Integrated Engineering
Department of Integrated Engineering
College of Science, Engineering & Technology
131 Traflon Science Center N • 507-389-2744
Websites: cset.mnsu.edu/ie and www.ire.mnscu.edu
Chair: Rebecca Bates

Faculty: Rebecca Bates, Leslie Flemming, Cheol-Hong Min, Dean Kelley, Elizabeth Pluskivik, Robert Slezer, Jacob Swanson
Affiliated Iron Range Faculty: Ronald Ulseth (Co-Director), Andy Lillesve

Accreditation. Integrated Engineering is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org. Twin Cities Engineering will apply for accreditation after the first students graduate from the program.

The Integrated Engineering major is offered through a novel engineering education program, unique to Minnesota State Mankato. Iron Range Engineering is offered in the Iron Range region of northeast Minnesota (Virginia, MN) and Twin Cities Engineering is offered in the Twin Cities metro area (Bloomington, MN). These programs focus on the 3rd and 4th year of the undergraduate engineering program. Students transfer into the Bachelor of Science in Engineering program after two years of pre-engineering work elsewhere.

Students learn traditional engineering knowledge and skills in a project-based learning environment. The Iron Range Engineering (IRE) educational model is a project-based-learning model in which students work with industry and others on real-life design projects with a focus on producing graduates with integrated technical/professional knowledge and competencies. Learning is done in the context of the design projects.

The IRE educational model emphasizes innovation, creativity, design, experimental techniques, modeling techniques with an ultimate goal of regional economic development in the Iron Range region. The B.S. in Engineering program allows students to tailor their education to focus on a variety of engineering fields or to create a multidisciplinary experience. Successful completion of the program culminates in the Bachelor of Science in Engineering.

Graduates of the Minnesota State Mankato B.S. in Engineering Program will achieve at least 2 of the following program educational objectives, but will be capable of achieving all within one to four years of graduation:
- Designing, implementing and integrating thermal, electrical, mechanical and computer-controlled systems, components, and processes that will serve the region, the nation, and the world;
- Continuing their education through technical or professional graduate programs, professional licensure, or certifications, and the wide variety of other types of life-long learning;
- Creating, developing, leading, and managing in a wide range of enterprises that result in sustainable and enhanced economic regional development through their disciplinary expertise;
- Demonstrating actions such as community service, professional ethics, professional responsibility and mentoring future engineers.

POLICIES/INFORMATION
MINIMUM INTEGRATED ENGINEERING PROGRAM ENTRY REQUIREMENTS

Entry Requirements. A minimum of 49 semester credit hours including the following courses and credits must be completed before the student enters the engineering curriculum in the Fall of the junior year in full standing.

- Calculus and Differential Equations (16 credits)
- General Physics (calculus-based) (8 credits)
- Additional math and science courses, including chemistry, (8 credits)
- Intro engineering courses including programming or introduction to engineering, statics, dynamics and lab-based electric circuits (13 credits)
- English Composition (4 credits)

All courses and credits shown above must be completed before full enrollment in 300-level engineering courses, unless special permission is granted by the department chair. All of the above courses must be taken for "grade." It is not acceptable for the student to take any of these courses on a pass/no credit basis. A grade of "C-" or better must be achieved in each course. Students may be admitted provisionally while these requirements are being satisfied.

Application to Program. To be considered for admission, the student must have a cumulative GPA of 2.5 for all science, math, and engineering courses. Admission to the Integrated Engineering Program is selective and subject to the approval of the Integrated Engineering program faculty. Admission to the Integrated Engineering Program also requires the completion of the application found at the following website: http://cset.mnsu.edu/ie/apply.html.

Each application will be evaluated individually and the decision of Integrated Engineering program faculty will be final. Failure to submit an application by stated deadline could result in the student being denied admission to the program. If a student is denied admission to the Integrated Engineering Program, he/she can reapply to the program for admission in subsequent years.

A. Minnesota State Mankato students.
   This application form (http://cset.mnsu.edu/ie/apply.html) is submitted to the Integrated Engineering Program along with a copy of the student’s Minnesota State Mankato transcript and any transfer evaluations. Pre-engineering students at Minnesota State Mankato are not guaranteed admission to the program.

B. Transfer Students.
   Transfer students must submit an application to Minnesota State Mankato and follow all transfer policies. Students may be able to complete the required pre-engineering curriculum at another college or university and have these courses and credits transferred to Minnesota State Mankato, when applying for admission to the Integrated Engineering Program.

GPA Policy. GPA Policy: Students graduating with a B.S. in Engineering degree must have:
1. A cumulative GPA of 2.5 or higher.
2. Grades of 1.67 (“C-”) or better for courses taken at Minnesota State Mankato to be accepted.

