

INTEGRATED ENGINEERING BSE, MINOR AND CERTIFICATES

Integrated Engineering

Department of Integrated Engineering
 College of Science, Engineering & Technology
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Chair: Dean Kelley

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Affiliated Iron Range Faculty: Ronald Ulseth (Co-Director), Andy Lillesve

Accreditation. Iron Range Engineering and Twin Cities Engineering are Accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org>.

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. The Integrated 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 Integrated 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

Academic Map/Degree Plan at www.mnsu.edu/programs/#All

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)
<u>Economics Course</u> (Choose 3 Credits).	
ECON 201	Principles of Macroeconomics (3)
ECON 202	Principles of Microeconomics (3)
<u>Communications</u> (Choose 3 - 4 Credits).	
CMST 102	Public Speaking (3)
ENG 271W	Technical Communication (4)
<u>Chemistry</u> (Choose 3 - 5 Credits).	
CHEM 191	Chemistry for Engineers (3)
CHEM 201	General Chemistry I (5)

Prerequisites to the Major

ENGR 110 can be replaced by either an introduction to engineering course or a programming course similar to CS 110. Circuit 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.

EE 230	Circuit Analysis I (3)
EE 240	Evaluation of Circuits (1)
ENGR 110	Introduction to Project-based Engineering (3)
MATH 122	Calculus II (4)
MATH 223	Calculus III (4)
MATH 321	Ordinary Differential Equations (4)
ME 212	Statics (3)
ME 214	Dynamics (3)
PHYS 222	General Physics II (3)
PHYS 232	General Physics II Laboratory (1)

CHOOSE 1 CLUSTER:

<u>Physics</u>	
PHYS 223	General Physics III (3)
PHYS 233	General Physics III Laboratory (1)
<u>Chemistry</u>	
CHEM 202	General Chemistry II (5)
<u>Biology</u> (choose 4 credits)	
BIOL 105	General Biology I (4)
BIOL 106	General Biology II (4)

INTEGRATED ENGINEERING CONTINUED

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.

ENGR 301	Design I (3)
ENGR 302	Design II (3)
ENGR 311	Professionalism I (3)
ENGR 312	Professionalism II (3)
ENGR 320	Engineering Core Competencies (1-2)
ENGR 370	Mechanical Core Competencies (1-6)
ENGR 371	Electrical Core Competencies (1-6)
ENGR 401	Capstone Design I (3)
ENGR 411	Professionalism III (3)
ENGR 412	Professionalism IV (3)
ENGR 420	Advanced Engineering Core Competencies (1-2)
ENGR 492	Seminar (1)

Thesis or Capstone Design (Choose 3 Credits).

Students have the option of completing a thesis or a fourth design project.

ENGR 402	Capstone Design II (3)
ENGR 498	Senior Thesis (3)

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.

ENGR 355	Elective Technical Competency (1-2)
ENGR 455	Advanced Technical Competency (1-8)
ENGR 470	Mechanical Advanced Competency (1-2)
ENGR 471	Electrical Advanced Competency (1-2)

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.

ENGR 355	Elective Technical Competency (1-2)
ENGR 455	Advanced Technical Competency (1-8)
ENGR 470	Mechanical Advanced Competency (1-2)
ENGR 471	Electrical Advanced Competency (1-2)

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.

ENGR 355	Elective Technical Competency (1-2)
ENGR 455	Advanced Technical Competency (1-8)
ENGR 470	Mechanical Advanced Competency (1-2)
ENGR 471	Electrical Advanced Competency (1-2)

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.

ENGR 355	Elective Technical Competency (1-2)
ENGR 455	Advanced Technical Competency (1-8)
ENGR 470	Mechanical Advanced Competency (1-2)
ENGR 471	Electrical Advanced Competency (1-2)

TECHNICAL INTEGRATION & DESIGN MINOR

16 Credits

Two Locations: Mesabi Range College,
Normandale Community College

The minor in Technical Integration & Design is for students who wish to learn about engineering design processes and gain experience working with and contributing to an engineering design team. Students will work with a team on an industry-sponsored project and complete 8 credits of technical competency coursework. In this context, they will develop their awareness of engineering technology and design processes while developing professional skills that can be carried forward into a career working

with engineers in industry, complementing the expertise developed in their major. Students should have junior/senior standing in their major and must apply for admission. The application form can be found at <http://cset.mnsu.edu/ie/minor.html>.

Policy. This minor is not available for Integrated Engineering majors.

GPA Policy: Students earning a minor in Technical Integration & Design must have:

1. A cumulative GPA of 2.5 or higher in minor courses.
2. Grades of 1.67 ("C-") or better for individual minor courses

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

Standards. Students must complete the application process for the minor, indicating relevant course experience, completing the essays, and presenting a learning plan. Students must have a 2.5 or higher GPA and be a junior or senior in their major. Admission to the minor is selective and subject to the approval of the Integrated Engineering faculty.

Core

ENGR 300	Introduction to Engineering Design for Non-Majors (4)
ENGR 311W	Professionalism I (3)
ENGR 492	Seminar (1)

Statistics & Modeling/Programming (Choose 2 Credits)

ENGR 320	Engineering Core Competencies (1-2)
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Engineering Economics & Entrepreneurship (Choose 2 Credits)

ENGR 420	Advanced Engineering Core Competencies (1-2)
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Elective

Choose 4 credits from the following.

Students in the minor can take 4 credits of ENGR 355.

