



**INDUSTRIAL AND SYSTEMS
ENGINEERING**

**UNDERGRADUATE PROGRAM
STUDENT HANDBOOK**

2016 - 2017

This handbook provides information about the BSISE curriculum. All Industrial and Systems Engineering (ISE) students should read it and fully understand its contents. Students should also read and understand the University Bulletin for Undergraduate Programs at North Carolina A&T State University. Each ISE student is responsible for knowing the contents and following the prescribed rules and regulations documented in this handbook and the University Bulletin.

The provisions of this handbook do not constitute a contract, expressed or implied, between any applicant or student and the ISE Department or North Carolina A&T State University. The University and the Department reserve the right to change any of the provisions, schedules, programs, courses, rules, regulations, or fees whenever university or departmental authorities deem it appropriate to do so.

If you have questions, please contact your advisor in the ISE Undergraduate Program Office McNair Hall. Additional copies of this handbook can be obtained on the department website.

**Department of Industrial and Systems Engineering
North Carolina A&T State University
Telephone: (336) 334-7780
Fax: (336) 334-7729**

<http://www.ncat.edu/coe/departments/inen/index.html>

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CHAPTER I THE INDUSTRIAL AND SYSTEMS ENGINEERING PROFESSION

(Portions of this chapter have been adapted from *Turner, Mize, Case, and Nazemtz, INTRODUCTION TO INDUSTRIAL AND SYSTEMS ENGINEERING, 3rd Ed., 1993, pp. 3-6, 16-18, 20-22, 24-34. Reprinted by permission of Prentice-Hall Inc., Englewood Cliffs, New Jersey).*

Overview of Industrial and Systems Engineering Activities

With the onset of the Industrial Revolution came the need for technically trained people who could visualize, plan and organize large and complex systems. Industrial and Systems Engineering emerged as a profession to increase the efficiency and effectiveness of these operations.

The formal definition of Industrial and Systems Engineering recently given by the Institute of Industrial Engineers (IIE) is as follows:

"Industrial and Systems Engineering is concerned with the design, improvement and installation of integrated systems of people, materials, information, equipment and energy. It draws upon specialized knowledge and skill in the mathematical, physical, social and information sciences together with the principles and methods of engineering analysis and design to specify, predict and evaluate the results to be obtained from such systems."

The word "Industrial" in the above definition also refers to service enterprises as well as manufacturing organizations that seek the skills of Industrial and Systems Engineers.

Employment Opportunities

Industrial and Systems Engineering has one of the most encouraging future outlooks regarding employment opportunities. This is attributed to increasing recognition in U.S. organizations of the value of an Industrial and Systems Engineer's role in their operations. Because of the type of education industrial and systems engineers receive, they are often promoted to management positions within five to ten years after graduation (substantiated by a US Department of Labor report).

Professional Registration

Engineers can secure professional registration. There are several advantages to being professionally registered, which are:

1. Full membership in the profession of engineering: No engineering credential is as widely accepted in engineering as the title of Professional Engineer (PE)
2. Preparation for career unpredictability: You may find that registration is necessary in order to qualify for a particular position or that it enhances your opportunities in an existing job. If you are thinking of doing work abroad, a PE license earned in the US will carry weight. Also if you leave engineering work for a year or more the PE will help you to regain employment later as an engineer.

3. Admission to practice in some occupations: In most states, you cannot offer your services as a consulting engineer without being licensed as a PE. In many companies, engineering registration is necessary before your company will allow you to testify before a public hearing as an expert.
4. Mobility and job security: Having a PE is an additional credential valued by most employers giving you job security and even mobility.
5. Public benefit: If you have a public license to practice engineering, the public is assured that you have passed a rigorous set of procedures chosen to safeguard the health, safety and welfare of the public.

A further benefit worth mentioning is that PE-licensed ISEs earn approximately \$10,000 more per year than their colleagues without a PE license.

There are two major steps in securing a PE license: (1) pass the Fundamentals of Engineering (FE) exam, and (2) after four years of engineering design experience, pass the PE Exam. The FE exam is a computer-based test offered year-round, and covers most engineering courses in your curriculum. It is advisable to take this exam when you are a senior, as most of the subject material is still clear in your mind.

More specific information regarding the FE exam and preparation materials can be found at <http://ncees.org/exams/fe-exam/>. You can obtain more information about PE registration from the North Carolina Board of Examiners for Engineers and Surveyors' web site <http://www.ncbels.org> or by contacting them at 310 West Millbrook Road, Raleigh, North Carolina 27609, Telephone (919) 841-4000, Fax (919) 841-4012.

CHAPTER II GENERAL INFORMATION

The Department of Industrial and Systems Engineering

The Department of Industrial and Systems Engineering (ISE) was established in 1977. Within the department are laboratories for Product, Process, and Facility Design; Manufacturing Processes and Systems; Automated Assembly and Packaging; Logistics and Warehousing; Human Performance; Human Machine Systems; Management and Simulation Systems; and Information Systems. The Industrial and Systems Engineering Department enjoys support from the College of Engineering, the University, research sponsors, and the local industries.

In addition to the Bachelor of Science program in Industrial and Systems Engineering, the ISE Department offers the Master of Science in Industrial and Systems Engineering as well as the Doctor of Philosophy in Industrial and Systems Engineering degrees.

The administrative staff of the undergraduate program of the ISE Department includes:

Department Chair: Dr. Tonya Smith-Jackson
408 McNair Hall
336-285-3759
tsmithj@ncat.edu

Undergraduate Program Director: Dr. Daniel Mountjoy
405 McNair Hall
336-285-3730
mountjoy@ncat.edu

Undergraduate Program Coordinator: Ms. Elaine Vinson
406 McNair Hall
336-285-3737
vinson@ncat.edu

Accreditation



The program of study leading to the Bachelor of Science in Industrial and Systems Engineering (BSISE) is accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org>.

Alumni

Approximately 600 companies and government agencies visit the campus every year to recruit N.C.A&T students. Our graduates are employed by many reputable firms. Some of our alumni have pursued graduate studies at various universities such as George Tech, Virginia Tech, The Ohio State University, North Carolina State University, Purdue University, Pennsylvania State University, Oklahoma State University, and Clemson University. Many graduates are employed in government agencies such as the Environmental Protection Agency (EPA), Federal Aviation

Administration (FAA), National Aeronautics and Space Administration (NASA), the U.S. Army, and the Naval Shipyard. Among the many companies that recruit ISE graduates from N.C. A&T are:

- | | | |
|--------------------------|--------------------------|--------------------|
| • General Motors | • Altec Industries | • Intel |
| • General Electric | • Altria Client Services | • Bank of America |
| • Toyota | • Deere-Hitachi | • Chrysler |
| • Boeing | • Lockheed Martin | • Sara Lee |
| • IBM | • Ford | • Cargill |
| • Accenture | • Rolls Royce | • Shell |
| • Honda Aircraft Company | • Procter and Gamble | • Northrop Grumman |
| • John Deere | • Cummins | • SAS |

Student Activities

Among the professional engineering organizations in which ISE students participate are:

- Institute of Industrial and Systems Engineers (IISE)
- Society of Manufacturing Engineers (SME)
- Human Factors and Ergonomics Society (HFES)
- Institute for Operations Research and Management Science (INFORMS)
- National Society of Black Engineers (NSBE)
- Society of Women Engineers (SWE)
- Society of Hispanic Professional Engineers (SHPE)
- American Indian Science and Engineering Society (AISES)
- National Society of Professional Engineers (NSPE)
- American Society for Quality (ASQ)
- Association for Operations Management (APICS)
- Alpha Pi Mu Honor Society
- Tau Beta Pi Honor Society

The ISE Department and the College of Engineering support student chapters for many of these societies. In addition, there are many campus-wide extra-curricular activities, including sports, publications, music, drama, student government and religious groups.

