# MECH
# Handbook 2022 - 2023

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 | (MECH 2150) | 4CR |
| Computer Aided Design and Manufacturing Processes | (MECH 2112) | 5CR |
| 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 3492) | 4CR |
| Stress Analysis and Design | (MECH 3502) | 4CR |
| Engineering Materials 2 | (MECH 3542) | 4CR |
| Machine Design 4M | (MECH 3652) | 4CR |
| Mechanical Laboratory in Solid Mechanics | (MECH 3982) | 2CR |
| Mechanical Laboratory in Thermofluids | (MECH 3992) | 2CR |

| Fourth Year Courses | | |
|---|---|---|
| Engineering Economics | (ENG 3000) | 3CR |
| Technology, Society, and the Future | (ENG 3020) | 3CR |
| Elements of Electric Machines and Digital Systems | (ECE 3010) | 4CR |
| Engineering Design | (MECH 4860) | 5CR |
| Physics 2: Waves and Modern Physics | (PHYS 1070) | 3CR |

| Technical Elective Courses Descriptions | | |
|---|---|---|
| **AEROSPACE OPTION (Choose 3 in List A and 2 from List B)** | | |
| **LIST A** | | |
| Aerodynamics | (MECH 3520) | 4CR |
| Aerospace Structures: Analysis and Design | (MECH 4182) | 4CR |
| Aerospace Materials and Manufacturing Processes | (MECH 4192) | 4CR |
| **LIST B** | | |
| Manufacturing Planning and Quality Control | (MECH 3582) | 4CR |
| Gas Turbine Propulsion Systems | (MECH 4200) | 4CR |
| Aircraft Performance, Dynamics, and Design | (MECH 4452) | 4CR |
| Systems Engineering(with permission) | (MECH 4432) | 4CR |
| Applied Aerospace Instrumentation | (MECH 4482) | 4CR |
| Operational Excellence(with permission) | (ENG 4110) | 4CR |
| **AEROSPACE STREAM (Choose 3)** | | |
| 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 |
| Contemporary Topics in Manufacturing Engineering 1<br>Topic: Fluid Power Systems | (MECH 4330) | 4CR |
| Contemporary Topics in Manufacturing Engineering 1<br>Topic: **Fall** Computer Integrated Manufacturing and Automation 1; **Winter** Computer Integrated Manufacturing and Automation 2 | (MECH 4330) | 4CR |
| Contemporary Topics in Manufacturing Engineering 2<br>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<br>Topic: Analysis of Composite and Multifunctional Materials | (MECH 4310) | 4CR |

| | | |
|---|---|---|
| Topics in Engineering Materials 1 | (MECH 4350) | 4CR |
| Topics in Engineering Materials 2<br>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 3520) | 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 |
| Principles of Turbomachinery | (MECH 4542) | 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 4822) | 4CR |
| **SOLID MECHANICS STREAM (Choose 3)** | | |
| Aerospace Structures: Analysis and Design | (MECH 4182) | 4CR |
| Contemporary Topics in Mechanical Engineering 1 | (MECH 4330) | 4CR |

| | | |
|---|---|---|
| Topic: Mechanical Vibration | | |
| Contemporary Topics in Mechanical Engineering 2<br>Winter Topic: Design of Biomechanical Devices | (MECH 4322) | 4CR |
| Contemporary Topics in Mechanical Engineering 2<br>Winter Topic: Ground Vehicle Testing Technology | (MECH 4322) | 4CR |
| Fundamentals of Finite Element Analysis | (MECH 4510) | 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 GPA or higher | (MECH 4162) | 6CR |
| Contemporary Topics in Mechanical Engineering 2<br>Fall Topic: Applied Instrumentation | (MECH 4322) | 4CR |
| Contemporary Topics in Mechanical Engineering 2<br>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. Pre-requisites: 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 (MECH 2150) 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

## Computer Aided Design and Manufacturing Processes (MECH 2112) 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 (ENG 3000) 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 (ENG 3020) 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

## 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.

**Difficulty:** 4 **Workload:** 1.5

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

# TECHNICAL ELECTIVE COURSES DESCRIPTIONS

For Aerospace Stream, the same courses are available as Aerospace option. Choose 3 from the below. For the courses available in Aerospace option and stream, check the table above.

