

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 4 credits of ENGR 492.

ENGR 301	Design I (3)
ENGR 302	Design II (3)
ENGR 311W	Professionalism I (3)
ENGR 312W	Professionalism II (3)
ENGR 321	Engineering Core: Statistics (1)
ENGR 322	Engineering Core: Programming/Modeling (1)
ENGR 331	Mechanical Core: Dynamic Systems (1)
ENGR 332	Mechanical Core: Fluid Mechanics (1)
ENGR 333	Mechanical Core: Manufacturing Processes (1)
ENGR 334	Mechanical Core: Material Science (1)
ENGR 335	Mechanical Core: Mechanics of Materials (1)
ENGR 336	Mechanical Core: Thermodynamics (1)
ENGR 341	Electrical Core: AC Circuits (1)
ENGR 342	Electrical Core: Control Theory (1)
ENGR 343	Electrical Core: Digital Logic (1)
ENGR 344	Electrical Core: Electronics (1)
ENGR 345	Electrical Core: Instrumentation (1)
ENGR 346	Electrical Core: Motors, Generators & Transformers (1)
ENGR 401	Capstone Design I (3)
ENGR 411W	Professionalism III (3)
ENGR 412W	Professionalism IV (3)
ENGR 421	Advanced Engineering Core: Engineering Economics (1)
ENGR 422	Advanced Engineering Core: Entrepreneurship (1)
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 PHI 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 Depth Requirement.

Major Unrestricted Electives

Choose one Focus area from the following.

Broad Focus (Choose 16 Credits)

Students choosing not to complete a focus area must complete 0-2 credits of ENGR 350-355 and 14-16 credits of ENGR 431, ENGR 432, ENGR 441, ENGR 442, ENGR 450-463, and ENGR 475-479. ENGR 450-463 and ENGR 475-479 are repeatable. The engineering field of these elective credits is unrestricted.

ENGR 350 - 355	Elective Technical Competencies
ENGR 431 - 432	Mechanical Advanced Competencies
ENGR 441 - 442	Electrical Advanced Competencies
ENGR 450 - 463	Advanced Technical Electives
ENGR 475 - 479	Advanced Technical Electives

Mechanical Focus (Choose 16 Credits)

Students choosing a mechanical focus must complete ENGR 431 and ENGR 432, 0-2 credits of ENGR 350-355 and 12-14 credits of ENGR 441, ENGR 442, ENGR 450-463, and ENGR 475-479. ENGR 450-463 and ENGR 475-479 are repeatable. At least 12 credits of ENGR 350-355, ENGR 450-463 and ENGR 475-479 must be in the field of mechanical engineering. At least two of the four engineering projects must include design of mechanical systems.

ENGR 350 - 355	Elective Technical Competencies
ENGR 431	Mechanical Advanced Competency: Heat Transfer (1)
ENGR 432	Mechanical Advanced Competency: Structural Analysis (1)
ENGR 441 - 442	Electrical Advanced Competencies
ENGR 450 - 463	Advanced Technical Electives
ENGR 475 - 479	Advanced Technical Electives

Electrical Focus (Choose 16 Credits)

Students choosing an electrical focus must complete ENGR 441 and ENGR 442, 0-2 credits of ENGR 350-355 and 12-14 credits of ENGR 431, ENGR 432, ENGR 450-463, and ENGR 475-479. ENGR 450-463 and ENGR 475-479 are repeatable. At least 12 credits of ENGR 350-355, ENGR 450-463 and ENGR 475-479 must be in the field of electrical engineering. At least two of the four engineering projects must include design of electrical systems.

