MECH HANDBOOK

2017-18

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.

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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 complimentary electives in the evenings during the summer. They are less demanding and you can 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.

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Conferences and Competitions

WESST Executive Meeting (WESST EM) - http://em.wesst.ca

Participation Available To: *UMES Executives only*

WESST EM brings together student representatives from 10 engineering schools in Western Canada. The conference includes a number of sessions, presentations, meetings and discussions centered around the development of student leadership skills.

WESST Retreat - http://wesst.ca/retreat/

Participation Available To: *All Engineering students*

This retreat offers students from the 10 WESST schools an opportunity to interact in a camp setting. In addition to WESST's AGM, retreat activities include sessions on building leadership skills and a number of social and team-building activities.

Conference on Diversity in Engineering (CDE) - http://2015.cde.cfes.ca/index.html

Participation Available To: *All Engineering students*

This conference focuses on the importance of diversity in Engineering, specifically examining the role of students in achieving the industry's related goals. CDE attracts approximately 150 engineering students from across Canada.

University of Manitoba Engineering Competition (UMEC) - http://umes.mb.ca/node/56

Participation Available To: *All Engineering students*

This competition is run annually by UMES and is held here at the U of M. All students are encouraged to participate, and those who qualify will be sponsored by UMES to subsequently attend WEC (see below).

CFES Congress - http://congress.cfes.ca

Participation Available To: *All Engineering students*

Congress is an annual, student-run conference hosted by a different CFES school each year. The conference serves not only as CFES' Annual General Meeting (AGM), but also as a platform for students to interact with both engineering students and professionals from across the country. Each year CFES Congress attracts 150 to 200 student delegates from over 40 Canadian engineering schools.

Western Engineering Competition (WEC) - http://wec2015.ca

Participation Available To: *Winners of UMEC*

Run annually by WESST, this competition provides students from 10 Western Canadian engineering schools the opportunity to engage in competition. The competition also includes a series of industry tours and networking activities. Those who place first or second in their category qualify for CEC.

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Canadian Engineering Competition (CEC) - http://cec2016.com

Participation Available To: *Winners of WEC*

This competition is run annually by CFES and brings together 150 of the most innovative and creative Canadian engineering undergraduate students. In addition to gaining competition experience, participants will have the opportunity to engage with engineering students and professionals from across the country.

International Engineering Competition (IEC) - http://cfes.ca/events-and-services/iec/

Participation Available To: *Winners of CEC*

Also organized annually by CFES, the International Engineering Competition engages students from across Canada, the United States and Europe in consulting and design engineering challenges. Much like CEC, participants are also provided the opportunity to interact with a diverse group of engineering students and professionals.

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Summer Session and Minors

Summer Sessions

Extended Education

188 Continued Education Complex
summer@umanitoba.ca
474-8008
http://umanitoba.ca/summer/

Taking summer session courses is a good way to reduce your workload during the year. However, do not rely on taking a given course during the summer as the course offerings at this time are very irregular. Those courses offered during the summer are targeted primarily at students who couldn't fit a course into their regular session or who failed/dropped a course during the regular session. If interested, you may petition a faculty to make a course available during the summer. Contact the Vice Stick Academic for help with putting a petition together.

Some courses which *are* typically offered in the summer include the engineering math courses (Calc I & II, Linear Algebra, Math 1 & 2), some preliminary year engineering courses (such as Intro. to Thermal Sciences and Statics), CHEM 1300 and many Arts and Management courses suitable for your complementary electives. Note that the Summer Session calendar is released in March. The term is generally divided into Spring and Summer "terms" of 2 months each, with some courses spanning both terms.

Minors

Engineering Student Affairs Office

EITC E1-284
Judy.Schroen-Galinaitis@umanitoba.ca
474-9808

Minors in Business, Arts, Music, Math, and Computer Science are offered to Engineering students. These programs help to broaden your education and increase your prospects for future employment. In order to obtain a minor you must complete 18 credit hours of courses from the given faculty.

Requirements for pursuing a minor include the completion of at least 30 credit hours toward your engineering degree, as well as a CGPA of at least 3.00. There are a limited number of spaces available in the minor programs therefore preference is given to students who are closest to completing their degree.

Visit the Engineering Undergraduate Student Affairs Office for more details on pursuing a minor. Applications for minors must be submitted to this office before the end of May.