P/N Grading Policy. P/N credit will not be applied to any course used to meet the degree requirements.

All students must follow all Minnesota State Mankato policies.

INTEGRATED ENGINEERING BSE
Degree completion = 128 credits

Required General Education
Students who complete the Minnesota Transfer Curriculum will satisfy the Composition (ENG 101) and Communications requirements.

ENG 101 Composition (4)
MATH 121 Calculus I (4)
PHYS 221 General Physics I (4)
Economic Course (choose 3 credits)
ECON 201 Principles of Macroeconomics (3)
ECON 202 Principles of Microeconomics (3)

Communications (choose 3-4 credit)
CMST 102 Public Speaking (3)
ENG 271W Technical Communication (4)
Chemistry (choose 3-5 credits)
CHEM 191 Chemistry Applications (3)
CHEM 201 General Chemistry I (5)

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### INTEGRATED ENGINEERING CONTINUED

**Pre-requisites to the Major**
An additional 3 credits of engineering design and programming are required. Engineering Analysis should be accompanied by a lab. Students need a total of 32 Math and Science credits comprised of courses from General Education and prerequisites to the major.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
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<tbody>
<tr>
<td>EE 230</td>
<td>Circuit Analysis I (3)</td>
</tr>
<tr>
<td>EE 240</td>
<td>Evaluation of Circuits (1)</td>
</tr>
<tr>
<td>ENGR 110</td>
<td>Introduction to Project-based Engineering (3)</td>
</tr>
<tr>
<td>MATH 122</td>
<td>Calculus II (4)</td>
</tr>
<tr>
<td>MATH 222</td>
<td>Calculus III (4)</td>
</tr>
<tr>
<td>MATH 321</td>
<td>Ordinary Differential Equations (4)</td>
</tr>
<tr>
<td>ME 212</td>
<td>Statics (3)</td>
</tr>
<tr>
<td>ME 214</td>
<td>Dynamics (3)</td>
</tr>
<tr>
<td>PHYS 222</td>
<td>General Physics II (3)</td>
</tr>
<tr>
<td>PHYS 232</td>
<td>General Physics II Laboratory (1)</td>
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</table>

**Choose 1 Cluster**

**Physics**
- PHYS 223 General Physics III (3)
- PHYS 233 General Physics III Laboratory (1)

**Chemistry**
- CHEM 202 General Chemistry II (5)

**Biology** (choose 4 credits)
- BIOL 105 General Biology I (4)
- BIOL 106 General Biology II (4)

**Major Common Core**
All students must complete 6 credits of ENGR 370, 6 credits of ENGR 371, 2 credits of ENGR 320, 2 credits of ENGR 420 and 4 credits of ENGR 492.

<table>
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<tr>
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<tr>
<td>ENGR 301</td>
<td>Design I (3)</td>
</tr>
<tr>
<td>ENGR 302</td>
<td>Design II (3)</td>
</tr>
<tr>
<td>ENGR 311</td>
<td>Professionalism I (3)</td>
</tr>
<tr>
<td>ENGR 312</td>
<td>Professionalism II (3)</td>
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<tr>
<td>ENGR 320</td>
<td>Engineering Core Competencies (1-2)</td>
</tr>
<tr>
<td>ENGR 370</td>
<td>Mechanical Core Competencies (1-8)</td>
</tr>
<tr>
<td>ENGR 371</td>
<td>Electrical Core Competencies (1-6)</td>
</tr>
<tr>
<td>ENGR 401</td>
<td>Capstone Design I (3)</td>
</tr>
<tr>
<td>ENGR 402</td>
<td>Capstone Design II (3)</td>
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<tr>
<td>ENGR 411</td>
<td>Professionalism III (3)</td>
</tr>
<tr>
<td>ENGR 412</td>
<td>Professionalism IV (3)</td>
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<tr>
<td>ENGR 420</td>
<td>Advanced Engineering Core Competencies (1-2)</td>
</tr>
<tr>
<td>ENGR 492</td>
<td>Seminar (1)</td>
</tr>
</tbody>
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**Major Restricted Electives**
Choose 6-7 credits of approved Arts and Humanities courses and choose 6-7 credits of Social Science courses for a total of 13 credits. The Depth Requirement can be fulfilled by a sequence of courses in the same department (such as HIST 180 and HIST 181 or PHIL 101 and PHIL 321W). A list of approved courses can be found at the program website. Students should also meet the University’s Diverse Cultures requirement. Students who complete the Minnesota Transfer Curriculum will satisfy the Major Restricted Electives requirement.