ENGR 350 - 355	Elective Technical Competencies
ENGR 431 - 432	Mechanical Advanced Competencies
ENGR 441	Electrical Advanced Competency: Electricity & Magnetism (1)

ENGR 442	Electrical Advanced Competency: Signals & Systems (1)
ENGR 450 - 463	Advanced Technical Electives
ENGR 475 - 479	Advanced Technical Electives

Other Focus Areas (Choose 16 Credits)

Students choosing a focus area other than mechanical or electrical must complete 0-2 credits of ENGR 350-355 and 14-16 credits of ENGR 431, ENGR 432, ENGR 441, ENGR 442, ENGR 450-463, and ENGR 475-479. ENGR 450-463 and ENGR 475-479 are repeatable. At least 14 credits of ENGR 350-355, ENGR 450-463 and ENGR 475-479 must be in the field of focus. At least two of the four engineering projects must include design of focus-area systems.

ENGR 350 - 355	Elective Technical Competencies
ENGR 431 - 432	Mechanical Advanced Competencies
ENGR 441 - 442	Electrical Advanced Competencies
ENGR 450 - 463	Advanced Technical Electives
ENGR 475 - 479	Advanced Technical Electives

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 321	Engineering Core: Statistics (1)
ENGR 322	Engineering Core: Programming/Modeling (1)
ENGR 421	Advanced Engineering Core: Engineering Economics (1)
ENGR 422	Advanced Engineering Core: Entrepreneurship (1)
ENGR 492	Seminar (1)

Elective

Choose 4 credits from ENGR 350-355. Courses are repeatable. Students in the minor can take 4 credits of 300-level electives.

Choose 4 Credits

ENGR 350 - 355	Elective Technical Competencies
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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

INTEGRATED ENGINEERING CONTINUED

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

Core

Major Common Core

ENGR	300	Introduction to Engineering Design for Non-Majors (4)
ENGR	311W	Professionalism I (3)
ENGR	321	Engineering Core: Statistics (1)
ENGR	322	Engineering Core: Programming/Modeling (1)
ENGR	421	Advanced Engineering Core: Engineering Economics (1)
ENGR	422	Advanced Engineering Core: Entrepreneurship (1)
ENGR	492	Seminar (1)

Major Unrestricted Electives

Choose 4 credits from ENGR 350-355. Courses are repeatable. TID Certificate students can take 4 credits of 300-level electives.

Choose 4 Credits.

ENGR 350 - 355 Elective Technical Competencies

PROJECT BASED ENGINEERING CERTIFICATE

15 Credits

Two Locations: Mesabi Range College,
Normandale Community College

The ProjectBased 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 prerequisites for the integrated engineering program before beginning the certificate program. 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

Major Common Core

ENGR 492 Seminar (1)

Engineering Design (Choose 3 Credits)

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

ENGR 301 Design I (3)
ENGR 401 Capstone Design I (3)

Professionalism (Choose 3 Credits)

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

ENGR 311W Professionalism I (3)
ENGR 411W Professionalism III (3)

Major Unrestricted Electives

Choose 8 credits from the following. Courses ENGR 450-463 and 475-479 may be taken for more than 1 credit. All other courses are 1 credit each.

Choose 0 - 2 Credits

ENGR 321 - 322 Engineering Core Competencies

Choose 0 - 6 Credits

ENGR 331 - 336 Mechanical Core Competencies

Choose 0 - 6 Credits

ENGR 341 - 346 Electrical Core Competencies

Choose 0 - 2 Credits

ENGR 421 - 422 Advanced Engineering Core

Choose 0 - 4 Credits

ENGR 431 - 432 Mechanical Advanced Competencies

ENGR 441 - 442 Electrical Advanced Competencies

Repeatable Courses (Choose 0 - 8 Credits)

ENGR 450 - 463 Advanced Technical Electives
ENGR 475 - 479 Advanced Technical Electives

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/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.
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
VI

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
VI

ENGR 321 (1) Engineering Core: Statistics

Introduction to statistics in an engineering context. Design of experiments, sources of data, sampling plans, descriptive statistics, inferential statistics, and statistical software are introduced and applied. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.
Prerequisite: Admission to major, minor or certificate programs.
Fall, Spring