Classes

The ISE Department limits class sizes to encourage better student-teacher interaction. Most classes do not exceed 40 students.

Faculty

All full-time, non-adjunct faculty members have earned doctorates in Industrial and Systems Engineering and/or related disciplines. Their teaching and research interests are diverse and reflect a range of interests within the ISE discipline. Additionally, persons from industry with specialized expertise present seminars and may teach courses in their areas. The following are full-time faculty in the ISE Department:

- **Davis, Lauren**, BS, Rochester Institute of Technology; MSIME, Rensselaer Polytechnic Institute; Ph.D. North Carolina State University; Associate Professor; Rm. 404 McNair Hall, lbdavis@ncat.edu
- **Desai, Salil, L.**, BSME, University of Bombay; MSIE, Ph.D., University of Pittsburgh; Associate Professor; Rm. 423 McNair Hall, sdesai@ncat.edu
- **Jiang, Steven X.**, BSME, East China Institute of Technology; MS, Nanjing University of Science & Technology; Ph.D., Clemson University; Associate Professor, Rm. 426-B McNair Hall; xjiang@ncat.edu
- **Li, Zhichao (Zinc)**, BS, MS, Tianjin University of Technology and Education ; Ph.D., Kansas State University ; Associate Professor; Rm. 403 McNair Hall; zli@ncat.edu
- **Mountjoy, Daniel N.**, BSE, MSE, Wright State University; Ph.D., North Carolina State University; Adjunct Associate Professor; Rm. 405 McNair Hall; mountjoy@ncat.edu
- **Oneyear, Stephen**, BS, MS, University of Wisconsin; Adjunct Associate Professor; Rm. 425 McNair Hall; sjoneyea@ncat.edu
- **Park, Eui H.**, BS, Yonsei University; MBA, City University; MSIE, Ph.D., Mississippi State University; Professor; Rm. 401 McNair Hall; park@ncat.edu
- **Qu, Xiuli (Shelly)**, BEEE, MSEE, University of Science and Technology Beijing; MSIE, Ph.D., Purdue University; Associate Professor; Rm 424 McNair Hall; xqu@ncat.edu
- **Seong, Younho**, BSISE, MSIE, Incheon University; Ph.D., State University of New York at Buffalo; Associate Professor; Rm. 422-A McNair Hall; yseong@ncat.edu
- **Smith-Jackson, Tonya**, BA, University of North Carolina; MS, PhD, North Carolina State University; Certified Professional Ergonomist; Professor; Rm. 408 McNair Hall; tsmithj@ncat.edu
- **Stanfield, Paul**, BSEE, MSIE, Ph.D., North Carolina State University; MBA, University of North Carolina at Greensboro; Professional Engineer; Associate Professor; Rm. 402 McNair Hall; stanfiel@ncat.edu

CHAPTER III

ACADEMIC POLICIES, REGULATIONS AND PROCEDURES

You are advised to refer to the University Bulletin for detailed information on University Academic Regulations.

1. All ISE students must satisfy the "Minimum C Grade for Select Courses" Policy of the College of Engineering. See below for details.
2. All ISE students must satisfy Prerequisite and Corequisite requirements for every course.
3. A minimum of 120 credit hours is required for graduating with a Bachelor of Science degree in Industrial and Systems Engineering. These 120 hours include required as well as elective courses. These are described in Chapter IV.

Minimum C Grade in Selected Courses Policy

This policy applies to all engineering programs in the College of Engineering. Specifically, when an engineering program requires students to take any of the following courses, students will have to obtain a minimum grade of "C" in each such course to meet graduation requirements. Furthermore, a minimum grade of "C" on any such course will be required to satisfy prerequisite requirements of subsequent courses. This change applies to each Bachelor of Science curricula in the College of Engineering, both to courses that are explicitly required and those that are recommended as elective courses. The effective date is Fall 2002. The complete set of courses with this "Minimum C" requirement is listed below:

- | | |
|------------|----------------|
| · CHEM 106 | · PHYS 242 |
| · CHEM 107 | · GEEN 100 |
| · MATH 131 | · ECEN 200/340 |
| · MATH 132 | · ISEN 260 |
| · MATH 224 | · ISEN 361 |
| · MATH 231 | · ISEN 370 |
| · MATH 431 | · MEEN 260 |
| · PHYS 241 | · MEEN 230/231 |

University Policy on Repetition of Courses

An undergraduate student may only repeat a course in which they earned a grade of "C-" or lower if it is a prerequisite course requiring a minimum grade of "C", or if a minimum grade of "C" is a requirement in the student's declared major. Students will not receive additional credit hours for repeated courses in which they originally earned a passing grade. Students who do not receive a passing grade in a course may repeat that course. For courses repeated subsequent to the effective date of the policy, during a student's academic career at the University a student may repeat any number of distinct courses totaling a maximum of sixteen (16) credit hours.

No single undergraduate course may be repeated more than two (2) times to include withdrawals (W's), for a maximum of three (3) attempts. No single graduate course may be repeated more than (1) one time, to include withdrawals (W's), for a maximum of two attempts. All grades received will be recorded on the student's permanent academic record. For repeats of courses

subsequent to the effective date of this policy, any undergraduate student who has exhausted their three (3) attempts or any graduate student who has exhausted two (2) attempts, and has not passed a required course in their major field of study will be dismissed from that major. The University may accept transfer credit for undergraduate General Education Core requirement courses.

Undergraduate students can repeat the same course only once for grade forgiveness. On a third attempt, the two (2) most recent grades will be used in computing the GPA.

Financial aid implications for repeated courses should be discussed with the Office of Financial Aid. Note that a tuition surcharge is applied when a student has attempted more than 140 credit hours.

University Policy on Withdrawals

Withdrawal from an Individual Course

A student may withdraw from any course or courses by submitting a Change of Schedule form to the Office of the Registrar on or before the last day to withdraw from an individual course, as published in the Academic Calendar.

Students who withdraw from a course or courses on or before the last day to withdraw from an individual course are assigned a grade of “W.” Failure to attend class does not constitute a withdrawal from that course or courses. For withdrawals done beginning Fall 2012, students are limited to a maximum of two (2) withdrawals per course, up to a maximum of five (5) courses during the student’s academic career. Upon a third (3) attempt in a single course, the student is not permitted to withdraw from the course and must receive a grade for the course.

A student who does not officially withdraw from a course or courses will be assigned a final grade in each course in which he or she was enrolled during the semester in question. Withdrawing from a course or courses may affect a student’s financial aid status, will count toward the tuition surcharge threshold, and may affect the student’s progress toward degree completion.

Students considering withdrawing from a courses or courses should consult their academic advisor and the Office of Student Financial Aid.

Withdrawal from the University

Any student who is officially registered for classes and who wishes to withdraw from the University must complete the withdrawal process by the last day to withdraw from the university as published in the academic calendar.

Students who withdraw from the University prior to the published withdrawal deadline shall receive a “W” in all classes in which they were enrolled. Failure to attend classes does not constitute a withdrawal from the University. A student who does not officially withdraw from the University will be assigned the final grade earned in each course in which he or she was enrolled during the semester in question.

Withdrawal applications by students who have a pending judicial charge will not be processed by the Registrar. Pending judicial charges must be cleared before a student may officially withdraw from the University.

Withdrawal from the University may have significant academic and/or financial aid implications. Students are strongly encouraged to seek advisement by their academic advisor or academic unit and financial aid officer before completing the withdrawal process.

Advisement Process

Advisor's Role

Students majoring in Industrial and Systems Engineering are assigned an academic advisor based upon their classification: freshmen and sophomores are advised by the Undergraduate Program Coordinator, while juniors, seniors, and transfer students are advised by the Undergraduate Program Director. The advisor: (a) provides information, advice, and recommendations in academic and related areas; (b) directs the students to sources which explain in detail academic regulations, course prerequisites and graduation requirements; (c) helps new students understand the degree to which one should assume responsibility for one's own program planning; (d) provides vocational guidance and occupational information in one's area of specialty, and (e) refers the student to the appropriate individual, office or agency when further assistance is necessary. The Department Chairperson, Undergraduate Program Director, and the Undergraduate Program Coordinator are also available to students needing information about different curricula and help in forming educational plans.

