



MECH HANDBOOK

 2020-21



University of Manitoba
Engineering Society



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Mechanical Engineering

Department Contacts

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Department Description

Mechanical engineering is an ever-growing field, thanks in part to the demand for more efficient and environmentally-friendly automobiles, aircrafts, homes, and manufacturing processes. Particular areas of emphasis include heat transfer, stress analysis, fluid mechanics, machine design and material science.

In addition to the standard Mechanical Engineering program, the department offers Aerospace and Manufacturing options as well as streams in Materials, Thermofluids and Solid Mechanics. Options require five technical electives while streams only require three. An additional choice for Mechanical students is to pursue an undergraduate thesis which counts as two technical electives. Students interested in any of these programs should consult with the Mechanical Department Office to select an appropriate set of elective courses.



Tips for Incoming Mechanical Students

These tips are from current mechanical students.

1. Find old midterms from previous years. If they are available, old midterms and finals are one of the best ways to prepare for your exams. Pay attention to the style of questions your professor has given in the past and to the concepts that were emphasized in previous years' exams.
2. Learn how to properly cross-reference in word, this is essential for classes with Dr. Paul Labossiere!
3. Make friends, you will have several group projects for which you get to choose your partners.
4. Don't leave all of your tech electives for your last year, they conflict with each other and you will not be able to get into the courses you want.
5. Consider taking your complementary electives in the evenings during the summer. They are less demanding, and you can lighten your course load during the school year.
6. Many of your courses will have weekly quizzes or assignments. Even though they aren't worth a large percentage of your grade, put in as much effort as you can. Your marks in these sections of the course can help boost your overall grade.
7. Take advantage of the professors' office hours, they can provide assistance on assignments and with studying for tests and exams.
8. Get your card encoded at the earliest opportunity, there are usually a few days it is done every fall term; it will be needed to access rooms such as the CAD lab.



What are Streams and Electives?

The Mechanical Engineering Program allows students to take 5 Technical Electives, which are simply non-core courses meant to supplement a student's knowledge on a variety of subjects. These elective slots give students a chance to pursue Mechanical and Manufacturing topics in a variety of different subject/research areas.

The program also offers different Options and Streams with courses that can be used to fill the Technical Elective slots. An Option consists of 5 courses to fill the 5 elective slots, while a Stream consists of 3 courses to fill 3 out of 5 elective slots. There are two available options, Aerospace and Manufacturing, and three streams, Materials, Solid Mechanics, and Thermofluids. After the completion of their second-year students can choose either to stay in the main Mechanical Engineering Degree Program or enter one of the Options/Streams. Upon making a decision, students can fill out the [Option/Stream Declaration Form](#) and return it to their undergraduate student advisor. For more information about the courses offered in each option and stream take a look at the [Options and Streams Information Sheet](#) available on the Mechanical Engineering website.

Complementary studies electives are courses that expose students to topics outside of the fields of science and engineering. The Mechanical Engineering Program requires that students take at least 6 credit hours of complementary electives. Students may choose any course at the 1000-level or above from the Faculty of Arts or Management to fulfill this requirement. For a full list of courses check out the [Undergraduate Program Requirements](#) for Mechanical Engineering.



Course List

For 4- and 5-year course schedules, stream information and other helpful spreadsheets, visit:

<http://umanitoba.ca/faculties/engineering/departments/mechanical/undergrad/mechprogcrs.html>

Second Year Courses		
Applied Chemistry for Engineers	(CHEM 1310)	3CR
Engineering Communication	(ENG 2030 or ENG 2040)	3CR
Engineering Mathematical Analysis 1	(MATH 2130)	3CR
Engineering Mathematical Analysis 2	(MATH 2132)	3CR
Numerical Methods	(CIVL 3590)	4CR
Computer Aided Design and Manufacturing Processes	(MECH 2012)	4CR
Thermodynamics	(MECH 2202)	4CR
Mechanics of Materials	(MECH 2222)	4CR
Fundamentals of Fluid Mechanics	(MECH 2262)	4CR
Engineering Materials 1	(MECH 2272)	4CR
Contemporary Statics for Engineers	(STAT 2220)	3CR



