<td></td>
<td><strong>TOTAL</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>FALL SEMESTER SOPHOMORE 2015</th>
<th></th>
<th>SPRING SEMESTER SOPHOMORE 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Credits</td>
<td></td>
<td>Credits</td>
</tr>
<tr>
<td>CS 1044 Intro to Programming in C or CS 1064 Intro to Programming in Python</td>
<td>3</td>
<td>MATH 2114 Differential Equations (C-) Pre: MATH 2226, (MATH 1114 or 2114)</td>
<td>3</td>
</tr>
<tr>
<td>MATH 1114 Elementary Linear Algebra (C-) or MATH 2114 Introduction to Linear Algebra (C-) Pre: MATH 1226 or a grade of B or better in MATH 1225</td>
<td>2-3</td>
<td>ESM 2104 Statics Co: MATH 2224 or 2244 or 2204 or 2204H or 2406H</td>
<td>3</td>
</tr>
<tr>
<td>MATH 2204 Intro Multivariable Calculus (C-) Pre: MATH 1226</td>
<td>3</td>
<td>STAT 4105 Theoretical Statistics (C-) Pre: MATH 2204 or MATH 2224</td>
<td>3(3, 3)</td>
</tr>
<tr>
<td>PHYS 2306 Foundations of Physics I w/lab Pre: MATH 2226, PHYS 2305</td>
<td>4</td>
<td>ISE 2034 Data Management for ISEs (C-) Pre: CS 1044 or CS 1064</td>
<td>3(3, 3)</td>
</tr>
<tr>
<td>ISE 2004 Introduction to ISE (C-) Pre: ENGE 1104 or 1114 or 1434 or 1216</td>
<td>2(2)</td>
<td>ISE 2204 Manuf Processes (C-) Pre: ENGE 1104 or 1114 or 1434 or 1216</td>
<td>3(3)</td>
</tr>
<tr>
<td>ISE 2014 Engineering Economy (C-) Pre: ENGE 1024 or 1434 or 1215 or BC 1224</td>
<td>2(2)</td>
<td>ISE 2040 Deterministic Oper Research I (C-) Pre: MATH 1114 or 2114</td>
<td>3(3)</td>
</tr>
<tr>
<td>ISE 2214 Manuf Processes Lab (C-) Pre: ENGE 1104 or 1114 or 1434 or 1216</td>
<td>1(1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>17-18</strong></td>
<td></td>
<td><strong>TOTAL</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>FALL SEMESTER JUNIOR 2016</th>
<th></th>
<th>SPRING SEMESTER JUNIOR 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Credits</td>
<td></td>
<td>Credits</td>
</tr>
<tr>
<td>ESM 2304 Dynamics Pre: 2104, (MATH 2224 or 2244 or 2204 or MATH 2204H) Co: MATH 2214</td>
<td>3</td>
<td>ECE 3054 Electrical Theory Pre: PHYS 2306 Co: MATH 2214</td>
<td>3</td>
</tr>
<tr>
<td>STAT 4706 Statistics for Engineers (C-) Pre: STAT 4105</td>
<td>3(3)</td>
<td>ISE 3214 Facilities Planning &amp; Logistics (C-) Pre: ISE 2014, 2404, 3414</td>
<td>3(3)</td>
</tr>
<tr>
<td>ISE 3414 Probabilistic Oper Research (C-) Pre: ISE 2004, STAT 4105, (MATH 2204 or 2244), MATH 2214 or 2244H, (CS 1044 or 1064)</td>
<td>3(3, 3)</td>
<td>ISE 3424 Discrete-Event Comp Sim (C-) Pre: ISE 3414, STAT 4105</td>
<td>3(3, 3)</td>
</tr>
<tr>
<td>ISE 3434 Deterministic Oper Research II (C-) Pre: ISE 2004, 2404, (MATH 2204 or 2244)</td>
<td>3(3)</td>
<td>ISE 4404 Statistical Quality Control (C-) Pre: ISE 3414, STAT 4105, STAT 4706</td>
<td>3(3, 3)</td>
</tr>
<tr>
<td>ISE 3614 Intro to Hum Factors Engr &amp; Ergo (C-) Pre: ISE 2004, 2034, (2204 or 2214), STAT 4105</td>
<td>3(3)</td>
<td>Technical Elective</td>
<td>3</td>
</tr>
<tr>
<td>CLE (Area 2, 3, or 7)</td>
<td>3</td>
<td>CLE (Area 2, 3, or 7)</td>
<td>3</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>18</strong></td>
<td></td>
<td><strong>TOTAL</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>FALL SEMESTER SENIOR 2017</th>
<th></th>
<th>SPRING SEMESTER SENIOR 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Credits</td>
<td></td>
<td>Credits</td>
</tr>
<tr>
<td>ISE 4005 Proj Mgmt &amp; System Design (C-) Pre: 2204, 2214, 3214, 3424, 3434, 3614, 4404 Co: 3624</td>
<td>3(3)</td>
<td>ISE 4006 Proj Mgmt &amp; System Design Pre: ISE 3624, 4005, 4204</td>
<td>2(3)</td>
</tr>
<tr>
<td>ISE 4204 Production Planning and Inv Ctrl (C-) Pre: ISE 2404, 3414, STAT 4706</td>
<td>3(3)</td>
<td>ISE 4214 Lean Manufacturing Pre: ISE 4204</td>
<td>3(3)</td>
</tr>
<tr>
<td>ISE 3624 Ind Ergo &amp; Work Meas (C-) Pre: ISE 3614, ESM 2104</td>
<td>3(3)</td>
<td>Technical Elective</td>
<td>3</td>
</tr>
<tr>
<td>ISE Technical Elective</td>
<td>3</td>
<td>ISE Technical Elective</td>
<td>3</td>
</tr>
<tr>
<td>CLE (Area 2, 3, or 7)</td>
<td>3</td>
<td>Free Elective</td>
<td>2-3</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>15</strong></td>
<td></td>
<td><strong>TOTAL</strong></td>
</tr>
</tbody>
</table>