## *Aerospace Option (Choose all 3 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: 4.5**

**Tips:** The problem sets all contain MATLAB portions so start them early and don't be afraid to ask Dr. Ferguson for help. Also make sure you attend the tutorials as he will walk through the solutions step-by-step.

### 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 maneuver loads. MECH 3502 is a prerequisite.

**Difficulty: 4 Workload:** 3

**Tips:** Not Available

### 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: 2.5 Workload:** 3

**Tips:** Attend class because most of the learning is done there. There is minimal homework for this course and the content is relatively straightforward.

## 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.

**Difficulty:** 4 **Workload: 4**

**Tips:** The final project is very challenging. Start early!

## 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.

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

**Tips:** Not Available

## Applied Aerospace Instrumentation (MECH 4482) 4CR

This course will introduce you to the design and deployment of measurement systems. You will be exposed to all elements of the measurement chain – from sensors, to signal conditioning, to data display. MECH 3430, 3982, 3992 is a prerequisite.

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

**Tips:** Not Available

## *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.

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

**Tips:** Not Available

### 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.

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

**Tips:** Not Available

## 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.

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

**Tips:** Not Available

## 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.

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

**Tips:** Not Available

## 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.

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

**Tips:** Not Available

****Design for Manufacturing (MECH 4240) 4CR**

MECH 3542 is a prerequisite.

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

**Tips:** Not Available

**Contemporary Topics in Manufacturing Engineering 1 (MECH 4310) 4CR**

***Topic: Fluid Power Systems***

(Lab required) This course will cover contemporary topics in Mechanical Engineering. The specific topics and a detailed outline will be available at the time of registration prior to the start of the registration prior to the start of the registration period for the session in which the course will be offered. Prerequisite: Permission of the department.

**Difficulty:** 3 **Workload: 1**

**Tips:** The material is a lot easier if you keep up with the practice problems and can follow along during class.

**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

**Tips:** Not Available

**Contemporary Topics in Manufacturing Engineering 2 (MECH 4342) 4CR**

***Topic: Systems Engineering***

Pre- or Corequisite: MECH 3170.

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

**Tips:** Not Available

## 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)

**Difficulty:** Not Available **Workload:** 5

**Tips:** Not Available

## Quality Assurance in Industry (MECH 4780) 4CR

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

**Tips:** Not Available

## 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

**Tips:** Not Available

## Manufacturing Process 1 (MECH 4960) 4CR

Topics will be selected from the 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.

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

**Tips:** Not Available

## 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; microelectronics 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.

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

## *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

**Tips:** Not Available

### 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

**Tips:** Not Available

### 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.

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

**Tips:** Not Available

## 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

**Tips:** Not Available

## 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

**Tips:** Not Available

## Fracture and Failure of Engineering Materials (MECH 4870)

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

**Tips:** Not Available

## *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.

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

**Tips:** Not Available

### 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.

**Difficulty:** 4 **Workload:** 5

**Tips:** Not Available

### 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.

**Difficulty:** **Workload:**

**Tips:** Not Available

## Contemporary Topics in Mechanical Engineering 1 (MECH 4310) 4CR

***Topic: Principles of Turbomachinery***

Prerequisite: MECH 2202 and MECH 3492.

**Difficulty:** 3 **Workload:** 3

**Tips:** Not Available

## 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

**Tips:** Not Available

## 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 prerequisites.

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

**Tips:** Not Available

## 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

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

**Tips:** Not Available

## 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.

**Difficulty:** 4 **Workload:** 4

**Tips:** Not Available

## 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.

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

**Tips:** Not Available

## 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.

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

**Tips:** Not Available

### Numerical Heat Transfer in Fluid Flow (MECH 3822) 4CR

MATH 2120, MATH 3132, MECH 3460 and MECH 3492 are prerequisites.