Third Year Courses

Engineering Mathematical Analysis 3	(MATH 3132)	3CR
Project Management	(MECH 3170)	4CR
Vibrations and Acoustics	(MECH 3420)	4CR
Measurement and Control	(MECH 3430)	4CR
Heat Transfer	(MECH 3460)	4CR
Kinematics and Dynamics	(MECH 3482)	4CR
Fluid Mechanics and Applications	(MECH 3493)	4CR
Stress Analysis and Design	(MECH 3502)	4CR
Engineering Materials 2	(MECH 3542)	4CR
Mechanical Laboratory	(MECH 3980)	4CR

Fourth Year Courses

Engineering Economics	(CIVL 4050)	3CR
Technology, Society, and the Future	(CIVL 4460)	3CR
Elements of Electric Machines and Digital Systems	(ECE 3010)	4CR
Machine Design 4M	(MECH 4650)	4CR
Engineering Design	(MECH 4860)	5CR
Physics 2: Waves and Modern Physics	(PHYS 1070)	3CR



Technical Elective Courses Descriptions

AEROSPACE OPTION

Aerodynamics	(MECH 3520)	4CR
Aerospace Structures: Analysis and Design	(MECH 4182)	4CR
Aerospace Materials and Manufacturing Processes	(MECH 4192)	4CR
Gas Turbine Propulsion Systems	(MECH 4200)	4CR
Aircraft Performance, Dynamics, and Design	(MECH 4452)	4CR

MANUFACTURING OPTION (Choose 5)

Robotics and Computer Numerical Control	(MECH 3550)	4CR
Introduction to Optimization	(MECH 3562)	4CR
Manufacturing Automation	(MECH 3570)	4CR
Manufacturing Planning and Quality Control	(MECH 3582)	4CR
Simulation Modelling and Facilities Planning	(MECH 3592)	4CR
Design for Manufacturing	(MECH 4240)	
Contemporary Topics in Manufacturing Engineering 1 Topic: Fluid Power Systems	(MECH 4310)	4CR
Contemporary Topics in Manufacturing Engineering 1 Topic: Fall Computer Integrated Manufacturing and Automation 1; Winter Computer Integrated Manufacturing and Automation 2	(MECH 4330)	4CR
Contemporary Topics in Manufacturing Engineering 2 Topic: Fall-Systems Engineering	(MECH 4342)	4CR
Operational Excellence	(ENG 4110)	4CR



Quality Assurance in Industry	(MECH 4780)	4CR
Mechatronics Systems Design	(MECH 4900)	4CR
Manufacturing Process 1	(MECH 4960)	4CR
Manufacturing Process 2	(MECH 4970)	4CR

MATERIALS STREAM (Choose 3)

Aerospace Materials and Manufacturing Processes	(MECH 4192)	4CR
Contemporary Topics in Mechanical Engineering 1 Topic: Analysis of Composite and Multifunctional Materials	(4310 or 4330)	4CR
Topics in Engineering Materials 1	(MECH 4350)	4CR
Topics in Engineering Materials 2 Topic: Biomaterials for Medical Applications	(MECH 4360)	4CR
Corrosion of Metals and Alloys	(MECH 4620)	4CR
Fracture and Failure of Engineering Materials	(MECH 4870)	

THERMOFLUIDS STREAM (Choose 3)

Aerodynamics	(MECH 3492)	4CR
Gas Turbine Propulsion Systems	(MECH 4200)	4CR
IC Engines	(MECH 4292)	4CR
Contemporary Topics in Mechanical Engineering 1	(MECH 4310)	4CR
Heating, Ventilation, and Air Conditioning	(MECH 4412)	4CR
Selected Topics in Fluid Mechanics 4M	(MECH 4560)	4CR
Energy Conversion and Utilization	(MECH 4680)	4CR



Renewable Energy	(MECH 4692)	4CR
Advanced Topics in Heat Transfer	(MECH 4694)	4CR
Design of Thermal Systems	(MECH 4702)	4CR
Numerical Heat Transfer in Fluid Flow	(MECH 3822)	4CR

SOLID MECHANICS STREAM (Choose 3)