*With the approval of the Faculty of Engineering, courses taken to complete minors may also be used to fulfill engineering course requirements.

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Summer Research Opportunities

The following is a list of research topics professors presented in Fall 2016. For more information about specific opportunities we have provided the contact information for the professors.

Dr. David Kuhn

Vascular Hemodynamics and Abdominal Aortic Aneurysm Growth and Rupture.

Dr. Eric Bibeau

Renewable energy, methods to map the renewable intermittent cooling resource and to estimate potential building devices cooling load offsets.

Dr. R. Jayaraman

Intelligent processing of polymer composite structures, durability of composite materials and structures, novel composite material development, interfaces in & joining of composite materials.

Dr. Mark Tachie

Experimental study of turbulent flows, turbulent boundary layers and open channel flows, separated and reattached turbulent flows, turbulent jets.

Dr. Nan Wu,

Better energy generator design by using piezoelectricity, self-powered wireless on-board damage detection system.

Dr. Qingjin Peng,

Sustainable product development, design for assembly and disassembly, VR-based modeling and simulation.

Dr. Scott Ormiston,

Computational Fluid Dynamics, heat exchangers, falling film flow with phase change, single phase flow in tube banks, heat loss from building foundations, two-phase flows, single phase natural and mixed convection.

Dr. Igor Telichev,

Impact Protection, micrometeoroid and orbital debris and protection of satellites, vehicle collision study.

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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.

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Course List

For 4 and 5 year course schedules, stream information and other helpful spreadsheets see 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

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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 (MECH 4310) 4CR
    Topic: Fluid Power Systems
Contemporary Topics in Manufacturing Engineering 1 (MECH 4330) 4CR
    Topic: Fall-Computer Integrated Manufacturing and Automation 1
        Winter-Computer Integrated Manufacturing and Automation 2
Contemporary Topics in Manufacturing Engineering 2 (MECH 4342) 4CR
    Topic: Fall-Systems Engineering
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 (4310 or 4330) 4CR
    Topic: Analysis of Composite and Multifunctional Materials
Topics in Engineering Materials 1 (MECH 4350) 4CR
Topics in Engineering Materials 2 (MECH 4360) 4CR
    Topic: Biomaterials for Medical Applications
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 (MECH 4310) 4CR
Topic: Mechanical Vibration
Contemporary Topics in Mechanical Engineering 2 (MECH 4322) 4CR
Winter Topic: Design of Biomechanical Devices
Contemporary Topics in Mechanical Engineering 2 (MECH 4322) 4CR
Winter Topic: Ground Vehicle Testing Technology
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 (MECH 4162) 6CR- Students should have a 3.0 DGPA or higher
Contemporary Topics in Mechanical Engineering 2 (MECH 4322) 4CR
Fall Topic: Applied Instrumentation
Contemporary Topics in Mechanical Engineering 2 (MECH 4322) 4CR
Fall Topic: Advanced Graphical Communication

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Course Descriptions

SECOND YEAR CORE COURSES DESCRIPTIONS

Applied Chemistry for Engineers (CHEM 1310) 3CR
Thermochemistry, chemical thermodynamics, and chemical kinetics. CHEM 1310 is a prerequisite.

Difficulty: 3.5 **Workload:** 3

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.

* 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

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

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.

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

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

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

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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

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

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

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

Stress Analysis and Design (MECH 3502) 4CR
Strength and stability of columns, torsion of thin-walled members, unsymmetric loading and shear centres, beam deflection and energy methods. MECH 2222 and MATH 2130 are prerequisites.

Difficulty: 3.5 **Workload:** 3.5

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

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

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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. Also, 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

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:** 6

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.

Physics 2: Waves and Modern Physics (PHYS 1070) 3CR
At the heart of modern communications, waves and oscillations are key to understanding the world around us from subatomic scales to biology, traffic flow, the stock market, climate change and the cosmos itself. Learn about the mysterious quantum world, the basis of the latest nanotechnology, where particles are waves and waves are particles. Explore Bohr's model of the atom and discover Heisenberg's Uncertainty Principle. This calculus based course addresses the underlying concepts for all modern science and engineering. This course, like Physics 1 (PHYS 1050), is intended for students considering a program in the physical sciences. Not to be held for credit with PHYS 1071, PHYS 1410, PHYS 1420. Prerequisites:PHYS 1050; and "C" or better in one of MATH 1500 or MATH 1510; Pre or Coreq: one of MATH 1700 or MATH 1710.