Superscripted annotation in Credits column indicates which semester a course is known 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](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) | | | | |
| CLE Area 3: Society & Human Behavior electives (6 hrs) | | | | |
| 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) | | | | |
| CLE Area 7: Global Issues Elective (3 hrs) | | | | |

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 133 credits.

**Electives**

The ISE degree requires 6 credits of **ISE Technical Electives** from a list, 6 credits of **Technical Electives**, and 2-3 credits of **Free Electives**. 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](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, 2204, 2214, 2404, STAT 4105, MATH 2214, MATH 2204; and
  - Be enrolled in 12 or more credits of ISE classes per year,

**Prerequisites:** Prerequisites for each course are listed after the course title. All ISE courses require a C- or better in any prerequisite ISE, STAT, and MATH courses. 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 133 semester credit hours with a minimum overall GPA of 2.00 and a minimum in-major GPA of 2.00.
Electives for ISE 2018 Checksheet

In addition to electives to satisfy CLE requirements, the ISE degree requires 6 credits of **ISE Technical Electives**, 6 credits of **Technical Electives**, and 2-3 credits of **Free Electives**.

In selecting electives, students should carefully note:

- That some courses may not be available to all students due to prerequisite requirements or due to major restrictions by the offering department.
- The number of credits for any course to ensure a sufficient number of credits will be taken (e.g., some courses may be only 2 credits).
- Courses with substantial duplication of courses required for the BSISE will not qualify for credit; if in doubt, check with an ISE Academic Advisor.
- Students pursuing a Minor may need to select specific courses as ISE Technical Electives, Technical Electives, or Free Electives to satisfy the Minor requirements.

**ISE Technical Electives**
The purpose of this requirement is to enable students to develop expertise in a particular area of the ISE discipline.

**Requirements:**

- 6 credits of ISE Technical Electives at the 3000 or 4000 level must be taken from the list below.
- A maximum of 3 credits of ISE 4974 or ISE 4994 is allowed without prior approval. Students wishing to take more than 3 credits of ISE 4974 or ISE 4994 must obtain permission from the ISE Undergraduate Program Director.

ISE 3004 Industrial Cost Control (Pre: ISE 2014 or ME 2024)
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**
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.

**Requirements:**

- 6 credits of Technical Electives must be taken on an A-F basis; any course offered only as P/F must be approved in advance (see ISE Academic Advisor).
- Up to 3 ISE credits may be used to satisfy this requirement, while 3 credits must be taken outside of ISE.
- Courses in the College of Engineering or Science allowed as Technical Electives (see exceptions noted below):
  - 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 3604, STAT 3615, STAT 3704, STAT 4604, STAT 4705, or STAT 4714.

**Free Electives**
The purpose of this requirement is to enable students to enhance or complement knowledge and skills by providing breadth in areas outside of ISE.

**Requirements:**

- 2-3 credits of Free Electives must be taken.
- Students may not use a given course to satisfy both the Free Elective requirement and CLE requirements. Any given course will satisfy only one requirement.