Faculty members are usually the best source of help to students having difficulty with particular subjects. Members of the faculty keep office hours and expect students to consult them individually whenever special assistance is needed.

Students have the primary responsibility to plan their individual programs and meet graduation requirements.

Changes in Schedule

A change in a student's schedule may be made with the consent of his or her advisor and department chair. Students may drop a course without penalty up until the official deadline of withdrawal. After the time limit has expired, withdrawal from any course will result in a grade of "W." Note that students may only receive a "W" two (2) times for any particular course, and five (5) times total across their undergraduate degree program.

Prerequisites/Corequisites

Prerequisites are courses or levels of achievement that a student is expected to have completed successfully by earning at least a passing grade prior to enrolling in a course. Students should refer to this handbook and/or the University Bulletin for course prerequisite requirements.

It is the student's responsibility to ensure they have satisfied prerequisites for any course in which they have enrolled. Failure to satisfy prerequisites will result in removal from enrollment in the course.

Those students who do not meet prerequisite or co-requisite requirements should not register for the course. If students register for the course, but later find they do not meet the prerequisite or co-requisite requirements, the students must drop the course and add other courses before the add/drop deadline. Such students will not be permitted to attend class lectures or take tests. They will receive a grade of "F" if the course is not dropped before the add/drop deadline.

Generally, substitutions for prerequisites/co-requisites will not be allowed for courses listed in this ISE Handbook.

Industrial and Systems Engineering Policy on Course Registration

All ISE students should make an appointment with their advisor before the registration period begins. Prior to the meeting, a registration plan must be completed by filling out the Advisement Registration Form made available in the ISE office. Based on the plan and any recommendations from the advisor, the student will be given their Personal Identification Number (PIN).

After gaining advisor approval, students can use AggieAccess to select courses. Failure to see the advisor or registering without approval may cause unnecessary delays in the student's graduation and the Registrar may be informed to drop such a student from all courses.

Behavior and Classroom Conduct

The Department of Industrial and Systems Engineering strives to provide an educational environment that is welcoming and conducive to learning, and promotes excellence in all areas of personal and professional development. To help the department attain success in this endeavor, ISE students are expected to be professional and courteous inside and outside the classroom, and should seek to develop collaborative relationships with faculty, staff and other students. Students should understand University policies on academic honesty and disruptive behavior (as published in the Undergraduate Bulletin), as well as the policies specific to their respective course instructors. By following the standards set forth in the Aggie Pride Compact, students will properly position themselves for success.

The Aggie Pride Compact can be found at:

<http://www.ncat.edu/divisions/academic-affairs/bulletin/2012-2014/student-life/>

NC A&T Industrial and Systems Engineering Department (Undergraduate Students) Academic Expectations

The ISE academic expectations describe the fundamental beliefs and actions necessary to achieve and sustain the intellectual climate that is paramount to the success of NC A&T's 2020 Preeminence Strategic Plan. While fundamental to the success of anyone engaged in an academic endeavor, we expect all members of the ISE department to internalize and adhere to the Academic Expectations on a consistent basis and to remind ISE peers of the importance of adherence to these expectations. As members of NC A&T ISE, we expect students to:

1. Take responsibility for learning by using office hours as needed, coming to class prepared, and reading and studying supplemental material independently.
2. Respect the teaching-learning environment, including peers, instructors, and guests.
3. Approach all learning activities with honesty, integrity, and by upholding the Student Code of Conduct.
4. Attend all class meetings on time and for the full time allotted.
5. Engage in active learning during class meetings by focusing on the subject matter and actively participating in class discussions and activities.
6. Commit to high quality deliverables such as homeworks, projects, and exams and submit these deliverables on time.
7. Allocate significant time to academic preparation by studying and reviewing material every day.
8. Utilize instructors' office hours to ensure mastery of the subject matter.
9. Follow the curriculum.
10. Show up for meetings on time as promised.
11. Ask for help immediately when needed.
12. Take responsibility for organization of your work and time management.

CHAPTER IV BACHELOR OF SCIENCE IN INDUSTRIAL AND SYSTEMS ENGINEERING CURRICULUM

Program Mission

The mission of the Bachelor of Science Program in Industrial and Systems Engineering (BSISE Program) follows from the mission of the North Carolina A&T State University, the widely accepted purpose of the industrial and systems engineering profession, and the needs of the Industrial and systems engineering community in the Central Piedmont region of North Carolina and the world.

The following statement describing the University's mission is taken from the Strategic Plan, *Preeminence 2020*:

North Carolina Agricultural and Technical State University is a public, doctoral/research, 1890 land-grant university committed to exemplary teaching and learning, scholarly and creative research, and effective engagement and public service. The university offers degrees at the baccalaureate, master's and doctoral levels and has a commitment to excellence in a comprehensive range of academic disciplines. Our unique legacy and educational philosophy provide students with a broad range of experiences that foster transformation and leadership for a dynamic and global society.

Program Educational Objectives

The BSISE Program Objectives are established by the faculty of the Department of Industrial and Systems Engineering. In determining these objectives, the stakeholders of the BSISE Program are consulted at least once every five years. Furthermore, the objectives are verified for consistency with the mission, goals and objectives of the University and the College of Engineering.

The objectives of the BSISE Program are to produce graduates who:

1. Apply technical and business skills based on industrial and systems engineering principles for a variety of employers in the manufacturing and service industries.
2. Apply information technology tools and systems engineering methods.
3. Lead and function in interdisciplinary, culturally and/or globally diverse teams.
4. Contribute to their communities, the profession of industrial and systems engineering, and the University.
5. Engage in lifelong learning, including the pursuit of graduate studies.

The following matrix shows the connections between Industrial and Systems Engineering courses in the BS curriculum and the Program Objectives.

		Program Educational Objectives				
		1	2	3	4	5
ISEN Course Number and Name		Apply technical and business skills based on industrial and systems engineering principles for a variety of employers in the manufacturing and service industries.	Apply information technology tools and systems engineering methods.	Lead and function in interdisciplinary, culturally and/or globally diverse teams.	Contribute to their communities, the profession of industrial and systems engineering, and the University.	Engage in lifelong learning, including the pursuit of graduate studies.
102	Graphical Visualization for Industrial Engineers	X	X			
162	Computer Programming in VB for Engineers	X	X			
246	Industrial Production Processes	X	X			
255	Methods Engineering	X	X			X
286	Engineering Teams and Leadership	X		X		
324	CAD/CAM	X		X		X
361	Engineering Economy and Cost Analysis	X	X			
370	Engineering Statistics	X				X
380	Information Technology for ISE	X	X			
386	Systems Approaches for ISE	X	X			
400	Problem Solving in ISE	X				X
415	Discrete Event Systems Modeling and Simulation	X	X			X
425	Quality Assurance	X		X		X
430	Deterministic Operations Research	X	X			X
435	Stochastic Operations Research	X				X
440	Decision Support Systems for ISE	X	X			
455	Production Control	X	X	X		X
465	Facilities Design	X	X			
471	Ergonomics	X	X	X		
472	Cognitive Human Factors	X	X	X		X
475	Design of Experiments	X	X			
486	Professionalism and Ethics for ISE	X			X	X
495	Design Projects in ISE	X	X	X	X	

Student Outcomes

The specific student outcomes, measured in terms of the knowledge and skills the graduates of the BSISE program are expected to possess upon graduation, are provided below.