Tips: Study the formula sheet and know how to manipulate all the formulas.

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TECHNICAL ELECTIVE COURSES DESCRIPTIONS

Aerospace Option (Choose all 5 courses)

Aerodynamics (MECH 3520) 4CR
Aeronautical definitions, compressible flow, plane normal shock waves, Mach. no. and shock waves in two-dimensional flow, potential flow theory in two-dimensional and axisymmetric flows. Two-dimensional wing theory, finite wing theory panel methods, elements of boundary layer theory. Compressibility and wings, wing design, flow control. MECH 3492 is a prerequisite.

Difficulty: 3.5 **Workload:** 3

Aerospace Structures: Analysis and Design (MECH 4182) 4CR
Methodology and techniques for design of aerospace structures and components to preclude failure with minimum weight, cost and resource consumption. Analysis of structural, air, gust and manoeuvre loads. MECH 3502 is a prerequisite.

Difficulty: 3.5 **Workload:** 3.5

Aerospace Materials and Manufacturing Processes (MECH 4192) 4CR
Properties of aerospace structural materials including glass and graphite fibre composites, light metal alloys and high strength steels. Properties of high temperature materials; superalloys, ceramics, intermetallic compounds, metal matrix composites. Specialized methods for manufacture of these materials. MECH 3542 is a prerequisite.

Difficulty: 3 **Workload:** 3.5

Gas Turbine Propulsion Systems (MECH 4200) 4CR
Gas turbine systems, shaft power cycles, gas turbine propulsion cycles, centrifugal compressors, axial flow compressors, combustion systems, design performance predictions, off-design operations and transient behaviour of gas turbines. Design performance predictions. MECH 2202 and MECH 3520 are prerequisites.

Aircraft Performance, Dynamics, and Design (MECH 4452) 4CR
A study of the morphology of aerospace vehicles; basic components and their functions, Aircraft performance; drag, thrust, lift, basics of orbital mechanics. MECH 3520 is a prerequisite.

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Manufacturing Option (Choose 5)

Robotics & Computer Numerical Control (MECH 3550) 4CR
This course builds up a foundation in the area of Computer Aided Manufacturing (CAM) such as computer numerically controlled machine tools and robotics. Intense hands on experience are provided in the laboratory sessions on part programming using Computer aided design (CAD) packages and robots to demonstrate application in the area of CAM. Several case studies and manufacturing applications will be discussed. MECH 2012 is a prerequisite.

Introduction to Optimization (MECH 3562) 4CR
The objective of this course is to develop the ability to formulate and analyze problems that will be encountered in a manufacturing system. The skills acquired will allow the students to approach problems from an optimization perspective. The students will be provided experience in related software packages. STAT 2220 is a prerequisite.

Manufacturing Automation (MECH 3570) 4CR
This course builds upon the foundation developed in a previous course: namely Robotics and Computer Numerical Control. The course covers a wide variety of topics in the area of computer controlled automation. The students are provided with hands on experience in design for automation. It will synthesize several aspects associated with integrated operation of computer controlled automated devices. MECH 3550 is a prerequisite.

Manufacturing Planning and Quality Control (MECH 3582) 4CR
The course covers topics such as: Group technology, Just-in-Time, Computer aided process planning, Statistical Process Control and Manufacturing Planning and Control. Issues related to the integration of several areas that fall with CIM are emphasized. Systems approach is introduced. MECH 2012 is a prerequisite.

Simulation Modelling and Facilities Planning (MECH 3592) 4CR
The objective of this course is to introduce simulation for manufacturing operations and the concepts of facilities location and layout. The students will learn how to program WITNESS, a simulation language, and through simulation, explore the effects of facility planning; resource availability e.g. machines and quality related problems on manufacturing productivity and timing. MECH 2012 is a prerequisite.