**Major Unrestricted Electives**
(choose one group from the following)

**Broad Focus** (choose 16 credits)
Students choosing not to complete a focus area must complete 0-2 credits of ENGR 355 and 14-16 credits of ENGR 455, ENGR 470 or ENGR 471. The engineering field of these elective credits is unrestricted.

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<tr>
<td>ENGR 355</td>
<td>Elective Technical Competency (1-2)</td>
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<td>ENGR 455</td>
<td>Advanced Technical Competency (1-8)</td>
</tr>
<tr>
<td>ENGR 470</td>
<td>Mechanical Advanced Competency (1-2)</td>
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<tr>
<td>ENGR 471</td>
<td>Electrical Advanced Competency (1-2)</td>
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**Mechanical Focus** (choose 16 credits)
Students choosing a mechanical focus must complete 2 credits of ENGR 470, 0-2 credits of ENGR 355 and 12-14 credits of ENGR 455 or ENGR 471. At least 12 credits of ENGR 355 and ENGR 455 must be in the field of mechanical engineering. At least two of the four engineering projects must include design of mechanical systems.

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<tr>
<td>ENGR 455</td>
<td>Advanced Technical Competency (1-8)</td>
</tr>
<tr>
<td>ENGR 470</td>
<td>Mechanical Advanced Competency (1-2)</td>
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<tr>
<td>ENGR 471</td>
<td>Electrical Advanced Competency (1-2)</td>
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**Electrical Focus** (choose 16 credits)
Students choosing an electrical focus must complete 2 credits of ENGR 471, 0-2 credits of ENGR 355 and 12-14 credits of ENGR 455 or ENGR 470. At least 12 credits of ENGR 355 and ENGR 455 must be in the field of electrical engineering. At least two of the four engineering projects must include design of electrical systems.

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<td>ENGR 470</td>
<td>Mechanical Advanced Competency (1-2)</td>
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<tr>
<td>ENGR 471</td>
<td>Electrical Advanced Competency (1-2)</td>
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</table>

**Other Focus Areas** (choose 16 credits)
Students choosing a focus area other than mechanical or electrical must complete 0-2 credits of ENGR 355 and 14-16 credits of ENGR 455, ENGR 470 or ENGR 471. At least 14 credits of ENGR 355 and ENGR 455 must be in the field of focus. At least two of the four engineering projects must include design of focus-area systems.

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### COURSE DESCRIPTIONS

**ENGR 110 (3) Introduction to Project-based Engineering**
Introduction of the engineering design process, professional skills necessary for the modern engineer, learning strategies needed for academic success, and overview of engineering applications relevant to society. Students will use engineering tools to complete an engineering team project.

*Fall, Spring*

**ENGR 293 (1) MAX Scholar Seminar**
This class provides MAX scholars with an opportunity to explore a set of topics related to achieving success in academic, professional and personal realms. Speakers will include faculty, graduate students, visiting researchers and industry members as well as student participants.

*Pre: Recipient of a MAX scholarship or instructor consent*  
*Fall, Spring*

**ENGR 301 (3) Design I**
Students learn and practice the essential elements of engineering design through industry project implementation: scoping, modeling, experimentation, analysis, modern tools, design reviews, multi-disciplinary systems view, creativity, safety, business plans, global/societal/environmental impacts.

*Fall, Spring*

**ENGR 302 (3) Design II**
Students further learn and practice the elements of engineering design through industry project implementation: scoping, modeling, experimentation, analysis, modern tools, design reviews, multi-disciplinary systems view, creativity, safety, business plans, global/societal/environmental impacts.

*Pre: ENGR 301*  
*Fall, Spring*

**ENGR 311W (3) Professionalism I**
Students learn and develop the elements of professionalism while operating in project teams interacting daily with clients from industry. Topics include leadership, metacognition, teamwork, written and oral communication, ethics, and professional and personal responsibility.

*Fall, Spring*  
*WI*

**ENGR 312W (3) Professionalism II**
Students further learn and develop the elements of professionalism while operating in project teams interacting daily with clients from industry. Topics include further examination of leadership, metacognition, teamwork, written and oral communication, ethics, and professional and personal responsibility.

