The Mechanical Engineering Department prepares students at all levels to effectively apply modern engineering principles to the evolving needs of industry and society through focused efforts in manufacturing, materials science, mechanical design, thermal sciences, and aerospace applications. The Department supports an accessible, collaborative, multidisciplinary research and learning environment that stimulates students and faculty members to reach their highest potential through hands-on education, leadership opportunities, and life-long learning.

The Mechanical Engineering Department at the University of North Dakota is committed to graduating mechanical engineers who will:

1. Successfully practice mechanical engineering in the areas of mechanical design, thermal systems, and manufacturing and materials in industry and government settings;
2. Practice mechanical engineering across a broad range of job functions from detailed design to laboratory experimentation to engineering management;
3. Practice engineering alone or as part of a larger team, demonstrating the appropriate teamwork, leadership and communication skills for each professional situation;
4. Apply the highest standards of professional and ethical conduct, understanding the broader implications of their engineering efforts on local, national and global society;
5. Maintain relevant knowledge of contemporary engineering and professional issues and an understanding of modern engineering tools through regular participation in professional development activities.

Continuous assessment of student learning in accordance with specific program outcomes, including input from program constituents such as students, alumni, employers and industry advisory groups, provides opportunity to measure success in meeting the mission of the department. Beginning with the freshman year, teamwork, problem solving, and design exercises are interwoven throughout the curriculum, culminating in a two-semester capstone design project during the senior year. Several courses include laboratories which develop experimental, teamwork, and communication skills. Technical papers required by selected courses develop knowledge of contemporary issues as well as communication skills. State-of-the-art computer software is used extensively throughout the curriculum. Within our bachelor’s degree we offer an Aerospace Concentration. This option adds five credits to the degree but results in the student earning a private pilot’s license as well as tailoring the engineering degree towards the aerospace industry. Students already possessing a private pilot’s license (or equivalent) may waive this requirement. Three other concentrations are also available: Mechanical Design; Thermal Sciences; and Materials and Manufacturing. Students are strongly encouraged to prepare for professional licensure by taking the Fundamentals of Engineering (FE) exam prior to graduation. Students who excel academically are also well-qualified to pursue graduate work in mechanical engineering or a related field.

The department offers combined Bachelor of Science in Mechanical Engineering (BSME)/Master of Science in Mechanical Engineering (MSME) and BSME/Master of Engineering (MEng) degrees. For more detailed information, see Mechanical Engineering in the Graduate Section and Combined Degree Program under the College of Engineering and Mines (http://und-public.coursecatalog.com/engineeringandmines) section.

The Mechanical Engineering program is accredited by the Engineering Accreditation Commission of ABET (www.ABET.org).

In addition to the normal transfer credit requirements, students in Mechanical Engineering must complete a minimum of 21 credit hours of 300-level or higher coursework in Mechanical Engineering at UND, including:

- ME 418 Manufacturing Processes 4
- ME 483 Mechanical Measurements Laboratory 3
- ME 487 Engineering Design 5
- ME 498 & ME 488 and Engineering Design

### College of Engineering and Mines

#### B.S. in Mechanical Engineering

Required 129 credits (36 of which must be numbered 300 or above, and 60 of which must be from a 4-year institution) including:

I. Essential Studies Requirements (see University ES listing).

II. The Following Curriculum:

#### Freshman Year

<table>
<thead>
<tr>
<th>First Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 121 General Chemistry I 1</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 121L General Chemistry I Laboratory 1</td>
<td>1</td>
</tr>
<tr>
<td>ENGL 110 College Composition 1</td>
<td>3</td>
</tr>
<tr>
<td>ME 101 Introduction to Mechanical Engineering 1,2</td>
<td>3</td>
</tr>
<tr>
<td>MATH 165 Calculus I 1</td>
<td>4</td>
</tr>
<tr>
<td>Arts and Humanities</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td><strong>17</strong></td>
</tr>
</tbody>
</table>

#### Second Semester

| ENGR 200 Computer Applications in Engineering 1,2 | 2 |
| ENGL 130 Composition II: Writing for Public Audiences | 3 |
| MATH 166 Calculus II 1 | 4 |
| PHYS 251 University Physics I 1 | 4 |
| Arts and Humanities | 3 |
| **Total Credits** | **16** |