BSISE Program Student Outcomes

The student outcomes, measured in terms of the knowledge and skills the graduates of the BSISE program are expected to demonstrate at graduation are:

- a. an ability to apply knowledge of mathematics, science, and engineering*;
- b. an ability to design and conduct experiments, as well as to analyze and interpret data*;
- c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability*;
- d. an ability to function on multidisciplinary teams;
- e. an ability to identify, formulate, and solve engineering problems*;
- f. an understanding of professional and ethical responsibility;
- g. an ability to communicate effectively;
- h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context*;
- i. a recognition of the need for, and an ability to engage in life-long learning;
- j. a knowledge of contemporary issues; and
- k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice*^{**}.

* Based on the program educational objectives, the program emphasizes these outcomes to prepare graduates to design (c), develop, implement, and improve integrated systems (e) that include people, materials, information, equipment and energy using appropriate analytical (a), computational(k), and experimental (b) practices with consideration for life cycle factors (c, h).

** Based on program educational objective 2, techniques, skills or tools that are computer-based and/or associated with systems engineering are emphasized.

Student outcomes are achieved by exposing students to a variety of subject material across the undergraduate curriculum. The table below shows where each outcome is to be assessed for undergraduate program improvement purposes. Standard rubrics used to assess each outcome are provided on the following pages. Note that these rubrics may be edited from time to time as part of the department's continuous improvement efforts.

ISE (ABET) Student Outcome	a	b	c	d	e	f	g	h	i	j	k
Freshman-Level Classes											ISEN 162
Sophomore-Level Classes	ISEN 246		ISEN 255	ISEN 286	ISEN 255	ISEN 286	ISEN 286		ISEN 380	ISEN 246	ISEN 380
Junior-Level Classes	ISEN 435	ISEN 370	ISEN 465		ISEN 430	ISEN 386	ISEN 386	ISEN 361		ISEN 471	ISEN 435
Senior-Level Classes	ISEN 425	ISEN 475	ISEN 446	ISEN 495	ISEN 415	ISEN 486	ISEN 486	ISEN 495	ISEN 489	ISEN 495	ISEN 415 ISEN 495

Outcome a: an ability to apply knowledge of mathematics, science, and engineering.

Indicator	Unsatisfactory (1)	Developing (2)	Satisfactory (3)	Exceptional (4)
Mathematical Modeling	Does not understand the connection between mathematical models and the physical processes and systems in engineering.	Chooses a mathematical model or scientific principle that applies to an engineering problem but has trouble in model development.	Chooses a mathematical model or scientific principle that applies to an engineering problem producing tangible results	Combines mathematical models and or scientific principles to formulate models of integrated systems of people, material, equipment, and information relevant to Industrial and Systems Engineering.
Application	Does not understand the application of calculus and linear algebra in solving engineering problems.	Shows nearly complete understanding of applications of calculus and/or linear algebra in problem solving.	Shows complete understanding of applications of calculus and/or linear algebra in problem solving.	Applies concepts of integral and differential calculus and/or linear algebra to solve problems.
Terms	Mathematical terms are interpreted incorrectly or not at all.	Most mathematical terms are interpreted correctly.	Shows appropriate engineering interpretation of mathematical and scientific terms	Shows appropriate engineering interpretation of mathematical and scientific terms and able to extend beyond scientific basis
Theory	Does not appear to grasp the connection between theory and the problem.	Some gaps in understanding the application of theory to the problem.	Shows satisfactory understanding of academic theories	Translates academic theory into engineering applications.
Calculation	Calculations not performed or performed incorrectly by hand or does not know how to use math software.	Significant errors in calculations by hand and applying math software.	Shows the successful and appropriate use of mathematical software	Executes calculations correctly by hand and using mathematical software.
Analysis	No application of statistics to analysis of data.	Uses statistical analysis of data as the basis for workmanlike judgments, drawing plausible conclusions from the work. Analysis has minor errors.	Uses statistical analysis of data as the basis for competent judgments, drawing reasonable and appropriately qualified conclusions from the data	Uses statistical analysis of data as the basis for deep and thoughtful judgment, drawing insightful, carefully qualified conclusions from this work.

Outcome b: an ability to design and conduct experiments, as well as to analyze and interpret data.

Indicator	Unsatisfactory (1)	Developing (2)	Satisfactory (3)	Exceptional (4)
Effectiveness of experimental design and/or procedures	Very ineffective. Would not allow experimenters to achieve all goals. Seeks no extra information for experiments other than what is provided by the instructor.	Develops a simplistic experimental plan of data gathering, does not recognize entire scope of study (e.g. not all parameters affecting the results were investigated.)	Mostly effective. Would allow experimenter to achieve most goals.	Formulates an experimental plan of data gathering to attain all stated objectives.
Execution of Procedures	Data are poorly documented. Does not follow experimental procedure.	Data collected are not all documented, units are missing or some measurements are not recorded.	Demonstrated adequate ability to conduct experiments. Collected most of the needed data.	Develops and implements logical experimental procedures. Carefully documents data collected.
Data Analysis	Statistical methods were completely misapplied or absent.	Statistical methods were attempted. Some methods were applied but with significant errors or omissions.	Most methods were correctly applied but more could have been done with the data.	Statistical methods were fully and correctly applied.
Interpretation of data	Makes no attempt to relate data to theory.	Applies appropriate theory to data when prompted to do so, but interprets physical significance of theory or variable involved; makes errors in unit conversions.	Applied theory to data correctly and interpreted most data correctly. Some conclusions may be questionable or over-interpreted.	Analyzes and interprets data carefully using appropriate theory. If required, translates theory into practice. Is aware of measurement error and is able to account for it statistically.

Outcome c: an ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

Indicator	Unsatisfactory (1)	Developing (2)	Satisfactory (3)	Outstanding (4)
Needs Identification	Fails to identify any desired needs for the system, component or process	Identifies some (half of) desired needs for the system, component or process	Identifies most desired needs for the system, component or process, but miss one or two desired needs	Identifies all desired needs for the system, component or process
Constraint Recognition and Consideration	Fails to recognize any constraints in the system, component or process to be designed	Recognizes some important constraints related to the system, component or process to be designed	Recognizes most important constraints related to the system, component or process to be designed	Recognizes all constraints related to the system, component or process to be designed
Design Approach	No design strategy; haphazard approach	Seeks help to develop single design strategy and approach with minor consideration of desired needs and constraints	Works primarily independently or within team to develop design strategy and approach, in which most desired needs and constraints are taken into consideration	Works totally independently or within team to develop multiple layers of strategy and novel approach, in which all desired needs and constraints are taken into consideration
Integration	Shows no regard for interface of people, materials, or equipment, energy and life cycle factors	Attempts to show relationship of people, materials, equipment, energy and life cycle factors but with unsubstantiated facts	Shows limited regard for interface of people, materials, or equipment, energy and life cycle factors	Shows relationships of people, materials, equipment, energy and life cycle factors with required facts with minimal advisory input
Analytical Practice	No use of analytical approaches taught in ISE courses	Minimal or incorrect use of analytical approaches taught in ISE courses	Proper use of one or two analytical approaches taught in ISE courses	Uses all appropriate analytical approaches taught in ISE courses
Documentation	Design is done incompletely without proper supporting equations and lack of documentation	Design is complete with minimal supporting equations or incorrect equations, and incomplete documentation	Design is done completely but lacks proper supporting equations and documentation to explain how the desired needs are met and what constraints are considered in the design	Design is complete with all correct supporting equations and complete documentation to show how the desired needs are met and what constraints are considered in the design

Outcome d: an ability to function on multidisciplinary teams.