****Design for Manufacturing (MECH 4240) 4CR**
MECH 3542 is a prerequisite.

Contemporary Topics in Manufacturing Engineering 1 (MECH 4310) 4CR
Topic: Fluid Power Systems

Contemporary Topics in Manufacturing Engineering 1 (MECH 4330) 4CR
Topic: Computer Integrated Manufacturing and Automation 1

Topic: Computer Integrated Manufacturing and Automation 2
Prerequisite: MECH 2012. Cannot hold with MECH 3550 or MECH 3570.

Difficulty: 3 **Workload:** 3

Contemporary Topics in Manufacturing Engineering 2 (MECH 4342) 4CR
Topic: Systems Engineering
Pre- or Corequisite: MECH 3170.

Operational Excellence (ENG 4110) 4CR
(Lab required) Methodical application of operational excellence and engineering principles and theory to address real industry problems, with emphasis on the data and fact-based engineering method of problem solving. Grounded in the Plan-Do-Study-Act system. Covers the seven step problem solving method (problem definition, examine the current situation, root cause analysis, action planning and testing, study the results, standardize the changes, and draw conclusions), applied concepts (Lean Six Sigma Management) and the fundamentals of teamwork, team dynamics and change management. It is expected that students will be challenged in terms of their understanding of the method, concepts, analytics, and the tools, and their application to solving 'real' operational problems. Students must attend both lecture and tutorial. Students will be required to attend meetings at industrial partner facilities. May not be held with MECH 4342 where the topic is Operational Excellence. Pre- or Corequisite: STAT 2220 or (STAT 1000 and STAT 2000)

Quality Assurance in Industry (MECH 4780) 4CR

Mechatronics Systems Design (MECH 4900) 4CR
The course covers topics in the analysis of control systems and components with the goal to provide students with tools and an understanding of issues related to integrating mechanical, electronic and software components towards building mechatronic devices.
Hands-on-experience is provided in the laboratory sessions on simulation and actual computer control of various devices. Problems considered would include application to fluid power systems, systems integration and validation. The focus is placed on learning to work with real hardware. MECH 3430 is a prerequisite.

Difficulty: 3.5 **Workload:** 3.5

Manufacturing Process 1 (MECH 4960) 4CR
Topics will be selected from relationship of manufacturing, material selection to design, process improvement techniques; casting of metals and polymers; machining and cutting; polymers and composites; processing of powders, ceramics and glasses. MECH 3542 is a prerequisite.

Manufacturing Process 2 (MECH 4970) 4CR
This course will introduce additional or expanded versions of topics introduced in MECH 4960, "Manufacturing Process 1", and building on course material form MECH 2290. Topics will be

selected from forming or metals; joining processes; rapid manufacturing; micro-electronics processing; surface engineering and fishing systems. Laboratory experience will be obtained on casting and rolling of metals and comparison of mechanical properties of the two routes. MECH 4960 is a prerequisite.

Materials Stream (Choose 3)

Aerospace Materials and Manufacturing Processes (MECH 4192) 4CR
Properties of aerospace structural materials including glass and graphite fibre composites, light metal alloys and high strength steels. Properties of high temperature materials; superalloys ceramics, intermetallic compounds, metal matrix composites. Specialized methods for manufacture of these materials. MECH 3542 is a prerequisite.

Difficulty: 3 **Workload:** 3.5

Contemporary Topics in Mechanical Engineering 1 (MECH 4310) 4CR
Topic: Analysis of Composite and Multifunctional Materials
Topics for this course change each term based on current developments in the field. MECH 3503 is a prerequisite. Past topics include rapid product development and 3D printing.

Difficulty: 3 **Workload:** 3

Topics in Engineering Materials 1 (MECH 4350) 4CR
Topics for this course change each term based on current developments in the field. MECH 3542 is a prerequisite.

Topics in Engineering Materials 2 (MECH 4360) 4CR
Topic: Biomaterials for Medical Applications
Topics for this course change each term based on current developments in the field. MECH 3542 is a prerequisite.

Difficulty: 3.5 **Workload:** 3.5

Corrosion of Metals and Alloys (MECH 4620) 4CR
Electrochemical basis of corrosion, corrosion prevention by cathodic protection, inhibitors, alloying and heat treatment, passivation, stress corrosion cracking, corrosion fatigue; ionic and electronic conduction; oxidation of metals and alloys. Prerequisite: MECH 3542 (or MECH 3540) MECH 3542 is a prerequisite.