ENGR 322 (1) Engineering Core: Programming/Modeling

Students gain breadth across all objectives and depth in either programming or mathematical modeling. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.
Prerequisite: Admission to major, minor or certificate programs.
Fall, Spring

ENGR 331 (1) Mechanical Core: Dynamic Systems

Application of differential equations to determine the time evolution of mechanical systems. Laplace transform approach for solving differential equations. Representing systems with transfer functions, block diagrams, and state space models. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to program.
Fall, Spring

ENGR 332 (1) Mechanical Core: Fluid Mechanics

Analysis of static and dynamic fluid systems using energy, continuity, impulse-momentum, Pascal, and Archimedes' principles. Applications in both steady and non-steady state. Fluid friction, pipe flow, flowmeters. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to program.
Fall, Spring

ENGR 333 (1) Mechanical Core: Manufacturing Processes

Introduction to the field of manufacturing and its relationship to other aspects of engineering. Study of established and emerging parts fabrication processes, such as 3D printing, welding, injection molding, casting, etc. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to program.
Fall, Spring

ENGR 334 (1) Mechanical Core: Material Science

Relationship between microstructures, processing, and properties of engineering materials with a focus on mechanical behavior and evaluation. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to program.
Fall, Spring

ENGR 335 (1) Mechanical Core: Mechanics of Materials

Introduction to material responses in various loading scenarios including axial, bending, shear, and torsion. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to program.
Fall, Spring

ENGR 336 (1) Mechanical Core: Thermodynamics

Application of first law of thermodynamics, mass balances, and property relationships to open and closed systems and power and refrigeration cycles. Introduction to the second law. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to program.
Fall, Spring

ENGR 341 (1) Electrical Core: AC Circuits

Behavior of RL, RC, and RLC circuits including natural, step, and driven responses. Application of Laplace transforms to circuit theory. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to program.
Fall, Spring

ENGR 342 (1) Electrical Core: Control Theory

Modeling and analysis of linear feedback control systems including block diagrams, stability, and root locus. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to program.
Fall, Spring

ENGR 343 (1) Electrical Core: Digital Logic

Introduction to combinational and sequential logic including logic gates, Boolean algebra, logic minimization, flip flops, and HDL. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to program.
Fall, Spring

ENGR 344 (1) Electrical Core: Electronics

Analysis of circuits containing active elements such as amplifiers, diodes, and transistors. Both field effect and bipolar junction devices are covered in the context of digital and analog circuits. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to program.
Fall, Spring

ENGR 345 (1) Electrical Core: Instrumentation

Issues related to measurement including transducers, resolutions, signal integrity, noise, analog to digital conversion, and loading. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to program.
Fall, Spring

ENGR 346 (1) Electrical Core: Motors, Generators & Transformers

Conversion of energy between the electrical, magnetic, and mechanical domains specifically including transformers; AC and DC motors; and AC and DC generators. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to program.
Fall, Spring

ENGR 350 (1-2) Elective Technical Competency

In-depth study of an engineering area related to an engineering project or foundation topic in a focus area. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to major, minor or certificate programs.
Fall, Spring

ENGR 351 (1-2) Elective Technical Competency in Mechanical Engineering

In-depth study of an engineering area related to an engineering project or foundation topic in the focus area of Mechanical Engineering. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to major, minor or certificate programs.
Fall, Spring

ENGR 352 (1-2) Elective Technical Competency in Electrical Engineering

In-depth study of an engineering area related to an engineering project or foundation topic in the focus area of Electrical Engineering. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to major, minor or certificate programs.
Fall, Spring

ENGR 353 (1-2) Elective Technical Competency in Systems Engineering

In-depth study of an engineering area related to an engineering project or foundation topic in the focus area of Systems Engineering. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to major, minor or certificate programs.
Fall, Spring

ENGR 354 (1-2) Elective Technical Competency in Programming

In-depth study of an engineering area related to an engineering project or foundation topic in the focus area of Programming. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to major, minor or certificate programs.
Fall, Spring