Indicator	Unsatisfactory (1)	Developing (2)	Satisfactory (3)	Exceptional (4)
Participation in meetings	Understands the importance of participating in meetings*	Present at most meetings*	Present at some meetings* and contributes to carrying forward the meetings*	Present at most meetings* and contributes to carrying forward the meetings*
Contribution	Understands the importance of individual contributions in team work	Makes little contributions to the work of the team	Makes some contribution to the work of the team	Makes pivotal contributions to the work of the team
Support	Understands the importance of supporting the work of fellow team members	Provides little support for work of fellow team members	Provides some support for work of fellow team members	Plays vital role in supporting the work of fellow team members
Initiative	Understands the importance of individual contributions to the planning of team's tasks	Makes little contribution in planning the activities of the team	Makes some contributions in planning the activities of the team	Plays a vital role in planning the activities of the team
Multidisciplinary	Cannot communicate the value of having teams with multiple disciplines.	Describes the value of having a multidisciplinary team.	Given a specific problem, able to list needed discipline and describe the contribution of each discipline.	Creates plan to integrate and lead team that is multidisciplinary with understanding of the strengths and limitations of contributing disciplines.

+ in this rubric teams are assumed to be composed of members primarily from a single academic major

* face-to-face or virtual

Outcome e: an ability to identify, formulate, and solve engineering problems.

Indicator	Unsatisfactory (1)	Developing (2)	Satisfactory (3)	Exceptional (4)
Identify Engineering Problem	Cannot comprehend nature of the problem	Recognizes the basic nature of the problem but cannot state in concise language what the core issue(s) are	Correctly identifies the basic problem and attempts to develop a problem statement using IE terminology	Identifies the complete core problem and makes a concise problem statement using correct IE terminology
Formulate Approach	Cannot describe problem and unable to begin formation of an approach	Solution approach format is incomplete and/or superficial but is correct to the level identified	Solution approach format using correct tools but alternative approaches not developed and minimal supporting documentation offered	Approach is properly formatted in IE terminology and supported with documentation as well as alternative formulations offered
Solve Engineering Problems	No solution offered	Partial solutions offered with insufficient depth to show mastery of concept	Solutions offered and supported with correct and proper IE tools utilized with minimal regard to a complete system approach	Solutions as well as alternative solutions offered with correct IE tools utilized demonstrating complete understanding of the IE system approach

Outcome f: an understanding of professional and ethical responsibility.

Indicator	Unsatisfactory (1)	Developing (2)	Satisfactory (3)	Exceptional (4)
Ethical Self-Awareness	Student not able to articulate core beliefs and values.	Student able to articulate core beliefs and values and their origins.	Student able to articulate core beliefs and values and perform self-analysis.	Student able to articulate core beliefs and values and perform self-analysis with exceptional depth and clarity.
Identification of Ethical / Legal Issues	Student fails to identify ethical/legal issues.	Student partially identifies ethical/legal issues.	Student identifies all intended ethical/legal issues.	Student identifies all intended ethical/legal issues, and discusses the relevance of these issues to the case.
Stakeholder Positions	Student does not identify/consider stakeholder(s) positions related to the ethical/legal issue(s).	Student correctly identifies/considers a single potential stakeholder’s position related to the ethical/legal issue(s).	Student correctly identifies/considers more than one potential stakeholders’ positions related to the ethical/legal issue(s).	Student correctly identifies/considers a wide range of potential stakeholders’ positions related to the ethical/legal issue(s).
Resolution	Student fails to provide a potential resolution to the problem.	Students provides problem resolution, but does not consider alternatives.	Student considers alternative ways to resolve the issue with some discussion of merit of each alternative.	Student considers more than two alternative ways to resolve the issue(s), and discusses their potential effects on all stakeholders.
Responsibility	Student is not able to describe the professional and ethical responsibility of engineers.	Student is able to describe the professional and ethical responsibility of engineers.	Student is able to describe and apply the professional and ethical responsibility of engineers.	Student is able to describe and apply professional and ethical responsibility and communicates a clear personal commitment to responsibility.

Outcome g: an ability to communicate effectively (written).

Indicator	Unsatisfactory (1)	Developing (2)	Satisfactory(3)	Exceptional (4)
Spelling and Grammar	Uses language that sometimes impedes meaning because of frequent errors in usage.	Uses language that generally conveys meaning to readers with clarity, although writing includes some errors.	Uses straightforward language that generally conveys meaning to readers. The language in the portfolio has few errors.	Uses graceful language that skillfully communicates meaning to readers with clarity and fluency, and is virtually error-free.
Content	Uses inappropriate and/or irrelevant content to develop ideas in most parts of the work.	Uses appropriate and relevant content to develop and/or explore simple ideas through parts of the work.	Uses appropriate and relevant content to explore ideas within the context of the discipline and shape the whole work.	Uses appropriate, relevant, and compelling content to illustrate mastery of the subject, conveying the writer's understanding, and shaping the whole work.
Graphic and Tabular Content	No figure or table is used when such usage is necessary, or uses figures/tables that are completely inappropriate and/or irrelevant.	Uses figures and/or tables that are inadequate, irrelevant, and/or not well integrated/referenced.	Uses adequate and relevant figures and/or tables that are integrated and/or referenced, with possibly redundant information or with little value added to the overall content.	Uses adequate, relevant, and compelling figures and/or tables that are well integrated and referenced, enhancing the overall content.
Sources and Evidence	Demonstrates no attempt to use sources to support ideas in the writing, or uses sources that are not credible or relevant.	Demonstrates an attempt to use credible and/or relevant sources to support ideas that are appropriate for the discipline and genre of the writing.	Demonstrates consistent use of credible, relevant sources to support ideas that are situated within the discipline and genre of the writing.	Demonstrates skillful use of high-quality, credible, relevant sources to develop ideas that are appropriate for the discipline and genre of the writing
Organization and Central Message	Organizational pattern is not observable within the presentation, and no central message can be deduced.	Organizational pattern is intermittently observable within the presentation, and central message can be deduced or is basically understandable but is not often repeated and is not memorable.	Organizational pattern is clearly and consistently observable within the presentation, and central message is clear and consistent with the supporting material.	Organizational pattern (specific introduction and conclusion, sequenced material within the body, and transitions) is clearly and consistently observable and is skillful and makes the content of the presentation cohesive, with a compelling central message (precisely stated, appropriately repeated, memorable, and strongly supported.)

Outcome g: an ability to communicate effectively (oral).

Indicator	Unsatisfactory (1)	Developing (2)	Satisfactory(3)	Exceptional (4)
Language and Delivery	Language choices are unclear and inappropriate to audience, and minimally support the effectiveness of the presentation. Delivery techniques detract from the understandability of the presentation, and speaker appears uncomfortable.	Language choices are mundane and commonplace and partially support the effectiveness of the presentation. Language in presentation is appropriate to audience. Delivery techniques make the presentation understandable, and speaker appears tentative.	Language choices are thoughtful and generally support the effectiveness of the presentation. Language in presentation is appropriate to audience. Delivery techniques make the presentation interesting, and speaker appears comfortable.	Language choices are imaginative, memorable, and compelling, and enhance the effectiveness of the presentation. Language in presentation is appropriate to audience. Delivery techniques (posture, gesture, eye contact, and vocal expressiveness) make the presentation compelling, and speaker appears polished and confident.
Supporting Material	Insufficient supporting materials make reference to information or analysis that minimally supports the presentation or establishes the presenter’s credibility/authority on the topic.	Supporting materials make appropriate reference to information or analysis that partially supports the presentation or establishes the presenter’s credibility/authority on the topic.	Supporting materials make appropriate reference to information or analysis that generally supports the presentation or establishes the presenter’s credibility/authority on the topic.	A variety of types of supporting materials (explanations, examples, illustrations, statistics, analogies, quotations from relevant authorities) make appropriate reference to information or analysis that significantly supports the presentation or establishes the presenter’s credibility/authority on the topic.
Response to Questions	Fails to answer questions or gives answers that are inappropriate or irrelevant to audience questions.	Gives ambiguous or unclear answers that do not address audience questions completely, and provide no means to offline follow-ups.	Gives adequate answers that address most or all audience questions, and/or provides means to offline follow-ups.	Gives answers that address all audience questions in a way that is insightful, inspiring and compelling and enhances the overall effectiveness of the presentation, and/or encourages/provides means to offline follow-ups.