#### Sophomore Year

<table>
<thead>
<tr>
<th>First Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 201 Statics 1</td>
<td>3</td>
</tr>
<tr>
<td>ME 201 Student Design 2</td>
<td>2</td>
</tr>
<tr>
<td>ME 341 Thermodynamics 1</td>
<td>3</td>
</tr>
<tr>
<td>MATH 265 Calculus III 1</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 252 University Physics II 1</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td><strong>16</strong></td>
</tr>
</tbody>
</table>

#### Second Semester

| ENGR 202 Dynamics 1 | 3 |
| ENGR 203 Mechanics of Materials 1 | 3 |
| ENGR 206 Fundamentals of Electrical Engineering | 3 |
| MATH 266 Elementary Differential Equations | 3 |
| PHYS 253 or CHEM 122/122L University Physics III 3 or General Chemistry II | 4 |
| **Total Credits** | **16** |

#### Junior Year

<table>
<thead>
<tr>
<th>First Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 301 Materials Science</td>
<td>3</td>
</tr>
<tr>
<td>ME 306 Fluid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>ME 322 Design of Machinery</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 460 Engineering Economy</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td><strong>15</strong></td>
</tr>
</tbody>
</table>

#### Second Semester

| ME 323 Machine Component Design | 3 |
| ME 323L Machine Component Design Laboratory | 1 |
| ME 418 Manufacturing Processes | 4 |
| ME 474 Fundamentals of Heat and Mass Transfer | 3 |
| MATH 321 Applied Statistical Methods 5 | 3 |
| **Total Credits** | **15** |
I. Mechanical Design Stem

ME 424 Systems Dynamics and Control (#) 3
ME 426 Mechanical Vibrations (#) 3
ME 429 Introduction to Finite Element Analysis (#) 3
ME 439 Introduction to Robotics 3
ME 484 Ground Vehicle Dynamics 3
ME 485 Multiphysics Modeling 3
ME 523 Advanced Machine Design (#) 3
ME 525 Metal Fatigue in Engineering (#) 3
ME 526 Advanced Vibrations (#) 3
ME 529 Advanced Finite Element Methods (#) 3
ME 532 Advanced Dynamics (#) 3

Mechanical Design Concentration - 129 hours

Requires ME 323 Machine Component Design/ME 323L Machine Component Design Laboratory and any four of the Mechanical Design Stem technical electives.

II. Thermal Sciences Stem

ME 342 Intermediate Thermodynamics (#) 3
ME 446 Gas Turbines (#) 3
ME 449 Internal Combustion Engines (#) 3
ME 451 Heating and Air Conditioning 3
ME 464 Computational Fluid Dynamics (#) 3
ME 476 Intermediate Fluid Mechanics (#) 3
ME 477 Compressible Fluid Flow (#) 3
ME 485 Multiphysics Modeling 3
ME 542 Thermodynamics of Materials 3
ME 545 Fluidized-Bed Combustion Engineering 3

Technical Elective 4

Credits 17

Senior Year
First Semester

ME 480 Mechanical Engineering Seminar 3
ME 483 Mechanical Measurements Laboratory 3
ME 487 Engineering Design 2
Social Science 3
Technical Electives 4 6

Credits 17

Second Semester

ME 488 Engineering Design 3
ME 370 Engineering Disasters and Ethics 2 or CHE 340
or PHIL 250
ME 428 Advanced Manufacturing Processes 3
ME 439 Introduction to Robotics 3
ME 524 Deformation and Fracture (#) 3
ME 525 Metal Fatigue in Engineering (#) 3
ME 542 Thermodynamics of Materials 3

Technical Elective 4

Credits 6

Total Credits 129

Technical Electives and Optional Concentrations

One technical elective must be taken from each stem unless the student is pursuing the Aerospace Concentration (see below). Students may receive an optional concentration, documented on the transcript, in one of the listed stems as indicated. Students who satisfactorily complete two full-time (40 hours/wk) or three part-time (20 hours+wk) ME 397 Cooperative Education experiences for a combined total of at least three credit hours are granted a waiver for one technical elective, provided one of the Cooperative Education experiences lasts for the duration of either a fall or spring semester. The waived technical elective is considered as elective at large and is not specified into any one of the three stems listed below.

