In this packet we describe five elective tracks that are available as part of the curriculum for ISE undergraduates in addition to the required set of core courses. These tracks give students an opportunity to acquire greater depth in one of the following areas of specialization:

- Data Analytics & Optimization*
- Supply Chain Management & Logistics*
- Management Systems & Operations Research
- Manufacturing
- Human Systems Integration & Design

In addition to these tracks, students frequently complete coursework and projects to pursue Lean Six Sigma Yellow or Green Green Belt certification, as well as minors in business, computer science, entrepreneurship, or design.

Please contact the ISE Undergraduate Program Coordinator, Krista Trigg at trigg.31@osu.edu, with questions.

*Students must apply and be accepted to both the Data Analytics & Optimization Track and the Supply Chain Management & Logistics Track prior to beginning the concentration. For deadlines regarding these applications, contact the ISE Advisor listed above.
DATA ANALYTICS & OPTIMIZATION

With the big data analytics trend, skills that encompass both data management and business analysis are in great demand. The Data Analytics and Optimization track focuses on using large data sets, computer models, and optimization methods to support data-driven decision-making. This powerful combination of big data analytics with optimization has been successfully demonstrated and will be increasingly needed in the management of:

- healthcare and transportation networks
- retail and financial decision making
- supply chain and logistics systems
- large scale information systems
- manufacturing operations
- energy and smart grids
- social networks

The ISE Data Analytics and Optimization track is an undergraduate elective track designed with a comprehensive and applied curriculum providing students with a strong background in data science, computer science, and optimization methods. The track requires a sequence of courses in computer science, operations research, cognitive engineering, and probability and statistics. Students will be prepared in the use of critical tool sets necessary for managing, visualizing, and extracting useful information from big data, as well as powerful skill sets such for modeling, simulation, optimization, and decision analysis in order to support efficient data-driven decision making.

Entry into this track is competitive, as there is only space for a limited number of students in the required courses. Students will be admitted based on EPHR as well as performance in programming, math, and statistics courses.

This track requires students to complete a minimum of 17 credit hours.

REQUIRED ELECTIVES (17 hours)

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Title</th>
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<tbody>
<tr>
<td>CSE 2221</td>
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<td>Software I: Software Components</td>
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<tr>
<td>CSE 2231</td>
<td>4</td>
<td>Software II: Software Development and Design</td>
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<tr>
<td>CSE 2321</td>
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<td>Foundations I: Discrete Structures</td>
</tr>
<tr>
<td>CSE 3241</td>
<td>3</td>
<td>Introduction to Database Systems</td>
</tr>
<tr>
<td>CSE 5243</td>
<td>3</td>
<td>Introduction to Data Mining</td>
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</tbody>
</table>
SUPPLY CHAIN MANAGEMENT & LOGISTICS

Complementing their broader background as industrial engineers, the Supply Chain Management & Logistics Track will provide students with an exceptional background for the design and management of supply chains. This includes quantitative modeling of supply chain systems, as well as the use of such modeling to support system design and decision making. Such skills are in great demand for career paths in areas such as healthcare, energy systems, financial management, insurance, manufacturing and production systems, military planning, shipping and distribution, and transportation.

Entry into this track is competitive, as there is only space for a limited number of students in the required courses. Students will be admitted based on EPHR as well as performance in programming, math, and statistics courses.

This track requires students to complete a minimum of 15 credit hours.

REQUIRED ELECTIVES (6 hours)

ISE 5110  3  Design of Engineering Experiments  
ISE 5410  3  Quantitative Models in Production and Distribution Logistics

MINIMUM ONE COURSE OF THE FOLLOWING ELECTIVES* (3 hours)

ISE 5350  3  Probabilistic Models and Methods in Operations Research  
ISE 5830  3  Decision Analysis

MINIMUM ONE COURSE OF THE FOLLOWING ELECTIVES (3 hours)

ISE 5682.01  3  Fundamentals of Product Design Engineering  
ISE 5760  3  Visual Analytics and Sensemaking  
ISE 5800  3  Advanced Project Management  
ISE 5810  4  Lean Sigma Foundations  
ISE 5820  3  Systems Thinking in Engineering and Design  
ISE 5870  3  Resilience Engineering

MINIMUM THREE HOURS FROM THE FOLLOWING ELECTIVES (3 hours)

BUSML 3380  1.5  Logistics Management  
BUSML 4380  1.5  Advanced Logistics Management (prerequisite BUSML 3380)  
BUSML 4383  1.5  Supply Chain Management (prerequisite BUSML 3380)  
BUSML 4385  1.5  Building a Sustainable Supply Chain (prerequisite BUSML 3380)  
BUSML 4387  1.5  Lean Logistics (prerequisite BUSML 3380)  
ISE 5350  3  Probabilistic Models and Methods in Operations Research  
ISE 5830  3  Decision Analysis

*It is highly recommended students complete both ISE 5350 and ISE 5830 as part of their elective choices.
MANAGEMENT SYSTEMS & OPERATIONS RESEARCH

The ISE track in Management Systems will be of interest to students who would like to apply their ISE and Operations Research knowledge and skills to careers paths in areas such as healthcare, energy systems, financial management, manufacturing and production systems, insurance, and transportation. This track includes a focus on logistics, supply chain management, optimization, simulation, lean sigma, logistics and supply chain management, as well as management systems engineering and the design of quality and productivity improvement programs.