Outcome h: the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

Indicator	Unsatisfactory (1)	Developing (2)	Satisfactory (3)	Exceptional (4)
Global issues	Students have little knowledge of global issues.	Students identify/describe some global issues related to their area.	Students identify most global issues related to the problem to be solved, but only consider some pertinent global issues to determine the solution approach.	Students examine and weigh the impact of all pertinent global issues to determine the best approach.
Environmental issues	Students have little knowledge of environmental issues.	Students identify/describe some environmental issues related to their area.	Students identify most environmental issues related the problem to be solved, but only consider some pertinent environmental issues to determine the solution approach.	Students examine and weigh the impact of all pertinent environmental issues to determine the best approach.
Economic issues	Students have little knowledge of economic issues.	Students identify/describe some economic issues related to their area.	Students identify most economic issues related to the problem to be solved, but only consider some pertinent economic issues to determine the solution approach.	Students examine and weigh the impact of all pertinent economic issues to determine the best approach.
Societal issues	Students have little knowledge of societal issues.	Students identify/describe some societal issues related to their area.	Students identify most societal issues related to the problem to be solved, but only consider some pertinent societal issues to determine the solution approach.	Students examine and weigh the impact of all pertinent societal issues to determine the best approach.

Outcome i: a recognition of the need for, and an ability to engage in life-long learning.

Indicator	Unsatisfactory (1)	Developing (2)	Satisfactory (3)	Exceptional (4)
Curiosity	Explores a topic at a surface level, providing little insight and/or information beyond the very basic facts indicating low interest in the subject.	Explores a topic with some evidence of depth, providing occasional insight and/or information indicating mild interest in the subject.	Explores a topic in depth, yielding insight and/or information indicating interest in the subject.	Explores a topic in depth, yielding a rich awareness and/or little-known information indicating intense interest in the subject.
Initiative	Completes required work.	Completes required work and identifies opportunities to expand knowledge, skills, and abilities.	Completes required work, identifies and pursues opportunities to expand knowledge, skills, and abilities.	Completes required work, generates and pursues opportunities to expand knowledge, skills, and abilities.
Independence	Begins to look beyond classroom requirements, showing interest in pursuing knowledge independently.	Beyond classroom requirements, pursues additional knowledge and/or shows interest in pursuing independent educational experiences.	Beyond classroom requirements, pursues substantial, additional knowledge and/or actively pursues independent educational experiences.	Educational interests and pursuits exist and flourish outside classroom requirements. Knowledge and/or experiences are pursued independently.
Transfer	Makes vague references to previous learning but does not apply knowledge and skills to demonstrate comprehension and performance in novel situations.	Makes references to previous learning and attempts to apply that knowledge and those skills to demonstrate comprehension and performance in novel situations.	Makes references to previous learning and shows evidence of applying that knowledge and those skills to demonstrate comprehension and performance in novel situations.	Makes explicit references to previous learning and applies in an innovative (new and creative) way that knowledge and those skills to demonstrate comprehension and performance in novel situations.
Reflection	Reviews prior learning (past experiences inside and outside of the classroom) at a surface level, without revealing clarified meaning or indicating a broader perspective about educational or life events.	Reviews prior learning (past experiences inside and outside of the classroom) with some depth, revealing slightly clarified meanings or indicating a somewhat broader perspectives about educational or life events.	Reviews prior learning (past experiences inside and outside of the classroom) in depth, revealing fully clarified meanings or indicating broader perspectives about educational or life events.	Reviews prior learning (past experiences inside and outside of the classroom) in depth to reveal significantly changed perspectives about educational and life experiences, which provide foundation for expanded knowledge, growth, and maturity over time.

Outcome j: a knowledge of contemporary issues.

Indicator	Unsatisfactory (1)	Developing (2)	Satisfactory (3)	Exceptional (4)
Breadth of awareness of current topics	Student provides less than three current topics and each topic has less than three words	Student provides less than three current topics but each topic has more than three words	Student provides four or more current topics and each topic has more than three words but the topics focus on the same industry sector.	Student provides five or more current topics and each topic has more than three words. The topic covers more than one industry sector.
Relevance of the topics to Current Engineering Issues	No example is given that relates to current engineering issues	Only two or three examples are related to current engineering issues	Four examples are related to current engineering issues	Five or more examples are related to current engineering issues
Engineering Trends	Student is not aware of new or emerging tools, methods, or approaches relevant to current topics	Student is able to recognize one or two new or emerging tools, methods, or approaches relevant to current topics	Student is able to recognize three or more new or emerging tools, methods, or approaches relevant to current topics	Student is able to recognize the tools, methods, or approaches relevant to current topics and can offer innovative potential solutions
Engagement	Student has no awareness of contemporary news sources (i.e., industry or trade journals) that feature contemporary or current topics	Student is aware of contemporary news sources but reads only occasionally (\leq four times per semester)	Student is aware of contemporary news sources and reads more than occasionally ($>$ 4 times per semester) and understands the impact of the trends on existing tools, methods, and approaches	Student is aware of contemporary news sources and reads more than occasionally ($>$ than 4 times per semester), understands the impact of the trends on existing tools, methods, and approaches, and is able to project how the evolution will impact future practice
Communication (both written and oral)	Student is not able to effectively communicate the current topics with intended audience.	Student is able to identify the topics but fails to provide his/her interpretation of the topics	Student is able to effectively communicate the topics and provide his/her own interpretation of the topics but does not discuss the potential solution.	Student is able to effectively communicate the topics, provide his/her own interpretation of the topics and discuss the potential solution.

*Current/contemporary = media codification is less than 18 months

Outcome k: an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Indicator	Unsatisfactory (1)	Developing (2)	Satisfactory (3)	Exceptional (4)
Alternatives	Given a practical problem, unable to determine an appropriate technique, skill, or tool.	Given a practical problem, able to determine a single appropriate technique, skill, or tool.	Given a practical problem, able to determine a multiple appropriate techniques, skills, or tools.	Given a practical problem, able to determine multiple appropriate techniques, skills, or tools including creative application of such techniques, skills, or tools.
Selection / Justification	Given a practical problem and multiple appropriate techniques, skills, and tools, not able to make selection, or justify selection if made.	Given a practical problem and multiple appropriate techniques, skills, and tools, able to pick an attractive technique, skill, or tool, but lacks understanding of its advantages and disadvantages.	Given a practical problem and multiple appropriate techniques, skills, and tools, able to list advantages and disadvantages of techniques, skills, or tools as well as justify suggested approach.	Given a practical problem and multiple appropriate techniques, skills, and tools, able to blend techniques, skills, and/or tools into integrated approach and demonstrate depth in justification.
Application	Not able to use suggested technique, skill, or tool in addressing the practical problem.	Uses suggested technique, skill, or tool with minor errors in addressing the practical problem.	Successfully uses selected technique(s), skill(s), or tool(s) in addressing the practical problem.	Enhanced use of selected technique(s), skill(s), or tool(s) in based on deeper understanding of the practical problem.
Interpretation / Implementation	Not able to interpret output of technique, skill, or tool.	Able to interpret output of technique, skill, or tool but not able to translate toward solution implementation.	Able to interpret output of technique, skill, or tool and able to translate toward solution implementation.	Able to interpret with depth the output of technique, skill, or tool and able to translate toward solution implementation and robustness.