III. Manufacturing and Materials Stem

ME 418 Manufacturing Processes and any four of the Manufacturing and Materials Stem technical electives.

Technical Elective

Credits 15

Manufacturing and Materials Concentration - 129 hours

Requires ME 306 Fluid Mechanics, ME 341 Thermodynamics and any four of the Thermal Sciences Stem technical electives.

IV. Aerospace Concentration - 134 hours

Requires ME 418 Manufacturing Processes and any four of the Manufacturing and Materials Stem technical electives.

Courses

ME 101. Introduction to Mechanical Engineering. 3 Credits.
This course encourages the development of visualization, technical communication, documentation, and fabrication skills including 3-D geometric modeling as applied to CAD applications using current methods and techniques commonly found in industry. Students will receive an introduction to engineering design and the analysis of a machine or system, including team problem solving. Approximately two-thirds of the course is classroom-based instruction and one third is laboratory (computer lab and/or shop) instruction and experimentation. Prerequisites: Mechanical Engineering major, F.S.
ME 102. Professional Assessment and Evaluation. 1 Credit.
This course is designed for students with industrial experience. Students complete a portfolio documenting educational and work experiences for evaluation, and individualized curriculum plans are developed. Various cademic programs in engineering are also introduced. Based on the assessment and evaluation, some engineering requirements may be waived. S/U grading only. Prerequisites: Work experience and/or technician school training plus completion of CHEM 121, CHEM 121L, PHYS 251, PHYS 252, MATH 165, MATH 166, and MATH 265. S/U grading. F,S,SS.

ME 201. Student Design. 2 Credits.
Team problem solving with design and build of a machine or mechanism, typically ASME Design Contest project. Machine shop safety and introduction to fabrication processes. Special topic lectures on contemporary Mechanical Engineering issues and research activities. Prerequisite: ME 101 or ENGR 101. Corequisites: PHYS 251 or ENGR 201. F.

ME 290. Laboratory Problems. 1-3 Credits.
Laboratory investigations of interest to student and faculty. Repeatable to a maximum of 6 credits. Prerequisite: Consent of instructor. Repeatable to 6 credits. On demand.

ME 301. Materials Science. 3 Credits.
The theory of the structure of matter, the prediction and evaluation of engineering properties of materials. Prerequisites: CHEM 121 with a grade of C or better, PHYS 252 with a grade of C or better, and admission to the professional Mechanical Engineering program. F.

ME 306. Fluid Mechanics. 3 Credits.
Fluid properties; fluid statics and dynamics; transport theory and transport analogies, conservation of mass, energy, and momentum; dimensional analysis; boundary layer concepts; pipe flows; compressible flow; open channel flow. Prerequisites: PHYS 251 and MATH 265, both with a grade of C or better. F,S.

ME 313. Material Properties and Selection. 3 Credits.
Study of relationships between materials, manufacture and design of engineering components. Prerequisite: ME 301 and admission to the professional Mechanical Engineering program. On demand.

ME 322. Design of Machinery. 3 Credits.
Analytical study of motions, velocities, accelerations and forces for design of machine elements. Introduction to spatial mechanisms, robotics, and actuator selection. Prerequisites: ENGR 200 with a grade of C or better, ENGR 202 with a grade of C or better, and admission to the professional Mechanical Engineering program. F.

ME 323. Machine Component Design. 3 Credits.
Design of machine elements such as shafts, bearings, gears, clutches, springs, threaded components, and bolted, riveted, welded, and bonded joints. Stress and failure theory analyses of the implementation of machine components are covered. Prerequisites: ENGR 203 with a grade of C or better, ME 322, and admission to the professional Mechanical Engineering program. S.

ME 323L. Machine Component Design Laboratory. 1 Credit.
Application of design and analysis tools developed in the Machine Component Design course. Laboratory emphasizes creative design, analysis techniques, construction methods, and design report writing. Prerequisite: Admission to the professional Mechanical Engineering program. Corequisite: ME 323. S.