ENGR 355 (1-2) Elective Technical Competency in Modern Engineering Tools

In-depth study of an engineering area related to an engineering project or foundation topic in the focus area of Modern Engineering Tools. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to major, minor or certificate programs.
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
WI

ENGR 421 (1) Advanced Engineering Core: Engineering Economics

Engineering economics topics including time value of money, simple and compound interest, annualized cash flows, inflation, and capital budgeting decision tools such as net present worth, payback period, return on investment, benefit/cost ratio, break-even analysis, and basic income statement reports. Topics are applied in a deep learning activity that relates to the team design project or a personal finance decision. Prerequisite: Admission to major, minor or certificate programs.
Fall, Spring

ENGR 422 (1) Advanced Engineering Core: Entrepreneurship

Introduction to basic value proposition strategies to develop an entrepreneurial mindset. Several business models and tools to develop and communicate the business case are explored, including the business model canvas. The business ecosystem of marketing, supply chain management, competitors, cost and revenue streams, as well as lean start up and lean manufacturing are explored as important factors in the design decisions that will add value to relevant customers and stakeholders. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work. Prerequisite: Admission to major, minor or certificate programs.
Fall, Spring

ENGR 431 (1) Mechanical Advanced Competency: Heat Transfer

Overview of heat transfer mechanisms including conduction, convection, and radiation. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work. Prerequisite: Admission to major, minor or certificate programs.
Fall, Spring

ENGR 432 (1) Mechanical Advanced Competency: Structural Analysis

Introduction to engineering standards in structural design; analysis of structures such as trusses, beams and frames with analytical, computational, and experimental methods for problem solving. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.
Fall, Spring

ENGR 441 (1) Advanced Electrical Core: Electricity & Magnetism

Maxwell's equations applied to electrostatics and magnetostatics. Electromagnetic wave propagation, transmission lines, and antennas. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.
Fall, Spring

ENGR 442 (1) Electrical Advanced Competency: Signals & Systems

Descriptions of signals in the time and frequency domain. Analysis of linear systems in the time and frequency domain. Includes applications of Fourier transforms. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.
Fall, Spring

ENGR 450 (1-8) Advanced Technical Competency

In-depth, advanced study of an engineering area related to an engineering project or foundation topic in a focus area. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work. Prerequisite: Admission to major, minor or certificate programs and faculty approval for study that extends a core topic area.
Fall, Spring

ENGR 451 (1-8) Advanced Technical Competency in Electrical Engineering

In-depth, advanced study of an engineering area related to an engineering project or foundation topic in the focus area of Electrical Engineering. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work. Prerequisite: Admission to major, minor or certificate programs and faculty approval for study that extends a core topic area.
Fall, Spring

ENGR 452 (1-8) Advanced Technical Competency in Mechanical Engineering

In-depth, advanced study of an engineering area related to an engineering project or foundation topic in the focus area of Mechanical Engineering. Prerequisite: Admission to major, minor or certificate programs and faculty approval for study that extends a core topic area.
Fall, Spring

ENGR 453 (1-8) Advanced Technical Competency in Biomedical Engineering

In-depth, advanced study of an engineering area related to an engineering project or foundation topic in the focus area of Biomedical Engineering. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work. Prerequisite: Admission to major, minor or certificate programs and faculty approval for study that extends a core topic area.
Fall, Spring

ENGR 454 (1-8) Advanced Technical Competency in Chemical Engineering

In-depth, advanced study of an engineering area related to an engineering project or foundation topic in the focus area of Chemical Engineering. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work. Prerequisite: Admission to major, minor or certificate programs and faculty approval for study that extends a core topic area.
Fall, Spring

ENGR 455 (1-8) Advanced Technical Competency in Computer Engineering

In-depth, advanced study of an engineering area related to an engineering project or foundation topic in the focus area of Computer Engineering. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.
Fall, Spring