Aerospace Structures: Analysis and Design	(MECH 4182)	4CR
Contemporary Topics in Mechanical Engineering 1 Topic: Mechanical Vibration	(MECH 4310)	4CR
Contemporary Topics in Mechanical Engineering 2 Winter Topic: Design of Biomechanical Devices	(MECH 4322)	4CR
Contemporary Topics in Mechanical Engineering 2 Winter Topic: Ground Vehicle Testing Technology	(MECH 4322)	4CR
Fundamentals of Finite Element Analysis	(MECH 4510)	4CR
Mechanical Vibration	(MECH 4470)	4CR
Aircraft Performance, Dynamics, and Design	(MECH 4452)	4CR
Advanced Strength of Materials	(MECH 4532)	4CR
Noise Control	(MECH 4550)	4CR
Advanced Mechanical Design	(MECH 4672)	4CR
Automotive Engineering	(MECH 4812)	4CR



OTHER ELECTIVES

Thesis - Students should have a 3.0 DGPA or higher	(MECH 4162)	6CR
Contemporary Topics in Mechanical Engineering 2 Fall Topic: Applied Instrumentation	(MECH 4322)	4CR
Contemporary Topics in Mechanical Engineering 2 Fall Topic: Advanced Graphical Communication	(MECH 4322)	4CR



Course Descriptions

SECOND YEAR CORE COURSES DESCRIPTIONS

Applied Chemistry for Engineers (CHEM 1310) 3CR

Thermochemistry, chemical thermodynamics, and chemical kinetics. This course expands on topics covered in high school chemistry that were not included in CHEM 1300. This course is more math intensive than CHEM 1300, which some people have difficulty with. CHEM 1300 is a prerequisite.

Difficulty: 3.5 **Workload:** 3

Tips: Start your lab write ups early so that you have time to ask questions if needed and also to consult with other peers.

Engineering Communication (ENG 2030 or ENG 2040) 3CR

Take only one of ENG 2030: Students work in a team-based environment to produce deliverables comparable to the engineering workplace. In-class tutorials focus on the sharpening of individual students' writing skills through an analytical, problem-solving and critical thinking approach. Students are exposed to a variety of communicative scenarios and emphasis is placed on development of a repertoire of skills necessary for effective communication in the engineering profession. OR ENG 2040: This team-based course focuses on a rhetorical approach, communication strategies and guided practice in the design of engineering communications. ENGL 1400/1310, ENG 1430 (or former ENG 2010) prerequisite.

Difficulty: 3 **Workload:** 5

Tips: Make sure to get started on your final report early to allow lots of time for editing. Wear business clothes for all presentations. Try to keep up with entries in your journal.



Engineering Mathematical Analysis 1 (MATH 2130) 3CR

Multivariable differential and integral calculus up to and including multiple integrals in cylindrical and spherical coordinates. For Engineering and Geophysics students only. Prerequisites: MATH 1210 or MATH 1211 and MATH 1710.

Difficulty: 3 **Workload:** 3

Tips: Make sure to review your notes from Calculus 2 before starting this class. The textbook has lots of practice problems, which are a great way to prepare for the tests. Make an effort to attend the tutorials, as the professors will go through practice problems.

Engineering Mathematical Analysis 2 (MATH 2132) 3CR

(Lab required) Infinite series, Taylor and Maclaurin Series; ordinary differential equations including Laplace transforms. For Engineering and Geophysics students only. MATH 1210 and MATH 1710 are prerequisites.

Difficulty: 4 **Workload:** 3

Tips: The best way to prepare for your midterms and final is to do lots of practice problems in the textbook. The tutorials are taught by the professor, so they are a great opportunity to go through additional practice problems and ask your questions.

Numerical Methods (CIVL 3590) 4CR

Numerical methods applied to problems in engineering; roots of nonlinear equations and systems of linear equations, numerical differentiation and integration, initial-value problems. COMP 1012 is a prerequisite and MATH 2132 is a pre or corequisite.

Difficulty: 3.5 **Workload:** 2

NOTE: this course is currently being changed to an engineering taught course instead of math, check your department's requirements before registration.



Computer Aided Design and Manufacturing Processes (MECH 2012) 4CR

Provide instruction on the application of computer aided design software packages. The students will work in groups in the design and development of a product using CAD packages. The course will be delivered through a combination of lectures and tutorials. ENG 1430 is a prerequisite.

Difficulty: 3.5 **Workload:** 4

Tips: Not Available

Thermodynamics (MECH 2202) 4CR

Cycles, transient flow processes, entropy, gas mixtures, psychrometry combustion. ENG 1460, MATH 1500/1510, and MATH 1700/1710 are prerequisites.