ENGR 355	Elective Technical Competency (1-2)
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TECHNICAL INTEGRATION & DESIGN CERTIFICATE

16 Credits

Two Locations: Mesabi Range College,
Normandale Community College

The Technical Integration & Design Certificate program is for students with junior or senior standing in their major or graduates who wish to learn about engineering design processes and gain experience working with and contributing to an engineering design team. Students will work with a team on an industry-sponsored project and complete 8 credits of technical competency coursework. In this context, they will develop their awareness of engineering technology and design processes while developing professional skills that can be carried forward into a career working with engineers in industry, complementing the expertise developed in their major. Students must apply for admission. The application form can be found at <http://cset.mnsu.edu/ie/minor.html>.

This certificate is not available for Integrated Engineering majors.

GPA Policy: Students earning a certificate in Technical Integration & Design must have:

1. A cumulative GPA of 2.5 or higher in certificate courses.
2. Grades of 1.67 ("C-") or better for individual certificate courses

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

Core

ENGR 300	Introduction to Engineering Design for Non-Majors (4)
ENGR 311W	Professionalism I (3)
ENGR 492	Seminar (1)

Statistics & Modeling/Programming (Choose 2 Credits)

ENGR 320	Engineering Core Competencies (1-2)
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Engineering Economics & Entrepreneurship (Choose 2 Credits)

ENGR 420	Advanced Engineering Core Competencies (1-2)
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Elective

Choose 4 credits from the following. TID Certificate students can take 4 credits of ENGR 355.

ENGR 355	Elective Technical Competency (1-2)
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PROJECT BASED ENGINEERING CERTIFICATE

15 Credits

Two Locations: Mesabi Range College,
Normandale Community College

The Project-Based Engineering Certificate program is for students with junior or senior standing in an engineering program in the US or abroad. Students will work with a team on an industry-sponsored project and complete 8 credits of technical competency coursework. In this context, they will further develop their skills in engineering technology, design and professionalism. Students should have completed pre-requisites for the integrated engineering program before beginning the certificate program. The application form can be found at <http://cset.mnsu.edu/ie/minor.html>.

INTEGRATED ENGINEERING CONTINUED

This certificate is not available for Integrated Engineering majors.

GPA Policy: Students earning a certificate in Technical Integration & Design must have:

1. A cumulative GPA of 2.5 or higher in certificate courses.
2. Grades of 1.67 ("C-") or better for individual certificate courses

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

Major Common Core

Students with junior standing in an engineering program will take ENGR 301 and ENGR 311W. Students with senior standing or an earned engineering bachelors degree will take ENGR 401 and ENGR 411W.

ENGR 492 Seminar I (1)

Engineering Design (Choose 3 Credits)

ENGR 301 Design I (3)

ENGR 401 Capstone Design I (3)

Professionalism (Choose 3 Credits)

ENGR 311W Professionalism I (3)

ENGR 411W Professionalism III (3)

Major Unrestricted Electives

Choose 8 credits from the following. No more than 2 credits each of ENGR 320, ENGR 420, ENGR 470 and ENGR 471 and no more than 6 credits each of ENGR 370 and ENGR 371 are allowed.

Choose 8 Credits

ENGR 320 Engineering Core Competencies (1-2)

ENGR 370 Mechanical Core Competencies (1-6)

ENGR 371 Electrical Core Competencies (1-6)

ENGR 420 Advanced Engineering Core Competencies (1-2)

ENGR 455 Advanced Technical Competency (1-8)

ENGR 470 Mechanical Advanced Competency (1-2)

ENGR 471 Electrical Advanced Competency (1-2)

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.

Prerequisite: Recipient of a MAX scholarship or instructor consent

Fall, Spring

ENGR 299 (3) Bridge to Project-based Engineering

An introductory project-based learning experience in engineering designed to prepare students for upper-division project-based work. Students will be exposed to teamwork, self-regulated learning, and the design process as they participate in the design and implementation of an engineering project

Prerequisite: Admission to Integrated Engineering major or consent.

On Demand: Fall, Spring, Summer

ENGR 300 (4) Introduction to Engineering Design for Non-Majors

Students working towards a minor in the Department of Integrated Engineering will participate in and reflect on the engineering design process, the professional aspects of working on an engineering team, and the intersection of engineering projects and their major. Design activities include such things as scoping, modeling, experimentation, analysis, modern tools, design reviews, multi-disciplinary systems view, creativity, safety, business plans, and global/societal/environmental impacts.

Prerequisite: Students must be admitted to the minor program in the Department of Integrated Engineering minor or certificate program.

Co-requisites : ENGR 311W

On Demand: Fall, Spring, Summer

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/sietal/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.

Prerequisite: 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.

Prerequisite: ENGR 311W

Fall, Spring

WI

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.

Prerequisite: Admission to major, minor or certificate programs.

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.

Prerequisite: Admission to major, minor or certificate programs.

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.

Prerequisite: 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.

Prerequisite: 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.

Prerequisite: 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.

Prerequisite: ENGR 302, ENGR 312W. At least 14 credits earned in technical competencies.

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.

Prerequisite: ENGR 401, ENGR 411W. At least 22 credits earned in technical competencies.

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.

Prerequisite: 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.

Prerequisite: ENGR 401, ENGR 411W

Fall, Spring
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ENGR 420 (1-2) Advanced Engineering Core Competencies

Students gain breadth across all objectives and depth in the areas of engineering economics and entrepreneurship.

Prerequisite: Admission to major, minor or certificate programs.

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.

Co-requisite: 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.

Prerequisite: 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.

Prerequisite: 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 Integrated 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.

Prerequisite: 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.

Prerequisite: Consent

Variable

ENGR 498 (3) Senior Thesis

Advanced study and research required. Topic of the senior thesis determined jointly by the student and the faculty advisor. Deliverables include written thesis and formal oral presentation.

Prerequisite: Senior standing in program and at least 14 credits earned in technical competencies

Fall, Spring, On Demand: Summer