*Pre: ENGR 311W*  
*Fall, Spring*  
*WI*
INTEGRATED ENGINEERING CONTINUED

ENGR 320 (1-2) Engineering Core Competencies  
Students gain breadth across all objectives and depth in the areas of engineering statistics and either programming or mathematical modeling.  
Pre: Admission to Program  
Fall, Spring

ENGR 355 (1-2) Elective Technical Competency  
In-depth study of an engineering area related to an engineering project or foundation topic in a focus area such as biomedical, chemical, combustion, computer, electrical, engineering management, environmental, mechanical, process, renewable energy, structural, systems or transportation engineering.  
Pre: Admission to Program  
Fall, Spring

ENGR 370 (1-6) Mechanical Core Competencies  
Students gain breadth across all objectives and depth in an area of: dynamic systems, manufacturing processes, material science, mechanics of materials, thermodynamics, fluid mechanics.  
Pre: Admission to program  
Fall, Spring

ENGR 371 (1-6) Electrical Core Competencies  
Students gain breadth across all objectives and depth in a focused area in these core competencies: instrumentation, AC circuits, signals and systems, electronics, digital logic, electric machines.  
Pre: Admission to program  
Fall, Spring

ENGR 398 (0) CPT: Co-Operative Experience  
Curricular Practical Training: Co-Operative Experience is a zero-credit full-time practical training experience for one summer and on adjacent fall or spring term. Special rules apply to preserve full-time student status. Please contact an advisor in your program for complete information.  
Pre: MATH 223. At least 60 credits earned; in good standing; instructor permission; co-op contract; other prerequisites may also apply.  
Fall, Spring, Summer

ENGR 401 (3) Capstone Design I  
The first in a two-semester sequence of capstone design. Students build on the experience gained in ENGR 301/ENGR 302 to bring their implementation to that expected of contributing engineers in industry.  
Pre: ENGR 302, ENGR 312W  
Fall, Spring

ENGR 402 (3) Capstone Design II  
This is the second capstone design course and fourth design course overall. Expectations include potential patent applications, entry in business plan competitions, or some similarly high level achievement.  
Pre: ENGR 401, ENGR 411W  
Fall, Spring

ENGR 411W (3) Professionalism III  
Students further learn and develop the elements of professionalism while operating in project teams interacting daily with clients from industry. Further development/practice of leadership, metacognition, teamwork, written and oral communication, ethics, and professional and personal responsibility in project context.  
Pre: ENGR 312W  
Fall, Spring  
WI

ENGR 412W (3) Professionalism IV  
Students further learn/develop professionalism while interacting regularly with clients from industry. Topics include further development and practice of leadership, metacognition, teamwork, written and oral communication, ethics, and professional and personal responsibility, in project context, with reflection on education growth.  
Pre: ENGR 411W  
Fall, Spring  
WI

ENGR 420 (1-2) Advanced Engineering Core Competencies  
Students gain breadth across all objectives and depth in the areas of engineering economics and entrepreneurship.  
Pre: Admission to Program  
Fall, Spring

ENGR 455 (1-8) Advanced Technical Competency  
In-depth study of an engineering area related to an engineering project or foundation topic in a focus area such as biomedical, chemical, combustion, computer, electrical, engineering management, environmental, mechanical, process, renewable energy, structural, systems or transportation engineering.  
Course may be repeated.  
Coreq: ENGR 370, ENGR 371  
Fall, Spring

ENGR 470 (1-2) Mechanical Advanced Competency  
Students gain breadth across all objectives and depth in an area of: heat transfer, structural.  
Pre: ENGR 370  
Fall, Spring

ENGR 471 (1-2) Electrical Advanced Competency  
Students gain breadth across all objectives and depth in an area of: 3-phase AC systems, control systems.  
Pre: ENGR 371  
Fall, Spring

ENGR 492 (1) Seminar  
Students learn about engineering practice through seminars with practicing engineers from industry and are assisted in their development as learners through workshops. This course is repeated by General Engineering students every semester.  
Fall, Spring

ENGR 493 (1) MAX Scholar Seminar  
This class is for MAX scholars and covers topics related to achieving success in academic, professional and personal realms. Speakers will include faculty, graduate students, visiting researchers and industry members. Students will mentor lower division scholars and do presentations.  
Pre: Recipient of a MAX scholarship or instructor consent.  
Fall, Spring

ENGR 494 (1) Global Experience in Engineering and Technology  
This class provides students pursuing a minor in “Global Solutions in Engineering and Technology” with an opportunity to explore a set of topics related to achieving success in advance of and following an international experience (internship, study abroad, etc.). Speakers will include faculty, graduate students, visiting researchers and industry members as well as student participants. Returning students will be required to participate in mentoring of students preparing for their international experience and provide written and/or oral presentations of various topics during the semester. This course is required both before and after participation in the international experience (min. 2 cr.)  
Variable

ENGR 496 (1-4) Selected Topics in Engineering  
Special topics not covered in other courses. May be repeated for credit on each new topic.  
Pre: Consent  
Variable