Difficulty: 4 **Workload:** 3.5

Tips: Not Available

Mechanics of Materials (MECH 2222) 4CR

Topics covered in this course include: axial and torsional loading, stress-strain and deformation in statically determinate/indeterminate systems, thermally induced stress, and stresses in beams (including reinforced beams) under pure bending and bending with shear. The mechanical properties of materials under various loading modes will be addressed. ENG 1440, PHYS 1050, COMP 1012, and MATH 1700/1710 is a prerequisite.

Difficulty: Not Available **Workload:** Not Available

Tips: Not Available

Fundamentals of Fluid Mechanics (MECH 2262) 4CR

Fundamental concepts used in the analysis of fluid behaviour, pressure in stationary fluids, forces on submerged surfaces, buoyancy, integral methods, Bernoulli equation, pipeline analysis. MATH 2130 is a prerequisite and MATH 2132 is a pre or corequisite.

Difficulty: 3 **Workload:** 3

Tips: Not Available



Engineering Materials 1 (MECH 2272) 4CR

Introduction to engineering materials; defects, strengthening mechanisms, and plasticity in engineering metals and alloys; fundamentals and application of heat treatment of metallic materials including topics such as diffusion, phase diagram, phase transformation, and thermal processing; mechanical properties of engineering metallic materials and their relationship to structure, defects, various strengthening mechanisms, and processing; structure of non-metallic polymers and ceramics. MECH 2222 and CHEM 1310 are prerequisites.

Difficulty: 3 **Workload:** 3

Tips: Not Available

Contemporary Statics for Engineers (STAT 2220) 3CR

Descriptive statistics, basic probability concepts, special statistical distributions, statistical inference-estimation and hypothesis testing, regression, reliability, statistical process control. A "C" or better in one of MATH 1710 or MATH 1700.

Difficulty: 2.5 **Workload:** 2

Tips: Not Available



THIRD YEAR CORE COURSES DESCRIPTIONS

Engineering Mathematical Analysis 3 (MATH 3132) 3CR

Vector integral calculus; series of ordinary differential equations; Fourier series and Partial differential equations. MATH 2130 and MATH 2132 are prerequisites.

Difficulty: 4 **Workload:** 3

Tips: Review your notes from Math 1 and 2 before starting this course. The textbook is an excellent source of practice problems for the midterm and final. The topics covered in Math 3 will be used in many of the third-year electrical engineering courses, so it is important to understand all the concepts covered in the class

Project Management (MECH 3170) 4CR

Topics covered in this course will include project planning, scheduling, resource allocation, process analysis, layout and control. The course will make use of industrial projects for developing a strong design and analytical approach pertinent to project management. MECH 2012 (or MECH 2010) or CIVL 2830 is a prerequisite.

Difficulty: 2.5 **Workload:** 3

Tips: This counts as one of the 6 courses for a business minor.

Vibrations and Acoustics (MECH 3420) 4CR

Vibrations and computer simulations of single-degree-of-freedom systems, viscous and friction damping, MD of systems and modal analysis, measurement and sources of noise, noise control. MATH 2132, MECH 3482 or MECH 2120 and MECH 3480 are prerequisites.

Difficulty: 3.5 **Workload:** 3

Tips: Not Available



Measurement and Control (MECH 3430) 4CR

Mathematical modelling of mechanical systems. Feedback systems and stability. Digital control; analog to digital and digital to analog control systems. MATH 3132 and ENG 1450 are prerequisites.

Difficulty: 3.5 **Workload:** 3

Tips: Not Available

Heat Transfer (MECH 3460) 4CR

Steady-state and transient heat conduction, fins. Forced and free convection, laminar and turbulent conditions, internal and external flows. Heat exchangers. Radiation properties and exchange. MATH 3132 and ENG 1460 are prerequisites.

Difficulty: 4 **Workload:** 3.5

Tips: This course is very similar to Thermo 2, study for it the same way.

Kinematics and Dynamics (MECH 3482) 4CR

Fundamentals of 2D and 3D rigid body motions (kinematics) and the forces/moments (kinetics) needed to produce such motions. Applications will emphasize elements of machine design. PHYS 1050, ENG 1440, COMP 1012, and (MATH 1710 or MATH 1700) are prerequisites.