This track requires students to complete a minimum of 15 credit hours.

MINIMUM NINE HOURS FROM THE FOLLOWING ELECTIVES (9 hours)

<table>
<thead>
<tr>
<th>Course</th>
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<tr>
<td>ISE 5110</td>
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<td>Decision Analysis</td>
</tr>
<tr>
<td>ISE 5870</td>
<td>3</td>
<td>Resilience Engineering</td>
</tr>
</tbody>
</table>

MINIMUM SIX HOURS FROM THE FOLLOWING ELECTIVES (6 hours)

Any ISE technical elective from this track (listed above)
Any ISE technical elective from another track
Any outside approved elective (listed on final page)
Students interested in the transformation of raw materials into commercially successful products might consider the ISE Manufacturing Engineering track. The curriculum in Manufacturing Engineering exercises students’ background in chemistry, physics, and mathematics toward the understanding and improvement of manufacturing materials, processes, and systems. Courses focus on process engineering, design for manufacturability, design of work-holding/dies/molds, numerical (computer) simulation, and automation/robotics as applied to machining processes, sheet forming operations, metal casting, and polymer processing.

This track requires students to complete a minimum of 15 credit hours.

**REQUIRED ELECTIVE (3 hours)**
ISE 3500 3 Process Engineering for Machining Operations

**MINIMUM SIX HOURS FROM THE FOLLOWING ELECTIVES (6 hours)**
- ISE 5463 3 Manufacturing of Energy Systems
- ISE 5530 3 Fundamentals of Tool Engineering
- ISE 5501 3 Fundamentals of Solid State Processing
- ISE 5502/MATSCEN 5451 3 Molten Metal Processing
- ISE 5520 1.5 Industrial Automation I
- ISE 5194 1.5 Industrial Automation II
- ISE 5521 1.5 Advanced Sheet Forming Laboratory
- ISE 5540 3 Polymer Processing Fundamentals
- ISE 5550 3 Principles of Precision Engineering
- ISE 5555 3 Manufacturing Processes and Machine Tools
- ISE 5682.01 3 Fundamentals of Product Design Engineering
- ISE 5683* 1 Fundamentals of Product Design Engineering Lab

**MINIMUM SIX HOURS FROM THE FOLLOWING ELECTIVES (6 hours)**
- Any ISE technical elective from this track (listed above)
- Any ISE technical elective from another track
- Any outside approved elective (listed on final page)

*Students who enroll in ISE 5682.01 are encouraged to take the corresponding lab, ISE 5683
HUMAN SYSTEMS INTEGRATION & DESIGN

The ISE track in Human Systems Integration & Design will be of interest to students who are “people-oriented” and are interested in designing work and work systems that rely on and/or support human performance. Students interested in product design will also find this track valuable. All types of operations can benefit from improvements in Human Systems Integration & Design, including companies involved in:

- healthcare
- transportation
- energy management
- information management
- retail and financial systems
- manufacturing and production systems.

This track in Human Systems Integration & Design focuses on strategies for improving productivity, quality, resilience and safety. In addition to general courses on human factors engineering and design, it includes courses concerned with occupational safety and health, as well as courses concerned with cognitive systems engineering.

This track requires students to complete a minimum of 15 credit hours.

MINIMUM NINE HOURS FROM THE FOLLOWING ELECTIVES (9 hours)

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<tr>
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<td>Design of Engineering Experiments</td>
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<td>ISE 5610</td>
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<td>Ergonomics in the Product Design Process</td>
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<td>ISE 5620</td>
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<td>Risk Assessment Tools for Occupational Musculoskeletal Disorders</td>
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<td>ISE 5640</td>
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<td>Occupational Safety: Analysis and Design of Work Environments</td>
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<td>ISE 5682.01</td>
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<td>Fundamentals of Product Design Engineering</td>
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<td>ISE 5705</td>
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<td>Cognitive Engineering Systems: Distributed and Cooperative Work</td>
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<td>ISE 5710</td>
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<td>Behind Human Error: Safety and Complex Systems</td>
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<td>ISE 5740</td>
<td>3</td>
<td>Cognitive Engineering Systems: Human-Centered Automation</td>
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MINIMUM SIX HOURS FROM THE FOLLOWING ELECTIVES (6 hours)

- Any ISE technical elective from this track (listed above)
- Any ISE technical elective from another track
- Any outside approved elective (listed on final page)

*Students who enroll in ISE 5682.01 are encouraged to take the corresponding lab, ISE 5683*
## OUTSIDE APPROVED ELECTIVES

*Pre-Requisites for each course still apply and **MUST** be met in order to enroll in the following courses*

<table>
<thead>
<tr>
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<td>BUSMHR 5530</td>
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</table>

The following courses are approved only if the additional science requirement for the major is already completed:

- ANATOMY 2220
- EARTHSC 1911
- ANATOMY 2300
- EARTHSC 2155
- ANATOMY 3300
- EARTHSC 2203
- ANTHROP 2200
- EARTHSC 2204
- BIOLOGY 1113
- EARTHSC 3203
- BIOLOGY 1114
- ENR 2155
- BIOLOGY 2100
- ENR 3280
- CHEM 1210
- EEOB 2510
- CHEM 1250
- EEOB 2520
- PHYSICS 3700
- GEOG 2200
- GEOG 3300