Difficulty: 3.5 **Workload:** 3.5

Fracture and Failure of Engineering Materials (MECH 4870)

Thermofluids Stream (Choose 3)

Aerodynamics (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. Prerequisite: MECH 2262 (or the former MECH 2260). Pre- or Co-requisite: MATH 2120. May not hold with the former MECH 3490.

Gas Turbine Propulsion Systems (MECH 4200) 4CR
Gas turbine systems, shaft power cycles, gas turbine propulsion cycles, centrifugal compressors, axial flow compressors, combustion systems, design performance predictions, off-design operations and transient behaviour of gas turbines. Design performance predictions. Prerequisites: MECH 2202 (or MECH 2200) and MECH 3520.

IC Engines (MECH 4292) 4CR
Thermodynamics of internal combustion engine cycles; fuels and lubricants; supercharging; carburetion; valving; manifolding; combustion chamber ignition and fuel injection; engine performance and testing; free piston engines. MECH 2202 is a prerequisite.

Contemporary Topics in Mechanical Engineering 1 (MECH 4310) 4CR
Topic: Principles of Turbomachinery
Prerequisite: MECH 2202 and MECH 3492.

Difficulty: 3 **Workload:** 3

Heating, Ventilation, and Air Conditioning (MECH 4412) 4CR
Psychometric processes, equipment selection, and the design of heating and cooling systems for typical buildings. MECH 2202 is a prerequisite.

Difficulty: 3 **Workload:** 3

Selected Topics in Fluid Mechanics 4M (MECH 4560) 4CR
Topics may include: wind tunnel design; experimental techniques; some exact solutions of the conservation equations; fundamentals of turbulence; secondary flows; fluidization; elementary meteorology; fluidics; other topics of current interest. MECH 3132 and MECH 3492 are prerequisite.

Energy Conversion and Utilization (MECH 4680) 4CR
Energy supply and demand, advanced thermodynamic cycles, conventional energy sources, alternative energy, conservation of energy, environmental considerations. Prerequisite: MECH 2202

Renewable Energy (MECH 4692) 4CR

Introduction to renewable energy systems, current and future global energy issues and the need for renewable energy applications, and distributed renewable energy generation. Renewable energy systems that will be considered are; solar heat, solar PV, biomass heat and power, hydropower, and wind power. Students will develop simple numerical models of renewable energy systems. MECH 2202/2262 is a prerequisite and MECH 3492 is a corequisite.

Advanced Topics in Heat Transfer (MECH 4694) 4CR
Some combination of the following advanced topics; conduction heat transfer radiation, heat-exchanger design, two-phase phenomena, fluidization, alternative energy, energy conservation. Other topics of current interest may also be included. MECH 3460 is a prerequisite.

Design of Thermal Systems (MECH 4702) 4CR
Modeling of thermal systems; system simulation; design applications of optimization methods: Lagrange multipliers, search methods, and dynamic geometric and linear programming. MECH 2202 is a prerequisite.

Numerical Heat Transfer in Fluid Flow (MECH 3822) 4CR
MATH 2120, MATH 3132, MECH 3460 and MECH 3492 are prerequisites.

Solid Mechanics Stream (Choose 3)

Aerospace Structures: Analysis and Design (MECH 4182) 4CR
Methodology and techniques for design of aerospace structures and components to preclude failure with minimum weight, cost and resource consumption. Analysis of structural, air, gust and manoeuvre loads. MECH 3502 is a prerequisite.

Difficulty: 3.5 **Workload:** 3.5

Contemporary Topics in Mechanical Engineering 1 (MECH 4310) 4CR
Topic: Mechanical Vibration
MECH 2202 and 3492 are prerequisites.

Difficulty: 3 **Workload:** 3

Contemporary Topics in Mechanical Engineering 2 (MECH 4322) 4CR
Winter Topic- Design of Biomechanical Devices
A lot of case studies are reviewed and a great opportunity to learn about current developments in the field. Course content depends on the professor. MECH 2202 is prerequisite.

Difficulty: 3 **Workload:** 3

Contemporary Topics in Mechanical Engineering 2 (MECH 4322) 4CR

Winter Topic - Ground Vehicle Testing Technologies
MECH 3420 and 3502 are prerequisites.