Fall 2016 BS in Industrial and Systems Engineering Curriculum

Freshman Year

Semester 1 (Fall) Courses		Cr	Semester 2 (Spring) Courses		Cr
ENGL 100	Ideas and their Expressions I	3	ENGL 101	Ideas and their Expressions II	3
CHEM 106	Gen. Chemistry VI	3		Humanities/Fine Arts Elective ¹	3
CHEM 116	Gen. Chemistry VI Lab	1	ISEN 162	Computer Programming in VB for Eng	2
MATH 131	Calculus I	4	MATH 132	Calculus II	4
GEEN 100	Engineering Design and Ethics	2	PHYS 241	General Physics I	3
GEEN 111	College of Engineering Colloquium I	1	PHYS 251	General Physics I Lab	1
			ISEN 121	ISE Colloquium	1
Semester Total 14			Semester Total 17		

Sophomore Year

Semester 3 (Fall) Courses		Cr	Semester 4 (Spring) Courses		Cr
PSYC 101	General Psychology	3		Global Awareness Elective ¹	3
ISEN 102	Graphic Visualization for ISE	2		African-American Culture/Hist Elective ¹	3
ISEN 246	Industrial Production Processes	3	MEEN 260	Materials Science	2
MATH 450	Linear Algebra and Matrix Theory	3	ISEN 255	Methods Engineering	3
PHYS 242	General Physics II	3	ISEN 286	Engineering Teams & Leadership	1
PHYS 252	General Physics II Lab	1	MATH 231	Calculus III	4
Semester Total 15			Semester Total 16		

Junior Year

Semester 5 (Fall) Courses		Cr	Semester 6 (Spring) Courses		Cr
ISEN 380	Information Technology for ISE	3	ISEN 324	Computer Aided Design and Mfg	3
ISEN 430	Deterministic Operations Research	3	ISEN 386	Systems Approaches for ISE	1
ISEN 361	Engineering Econ and Cost Analysis	3	ISEN 435	Stochastic Operations Research	3
ISEN 370	Engineering Statistics	3	ISEN 465	Facilities Design	3
ISEN 471	Ergonomics	2	ISEN 472	Cognitive Human Factors	2
			MEEN 230	Statics/Mechanics of Materials	3
Semester Total 14			Semester Total 15		

Senior Year

Semester 7 (Fall) Courses		Cr	Semester 8 (Spring) Courses		Cr
ISEN 425	Quality Assurance	3	ISEN 440	Decision Support Systems for ISE	3
ISEN 455	Production Control	3	ISEN 486	Professionalism and Ethics for ISE	1
ISEN 415	Discrete Event Systems Mod. & Sim.	3	ISEN 495	Design Projects in ISE	3
ISEN 475	Design of Experiments	3	ISEN 480	Systems Engineering	3
ISEN 400	Problem Solving in ISE	1		ISE Technical Elective ¹	3
	ISE Technical Elective ¹	3			
Semester Total 16			Semester Total 13		
			Program Total 120		

¹ See your academic advisor for a list of eligible courses to satisfy these requirements.

GENERAL EDUCATION REQUIREMENTS

Starting in the Fall 2016 semester, general education requirements at N.C. A&T are met through taking a selection of courses to meet the following student learning outcomes:

Student Learning Outcome	Credit Hours
Written Communication	6
Mathematical, Logical, and Analytical Reasoning (at least one course with MATH prefix)	6
Scientific Reasoning (at least one lab-based course)	7
Social/Behavioral Sciences*	3
Humanities/Fine Arts*	3
Global Awareness*	3
Knowledge of African-American Culture and History*	3
* If a course meets requirements in two or more outcomes, the student has the option to use the course for one outcome and must select another course to fulfill the requirement for each outcome.	
Student Success (to be met through courses offered by a department, school/college, or the Center for Academic Excellence)	1

General Education and the ISE Curriculum

For ISE students, most general education requirements are met by following the prescribed curriculum. ISE students must, however, select courses to meet the following remaining general education requirements:

Student Learning Outcome	Credit Hours
Humanities/ Fine Arts	3 credit hours
Global Awareness	3 credit hours
Knowledge of African-American Culture and History	3 credit hours

The current list of approved general education electives can be found at:

http://www.ncat.edu/provost/general_education_resources/general_education_course_list/

CATALOG DESCRIPTIONS OF REQUIRED COURSES**Basic Science Courses**

CHEM 106 General Chemistry VI 3(3-0)

This is a course which emphasizes basic principles and important theoretical concepts of chemistry. Topics will include atomic structure, electronic configuration, the wave mechanical model of the atom, chemical bonding, states of matter, chemical equilibria, systems of acids and bases, and electrochemistry. Prerequisites: SAT MATH score of 490 or SAT Subject MATH Level II score of 470 or ACT MATH score of 19 or completion of CHEM 103 with a grade of C or better. Corequisite: CHEM 116. (F;S;SS)

CHEM 116 General Chemistry VI Laboratory 1(0-3)

This is a course which emphasizes quantitative studies of chemical reactions such as acid-base studies, redox reactions, and equilibrium reactions. Emphasis is also placed on the development of manipulative skills in the laboratory. Corequisite: CHEM 106. (F;S;SS)

PHYS 241 General Physics I 3(3-1)

This is a calculus-based physics course that covers the fundamental principles of Newtonian mechanics, heat, and thermodynamics. Corequisites: MATH 132 and PHYS 251.

PHYS 242 General Physics II 3(3-1)

This course is a continuation of PHYS 241. It is a calculus-based study of physics, which covers the fundamental principles of electricity, magnetism, wave motion, and optics. Corequisite: PHYS 252.

PHYS 251 General Physics I Laboratory 1(0-2)

This is a laboratory course where a selected group of physics experiments will be performed. Emphasis is placed on the development of experimental technique, analysis of data, and physical interpretation of experimental results. Corequisite: PHYS 241.

PHYS 252 General Physics II Laboratory 1(0-2)

This course is a continuation of Physics 251. Corequisite: PHYS 242.

Mathematics Courses:

MATH 131 Calculus I 4(4-0)

Limits and continuity of functions, the derivative, applications of the derivative, the definite integral and applications of the definite integral will be studied. Prerequisite: MATH 104 or MATH 110 or MATH 111 or an SAT Math score at least 550 or an SAT Math Level II score at least 540 or an ACT Math score at least 22 or a Math Department Precalculus Test score at least 17.

MATH 132 Calculus II 4(4-0)

Topics in analytical geometry, differentiation and integration of exponential, logarithmic, trigonometric, inverse trigonometric and hyperbolic functions, additional techniques and applications of integration, indeterminate forms, improper integrals, Taylor's Formula and infinite series will be studied. Prerequisite: MATH 131.

MATH 231 Calculus III 4(4-0)

This course will cover plane curves and polar coordinates, vector and solid geometry, vector valued functions, partial differentiation, multiple integrals, applications of multiple integrals and vector analysis. Prerequisite: MATH 132.

MATH 450 Linear Algebra and Matrix Theory 3(3-0)

This course is an introduction to linear algebra and matrix theory; the algebra of matrices and its application to the solutions of systems of linear equations, determinants, real and complex vector spaces, bases, dimension, linear transformations, eigenvalues and eigenvectors. Prerequisite: MATH 132.

General Engineering Courses

GEEN 100 Engineering Design and Ethics 2(2-0)

This course introduces students to engineering and computer science disciplines and functions, professional licensure, the Fundamentals of Engineering exam, code of ethics, safety, the design process, creative thinking, teamwork, and technical writing. A case study on ethics and the application of the design process through a team project are required.

GEEN 111 College of Engineering Colloquium I 1(1-0)

This course includes lectures, seminars, and activities important to the retention and matriculation of students in the college of engineering. Students are introduced to various engineering and computer science degree programs and their respective professions, and are also provided with group advisement regarding department, college, and university-level policies and procedures.

ISEN 361 Engineering Economy and Cost Analysis 3(3-0)

This course introduces the concept of time value of money, cash flows, and the methods of evaluating alternatives based on present worth, annual worth, rate of return, payback period and cost benefit analysis. The course also introduces breakeven analysis, replacement analysis, depreciation methods and the effect of income taxes and inflation on economy studies.

Prerequisite: Sophomore standing.