ME 341. Thermodynamics. 3 Credits.
Fundamental energy relationships applied to both closed and open systems. Determination of thermodynamic properties, first and second laws of thermodynamic processes and basic cycles. Prerequisites: PHYS 251 and MATH 166, both with a grade of C or better. F,S.

ME 342. Intermediate Thermodynamics. 3 Credits.
Power and refrigeration cycles. Exergy analysis, psychrometrics, reacting and non-reacting mixtures. Prerequisite: ME 341 with a grade of C or better and admission to the professional Mechanical Engineering program. On demand.

ME 370. Engineering Disasters and Ethics. 3 Credits.
Engineering disasters will be the basis for teaching an ethics course to engineering students. Starting with the premise that most people know the difference between right and wrong (this is not a course on criminal activity!), the course explores how engineers, in spite of their best intentions, sometimes create disastrous situations. The effect of cumulative adverse detail is difficult to teach except with case studies. Also explored is cost vs. safety trade-offs, the role of lawsuits, and government regulation. Prerequisites: Junior or Senior standing. F.

ME 388. Undergraduate Research in Mechanical Engineering. 3 Credits.
Students will conduct a supervised independent study in a research laboratory or as part of a design team culminating in a research report. Prerequisite: Approval from department chair and faculty sponsor. S.

ME 397. Cooperative Education. 1-2 Credits.
A practical work experience with an employer closely associated with the student’s academic area. Arranged by mutual agreement among student, department and employer. Repeatable to 12 credits. Prerequisite: Admission to the professional Mechanical Engineering program. Repeatable to 12 credits. S/U grading. F,S,SS.

ME 418. Manufacturing Processes. 4 Credits.
Descriptive and analytical study of manufacturing methods and economics as they pertain to machining, metrology and automation. Includes laboratory. Prerequisites: ENGR 203 with a grade of C or better, ME 301, and admission to the professional Mechanical Engineering program. F.

ME 420. Composite Materials. 3 Credits.
Prerequisites: ME 301 and admission to the professional Mechanical Engineering program. On demand.

ME 424. Systems Dynamics and Control. 3 Credits.
Theory, analysis, and design of linear closed-loop control systems containing electronic, hydraulic, and mechanical components. Differential equations. LaPlace transforms, Nyquist and Bode diagrams are covered. Prerequisites: MATH 266, ME 322, and admission to the professional Mechanical Engineering program. On demand.

ME 426. Mechanical Vibrations. 3 Credits.
Vibration analysis and design as it applies to single and multi degree freedom mechanical systems, isolation and absorption of vibration, vibration of continuous systems, numerical methods of solution. Prerequisites: ENGR 202 with a grade of C or better, MATH 266, and admission to the professional Mechanical Engineering program. S.

ME 428. Advanced Manufacturing Processes. 3 Credits.
Individual projects involving the manufacturing economics and flow charts for selected products and basic technical principles of manufacturing processes. Includes laboratory. Prerequisites: ME 418 and admission to the professional Mechanical Engineering program. On demand.

ME 429. Introduction to Finite Element Analysis. 3 Credits.
Finite element analysis is introduced as a design tool. Emphasis is given to modeling techniques and element types. Matrix methods are used throughout the class. Prerequisites: ENGR 203 with a grade of C and admission to the professional Mechanical Engineering program. On demand.

ME 439. Introduction to Robotics. 3 Credits.
A systems engineering approach to robotics. Presents an introduction to manipulators, sensors, actuators, and end effectors for automation. Topics covered include kinematics, dynamics, control, programming of manipulators, pattern recognition, and computer vision. Prerequisites: ENGR 200 with a grade of C or better, MATH 166 with a grade of C or better, and admission to the professional Mechanical Engineering program. On demand.

ME 446. Gas Turbines. 3 Credits.
General principles, thermodynamics, and performance of gas turbine engines. Design consideration of engine components. Prerequisites: ME 341 with a grade of C or better and admission to the professional Mechanical Engineering program. On demand.