Mechanical Vibration (MECH 4470) 4CR

Aircraft Performance, Dynamics, and Design (MECH 4452) 4CR

Fundamentals of Finite Element Analysis (MECH 4510) 4CR
Fundamentals of the Finite Element Method, basic components in a Finite Element procedure, application of FEM to solve engineering problems and use of commercial software. MECH 2120 and 3132 and MECH 2222 are prerequisites.

Advanced Strength of Materials (MECH 4532) 4CR
Stress and strain in three dimensions; thick walled cylinders, beams of elastic foundations, unsymmetrical bending and sheet-stringer construction, curved beams. Additional topics such as the analysis of fibre-composite material, techniques in experimental stress analysis and studies in metallics fatigue may be presented. MECH 3502 is a prerequisite.

Noise Control (MECH 4550) 4CR
An elective course open to all branches of Engineering; a recommended course for students taking Air Conditioning. Wave propagation, transducers and measurement techniques, psycho-acoustic criteria, legislation, techniques of noise and vibration control. MECH 3520 is a prerequisite.

Advanced Mechanical Design (MECH 4672) 4CR
Graphical, analytical and computer techniques for the analysis and design of mechanisms to produce a desired set of motion characteristics; design of linkages, double lever, slider and dwell mechanism; cognate linkages. Kinetic synthesis tasks function generation, path generation and motion generation. MECH 3482 is a prerequisite.

Automotive Engineering (MECH 4812) 4CR
Introduction to the design of passive suspension systems; control of active suspension systems; tire dynamics; ergonomics, safety and crash dynamics; automotive lighting and digital display trains. MECH 3502 is a prerequisite and MECH 3420 is a pre or corequisite

Difficulty: 3 **Workload:** 3

Other Electives

Thesis (MECH 4162) 6CR - Students should have a 3.0 DGPA or higher

This course will give students the opportunity to gain research or design experience in their area of interest. Thesis topics must be approved by the head of the department or designate. Prerequisites: This course is restricted to students in year 4 of Mechanical Engineering. Advisor Approval

Contemporary Topics in Mechanical Engineering 2 (MECH 4322) 4CR
Fall Topic: Applied Instrumentation
Prerequisite: MECH 3430 and MECH 3980.

Contemporary Topics in Mechanical Engineering 2 (MECH 4322) 4CR
Fall Topic: Advanced Graphical Communication
Prerequisite: MECH 2012.

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Glossary

These are a few terms that may be helpful to know throughout your studies in our faculty.

- **APEGM:** The Association of Professional Engineers and Geoscientists of Manitoba. This organization governs the work of all Professional Engineers and Geoscientists in Manitoba.
- **CFES:** The Canadian Federation of Engineering Students (which includes U of M). This national organization provides a diverse range of services as they work to support a number of Canadian Engineering schools.
- **Co-Requisite:** Refers to a course which must be taken concurrently with another course.
- **EngO:** The U of M's Engineering Orientation, also known as the two funnest days of the year. Be sure to attend on September 8th and 9th!
- **Frosh:** Refers to a first-year student.
- **HIRED:** Helping Industry Reach Engineers Directly. These sessions are held every Monday evening and provide students the opportunity to interact with industry (there's free pizza!).
- **Lab:** Refers to the portion of a course involving hands-on experiments. Most labs also require the submission of an individual or group report.
- **Midterm:** Most courses include one or two midterm exams which cover a selected portion of the course content. Although they come up quickly, midterms serve as an effective tool to keep updated with course material.
- **Prerequisite:** Refers to a course which must be completed prior to registration for another course.
- **TA:** Teaching Assistant. TAs will usually be available to students during labs/tutorials and can be very helpful in answering questions.
- **Technical Societies:** Also called "Tech Socs", this term refers to the many engineering student groups associated with UMES. Tech Soc lounges are located on the fifth floor of E1.
- **The Window:** Opens onto the Engineering Atrium and is a great resource for all engineering students. Stop by The Window to purchase snacks, UMES merchandise and event tickets or to simply ask questions.
- **Tutorial:** Refers to the portion of a course involving practice problems. Some tutorials require these questions be submitted while others do not.
- **UMES:** The University of Manitoba Engineering Society. Refers to the faculty student council which coordinates many important events and services.
- **WESST:** The Western Engineering Students' Societies Team (which includes U of M). WESST provides a diverse range of services to its 10 Western Canadian member schools.