ENGR 456 (1-8) Advanced Technical Competency in Engineering Management

In-depth, advanced study of an engineering area related to an engineering project or foundation topic in the focus area of Engineering Management. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work. Prerequisite: Admission to major, minor or certificate programs and faculty approval for study that extends a core topic area.
Fall, Spring

ENGR 457 (1-8) Advanced Technical Competency in Environmental Engineering

In-depth, advanced study of an engineering area related to an engineering project or foundation topic in the focus area of Environmental Engineering. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work. Prerequisite: Admission to major, minor or certificate programs and faculty approval for study that extends a core topic area.
Fall, Spring

ENGR 458 (1-8) Advanced Technical Competency in Industrial Engineering

In-depth, advanced study of an engineering area related to an engineering project or foundation topic in the focus area of Industrial Engineering. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work. Prerequisite: Admission to major, minor or certificate programs and faculty approval for study that extends a core topic area.
Fall, Spring

ENGR 459 (1-8) Advanced Technical Competency in Manufacturing Engineering

In-depth, advanced study of an engineering area related to an engineering project or foundation topic in the focus area of Manufacturing Engineering. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work. Prerequisite: Admission to major, minor or certificate programs and faculty approval for study that extends a core topic area.
Fall, Spring

ENGR 460 (1-8) Advanced Technical Competency in Materials Science and Engineering

In-depth, advanced study of an engineering area related to an engineering project or foundation topic in the focus area of Material Science & Engineering. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work. Prerequisite: Admission to major, minor or certificate programs and faculty approval for study that extends a core topic area.
Fall, Spring

ENGR 461 (1-8) Advanced Technical Competency in Process Engineering

Admission to major, minor or certificate programs and faculty approval for study that extends a core topic area. Prerequisite: Admission to major, minor or certificate programs and faculty approval for study that extends a core topic area.
Fall, Spring

ENGR 462 (1-8) Advanced Technical Competency in Systems Engineering

In-depth, advanced study of an engineering area related to an engineering project or foundation topic in the focus area of Systems Engineering. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work. Prerequisite: Admission to major, minor or certificate programs and faculty approval for study that extends a core topic area.
Fall, Spring

ENGR 463 (1-8) Advanced Technical Competency in Transportation Engineering

In-depth, advanced study of an engineering area related to an engineering project or foundation topic in the focus area of Transportation Engineering. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to major, minor or certificate programs and faculty approval for study that extends a core topic area.

Fall, Spring

ENGR 475 (1-8) Advanced Technical Competency in Combustion

In-depth, advanced study of an engineering area related to an engineering project or foundation topic in the focus area of Combustion. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to major, minor or certificate programs and faculty approval for study that extends a core topic area.

Fall, Spring

ENGR 476 (1-8) Advanced Technical Competency in Entrepreneurship

In-depth, advanced study of an engineering area related to an engineering project or foundation topic in the focus area of Entrepreneurship. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to major, minor or certificate programs and faculty approval for study that extends a core topic area.

Fall, Spring

ENGR 477 (1-8) Advanced Technical Competency in Leadership

In-depth, advanced study of an engineering area related to an engineering project or foundation topic in the focus area of Leadership. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to major, minor or certificate programs and faculty approval for study that extends a core topic area.

Fall, Spring

ENGR 478 (1-8) Advanced Technical Competency in Renewable Energy

In-depth, advanced study of an engineering area related to an engineering project or foundation topic in the focus area of Renewable Energy. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to major, minor or certificate programs and faculty approval for study that extends a core topic area.

Fall, Spring

ENGR 479 (1-8) Advanced Technical Competency in Structural Analysis

In-depth, advanced study of an engineering area related to an engineering project or foundation topic in the focus area of Structural Analysis. Students will do in-depth learning of some aspect of content area. Coursework may be tied to project work.

Prerequisite: Admission to major, minor or certificate programs and faculty approval for study that extends a core topic area.

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