ME 449. Internal Combustion Engines. 3 Credits.
Fundamentals of spark ignition and compression ignition engines, related components and processes. Prerequisites: ME 342 and admission to the professional Mechanical Engineering program. On demand.

ME 451. Heating and Air Conditioning. 3 Credits.
Psychrometrics, heating and cooling loads and analysis of air conditioning systems. Prerequisites: ME 342 and admission to the professional Mechanical Engineering program or consent of instructor. Corequisite: ME 474. On demand.
ME 464. Computational Fluid Dynamics. 3 Credits.
Provides a practical experience using computational fluid dynamics and provides supporting material in fluid dynamics, which is useful in understanding the need to resolve grids in boundary layers and other regions of high velocity gradients. The course is structured as half lecture and half laboratory. The lecture covers topics related to laminar and turbulence boundary layers with and without acceleration, turbulence modeling, wakes and jets. The laboratory provides experience in building grids using the program GAMBIT, the solid/fluid modeling and meshing program, and calculating solutions using FLUENT, a commercial flow solver. Prerequisites: ME 306, MATH 266, and admission to the professional Mechanical Engineering program. On demand.

ME 466. Aerodynamics. 3 Credits.
ME 466 Aerodynamics is an introductory course on the fundamentals of aerodynamics for engineers. The class will cover a review of fluid mechanics including boundary layers and compressible flow. The course topics include parameters for airfoil and wings, incompressible flow over airfoils and wings of infinite and finite span, compressible and transonic flow over wings and aircraft, supersonic flow over thin airfoils, and supersonic flow over wings and airplane configurations. The course will follow a standard text “Aerodynamics for Engineers,” 6th Edition by Bertin and Cummings. The course will qualify as either a thermal fluid science elective or an aerospace concentration elective. Prerequisites: ME 306 and ME 341. S, odd years.

ME 474. Fundamentals of Heat and Mass Transfer. 3 Credits.
Convection, conduction, radiation, dimensional analysis and design of heat transfer equipment. Prerequisites: MATH 266, ME 306, ME 341 with a grade of C or better, and admission to the professional Mechanical Engineering program. S.

ME 476. Intermediate Fluid Mechanics. 3 Credits.

ME 477. Compressible Fluid Flow. 3 Credits.
Introduction to the theory and application of one-dimensional compressible flow. Course topics include isentropic flow in converging and diverging nozzles, normal shock waves, oblique shock waves, Prandtl-Meyer flow, flow with friction and heat addition. Prerequisite: Admission to the professional Mechanical Engineering program. Prerequisites or Corequisites: ME 341 with a grade of C or better and ME 306. On demand.

ME 480. Mechanical Engineering Seminar. 3 Credits.
Reports and presentations on current developments in mechanical engineering and engineering ethics. Prerequisites: Senior Standing and admission to the professional Mechanical Engineering program. F.

ME 483. Mechanical Measurements Laboratory. 3 Credits.
Experiments and written reports on the operation and performance of instruments and basic mechanical engineering equipment. Prerequisites: EE 206 and admission to the professional Mechanical Engineering program. F.

ME 484. Ground Vehicle Dynamics. 3 Credits.
ME 484 is a junior and senior level elective course. This course deals with the design of ground vehicle suspension and steering systems. Vehicle ride, handling and safety systems are covered along with passive and active suspension control. Prerequisite: ME 322 and admission to the professional Mechanical Engineering program or consent of instructor. On demand.

ME 485. Multiphysics Modeling. 3 Credits.
Theory and techniques of modeling coupled thermal, fluid, mechanical, and/or electrical fields in components design. The focus is on the fundamental techniques used to simultaneously derive and solve coupled equations and the use of commercial multi physics finite element software. Prerequisite: ME 323. S.

ME 487. Engineering Design. 2 Credits.
The first course of a two-course sequence in Engineering Design, students will establish important features of the machine or system to be designed, perform market analysis, establish design objectives, explore alternatives, conduct research, specify constraints. Prerequisites: ME 323, ME 323L, ME 474 or any one elective from the thermal science group, and admission to the professional Mechanical Engineering program. Corequisite: ME 483. Prerequisite or Corequisite: ENGR 460. F.