ISEN 370 Engineering Statistics 3(3-0)

This course introduces data presentation and analysis, frequency distributions, probability concepts and axioms of probability. Random variables, discrete and continuous probability distributions, calculus based probability calculations, joint distributions, conditional probability and independence are covered. Independence of events is applied to engineering system reliability. Students are introduced to concepts of sampling, sampling distributions, estimation, confidence intervals, and hypothesis testing. Prerequisite: MATH 132.

ISEN 380 Information Technology for Industrial and Systems Engineers 3(2-2)

This course introduces the planning and design techniques used for enterprise information systems. The course addresses basic concepts of database systems, network systems, system analysis and planning, and human-computer systems. Systems concepts, fundamentals of VBA, and the role of computers in industrial and systems engineering are stressed. Prerequisite: ISEN 162.

ISEN 386 Systems Approaches for Industrial and Systems Engineers 1(1-0)

This course introduces current techniques for systems design, analysis and improvement.

Prerequisite: Junior standing as ISE major.

ISEN 400 Problem Solving in Industrial and Systems Engineering 1(0-2)

This course emphasizes open-ended problem solving. Students work in teams to solve problems spanning a variety of industrial and systems engineering topics. Prerequisites: Senior standing as ISE major, ISEN 361, ISEN 430, ISEN 465, ISEN 471.

ISEN 415 Discrete Event Systems Modeling and Simulation 3(2-2)

Concepts of random variate generation, Monte Carlo and discrete event simulation will be introduced. One general simulation language is taught in depth. The use of simulation modeling in design and improvement of production and service is emphasized. Projects are required.

Prerequisites: ISEN 380, senior standing as ISE major.

ISEN 425 Quality Assurance 3(3-0)

This course introduces the concepts of quality control and assurance. Topics include statistical control charts, attributes and variable sampling plans, quality philosophies, process capability, quality function deployment, ISO 9000 and quality auditing. Applications in service and production systems are emphasized. Prerequisite: ISEN 370.

ISEN 430 Deterministic Operations Research 3(3-0)

Deterministic models of operations research are discussed with special emphasis on linear programming. Topics covered include formulation and computer solution of mathematical programs, simplex algorithm, transportation problem, and network flow. Prerequisite: MATH 350.

ISEN 435 Stochastic Operations Research 3(3-0)

This course introduces the concepts of probabilistic operations research models and solution techniques. Specific topics include Poisson processes, Markov chains, queuing models and their applications, decision and risk analysis, and dynamic programming. Prerequisites: ISEN 370 and MATH 350.

ISEN 440 Decision Support Systems for Industrial and Systems Engineers 3(3-0)

This course covers the design of decision support systems for production and service systems based on quantitative models. Applications of spreadsheets, databases, and integrated software development environments are emphasized. Prerequisites: ISEN 380, ISEN 430, and senior standing.

ISEN 455 Production Control 3(3-0)

This course introduces the concepts of demand forecasting, aggregate production planning, inventory control, project planning, line balancing and job scheduling. Relationships with demand-driven methods, enterprise resource planning, and supply chain management are covered. Corequisite: ISEN 430.

ISEN 465 Facilities Design 3(2-2)

The course presents a study of the theory and practice of facilities design: activity and flow analysis, space requirements, layout techniques, material handling, warehousing, location selection, and problem-solving with computer-aided layout techniques. Design projects in facilities layout required. Prerequisite: ISEN 255.

ISEN 471 Ergonomics 2(1-2)

This course introduces ergonomics and biomechanics concepts. Topics include psychomotor work capabilities, anthropometry, environmental stressors, physical workload, safety, hazard and risk factor identification, work station design, and material handling. Data collection methods and report writing are emphasized. Lab projects are required. Prerequisite: Junior standing as ISE major.

ISEN 472 Cognitive Human Factors 2(1-2)

This course introduces elements of cognitive human factors. Topics include human sensation and perception, cognition, information processing, attention, signal detection theory, mental workload, and decision-making. Lab projects are required. Prerequisite: Junior standing as ISE major.

ISEN 475 Design of Experiments 3(3-0)

This course introduces various experimental designs to analyze data for research projects, process improvements, human factors studies and surveys. Designs covered include complete and incomplete randomized designs, Latin squares and factorial designs. Suitable laboratory apparatus is used to study the effect of design parameters on selected responses. Statistical software is utilized to analyze results. Parametric statistics such as analysis of variance are introduced. Prerequisite: ISEN 370.

ISEN 480 Systems Engineering 3(3-0)

This course covers applications and case studies that address cost, human factors, energy, information, and materials as applied to the design of production and service systems. Group work will be emphasized. Selection of appropriate analytical, computational and experimental techniques will be required. A design project is required. Prerequisites: ISEN 465, ISEN 471, ISEN 472, and senior standing

ISEN 486 Professionalism and Ethics for Industrial and Systems Engineers 1(1-0)

This course covers professional licensing, professional practice, ethics, laws and regulations such as the Americans with Disabilities Act, and the role of continuing education. Prerequisite: Senior standing.

ISEN 495 Design Projects in Industrial and Systems Engineering 3(0-6)

This course requires students to work on a real-world design project from industry. The project requires students to analyze, design, and recommend through economic justification the best design alternative. A final report and an oral presentation are required. Students demonstrate the feasibility of their designs in terms of safety, aesthetics, reliability, cost, social and ethical values. This course is only open to ISE majors. Prerequisites: Senior standing as ISE major, ISEN 361, ISEN 415, ISEN 430, ISEN 465, ISEN 471.

INDUSTRIAL AND SYSTEMS ENGINEERING TECHNICAL ELECTIVES

The following courses have been approved by the faculty of the Department of Industrial and Systems Engineering as meeting technical elective requirements for the BS in Industrial and Systems Engineering degree program. Please note that all courses have prerequisite requirements that must be satisfied. *Any deviations from this list must be pre-approved* by the Undergraduate Program Director.

ISEN 428 Lean Six Sigma 3(3-0)

This course focuses on the practical application of lean techniques in conjunction with the Six Sigma DMAIC (define, measure, analyze, improve, control) roadmap. This involves application of process flow, quality and data analysis techniques to solve business and operations problems. This course provides the training basis for achieving the skill level of a Six Sigma Green Belt. Prerequisite: ISEN 370.

ISEN 446 Automation and Production Systems 3(2-2)

This course introduces the concepts of automation such as programmable controllers and robotics, design for manufacturing and assembly, material selection, flexible manufacturing systems, group technology, just-in-time manufacturing, process planning, and economics of manufacturing. Prerequisite: ISEN 324.

ISEN 453 Technical Entrepreneurship 3(2-2)

This course introduces technology entrepreneurial perspective and technology venture creation. The course addresses concepts essential to the entrepreneurial process such as taking a technology idea and finding a commercial opportunity, gathering resources, leading the team, building a business plan, marketing the concept, and managing rapid growth. Prerequisite: Senior standing.

ISEN 458 Management of Engineering Projects 3(3-0)

This course provides an overview of activities required of a technical project manager. Such activities include project life cycle, team formation and leadership, planning, scheduling, budgeting, and control. Project management software is utilized. Prerequisite: Senior standing.

ISEN 468 Material Handling Systems Design 3(2-2)

This course focuses on design, and analysis of materials handling and flow in manufacturing facilities and warehouses. Principles, functions, equipment and theoretical approaches in materials handling are discussed. Tools for the automation of materials handling are introduced. Design projects are required. Design projects are required. Prerequisite: ISEN 465.

ISEN 473 Occupational Biomechanics 3(3-0)

This course introduces the underlying principles behind the mechanical behavior of the musculoskeletal system during industrial work situations. Their applications in the evaluation and design of industrial jobs are emphasized. Course topics include the musculoskeletal system, biomechanical models, work capacity, and bioinstrumentation. Prerequisite: ISEN 471.

ISEN 485 Selected Topics in Industrial and Systems Engineering Variable Credits (1-3)
Selected engineering topics of interest to students and faculty. The topics will be selected before the beginning of the course and will be pertinent to the programs of the students enrolled.
Prerequisite: Senior standing.