Difficulty: 4 **Workload:** 4

Tips: Not Available

Fluid Mechanics and Applications (MECH 3492) 4CR

The angular momentum principle, introduction to differential analysis of fluid motion, internal and external incompressible viscous flow, fluid machinery and multiple-path systems, fluid coupling and torque couplings and torque converters. PHYS 1050, ENG 1440, COMP 1012, and (MATH 1710 or MATH 1700) and MECH 2262 (MECH 2260 or 025.226) are prerequisites.

Difficulty: 3.5 **Workload:** 3.5

Tips: Not Available



Stress Analysis and Design (MECH 3502) 4CR

Strength and stability of columns, torsion of thin-walled members, asymmetric loading and shear centres, beam deflection and energy methods. MECH 2222 and MATH 2130 are prerequisites.

Difficulty: 3.5 **Workload:** 3.5

Tips: Not Available

Engineering Materials 2 (MECH 3542) 4CR

Mechanical properties of engineering non-metallic materials such as polymers, ceramics and composites, and their relationship to structure and processing; introduction to various shaping and joining processes used in manufacturing, their advantages and limitations; selection and application of engineering materials. MECH 2272 or (MECH 2270 and MECH 2290) is a prerequisite.

Difficulty: 3 **Workload:** 2.5

Tips: Not Available

Mechanical Laboratory (MECH 3980) 4CR

Laboratory course on topics that complement and reinforce concepts developed in second and third year mechanical engineering courses. Comprehensive experiments followed by submission of laboratory reports will be required. MECH 2272 or (MECH 2270 and MECH 2290) is a prerequisite.

Difficulty: 3 **Workload:** 3

Tips: Not Available



FOURTH YEAR CORE COURSES DESCRIPTIONS

Engineering Economics (CIVL 4050) 3CR

Introduction to engineering economics. Time value of money and discounted cash flow calculations. Comparing alternatives. Replacement analysis and life-cycle costing. Public sector engineering economy studies. Private sector engineering economy studies. Before and after-tax analysis. Applications in cost-estimating. Applications in asset management systems. Basic accounting. Accommodating capital limitations. Dealing with inflation. Dealing with risk and uncertainty. STAT 2220 (override for MECH students please contact your advisor) is a prerequisite.

Difficulty: 3 **Workload:** 3

Tips: If you can, try to take this course in the summer. You absolutely need the textbook!

Technology, Society, and the Future (CIVL 4460) 3CR

Impact of technology and technological change on society - past, present, future; specific technologies, e.g. construction, machine power, computers, communications, medical, military; the process of technological change; invisible effects of technology; technology and resource use; sustainable development, limits to growth and the role of technology.

Prerequisite: A grade of "C" or better in one of the courses from the list of Written English for Engineering Students, or the former ENGL 1310, or the former ENGL 1320. ENG 1440(or equivalent) is a prerequisite.

Difficulty: 2.5 **Workload:** 3

Tips: Not Available



Elements of Electric Machines and Digital Systems (ECE 3010) 4CR

Introduction to elementary concepts in ac circuits, electric machines, and digital sub-systems. Topics include electrical impedance, capacitors, inductors, electric motors, logic gates, decoders, multiplexing, flip flops, registers, microprocessor structures, I/O and data acquisition. Not available to students in Electrical or Computer Engineering. Prerequisite ENG 1450, MATH 2132, and a year class designation of Year 3 or Year 4.

Difficulty: 4 **Workload:** 2

Tips: Make friends with an electrical student and get them to help explain difficult concepts.

**Machine Design 4M (MECH 4650) 4CR

Stress analysis and the design of various machine elements; shafts and couplings, springs, threaded fasteners and power screws, clutches and power transmission components; spur, bevel, worm and helical gears; lubrication, journal and roller bearings. Not to be held for credit with the former 025.465. Prerequisites: MECH 3482 (or MECH 212) and MECH 3502 (or MECH 3500).

Difficulty: 2 **Workload:** 5

Tips: You will get as much out of this course as you put into it.

Engineering Design (MECH 4860) 5CR

Design projects; teams of students prepare written and oral design reports on solutions to specific problems from Manitoba industries; series of seminars by invited speakers. ENG 2010 is a prerequisite and must be eligible to graduate.

Difficulty: 2 **Workload:** 5

Tips: Not Available