**Difficulty:** 4 **Workload: 5**

**Tips:** The assignments and project are very time consuming so start early. Exams are open book so it's worth it to buy the Instructor's notes from the bookstore. Try to find a few friends in the class to help each other through assignments

## *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 maneuver loads. MECH 3502 is a prerequisite.

**Difficulty:** 3.5 **Workload:** 3.5

**Tips:** Not Available

### Contemporary Topics in Mechanical Engineering 1 (MECH 4310) 4CR

***Topic: Mechanical Vibration***

MECH 2202 and 3492 are prerequisites.

**Difficulty:** 3 **Workload:** 3

**Tips:** Not Available

## 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 a prerequisite.

**Difficulty:** 2.5 **Workload:** 2.5

**Tips:** Pay attention during lectures because some of the case studies will end up on the final.

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

***Winter Topic - Ground Vehicle Testing Technologies***

MECH 3420 and 3502 are prerequisites.

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

**Tips:** Not Available

## Mechanical Vibration (MECH 4470) 4CR

Not Available

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

**Tips:**

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

Not Available

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

**Tips:** Not Available

## 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.

**Difficulty:** 4 **Workload:** 3

**Tips:** Not Available

## 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.

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

**Tips:** Not Available

## 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.

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

**Tips:** Not Available

### 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.

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

**Tips:** Not Available

### 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

**Tips:** Not Available

## *Other Electives*

### Thesis (MECH 4162) 6CR - Students should have a 3.0 GPA 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

**Difficulty:** 4.5 **Workload:** 3.5

**Tips:** Not Available

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

***Fall Topic: Applied Instrumentation***

Prerequisite: MECH 3430 and MECH 3980.

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

**Tips:** Not Available

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

***Fall Topic: Advanced Graphical Communication***

Prerequisite: MECH 2012.

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

**Tips:** Not Available

# Summer Research Opportunities

*For general information about research in the mechanical department, please visit:*
http://umanitoba.ca/faculties/engineering/departments/mechanical/research/index.html

The following is a list of research topics professors presented in Summer 2023. For more information about specific opportunities we have provided the contact information for the professors.

Dr. Subramaniam Balakrishnan,

Computer Assisted Industrial Engineering, Computer Integrated Manufacturing, Robotics

Dr. Madjid Birouk,

Combustion of fuels and bio-fuels, fuel nozzles, droplets gasification, swirling flows

Dr. David Kuhn,

Multiphase flow in complex geometries, modelling of abdominal aortic aneurysms

Dr. Eric Bibeau,

Kinetic turbines, biomass, wind turbine icing, plug-in electric vehicles, district Energy Systems

Dr. Philip Ferguson,

Satellite, Attitude Control, Navigation, Space Objects, Composites, Reaction Wheels, Drones, Simulation, Orbit Control

Dr. Vijay Chatoorgoon

Aerospace Engineering, Acoustic Wave Propagation, Supercritical Flow Stability

Dr. R. Jayaraman,

Polymer and Composite Processing, Durability & Interfaces in Polymers and Composites, Novel Composite Materials

Dr. Mark Tachie,

Experimental Fluid Dynamics, Turbulent Flows Over Rough Surfaces, Laser Doppler Velocimetry, Particle Image Velocimetry

Dr. Qingjin Peng,

Virtual manufacturing, Sustainable product, Modeling and simulation, Product adaptability

# Academic/Counselling Student Resources

If you're ever stuck on a class, need help on a certain section, or just want clarity, UMES offers a paid tutoring service! This service offers students a chance to learn from real students who have taken the class already and received a high grade in the class.

Mobile Application name: Nimbus
Available on Google play, Apple store, and web browser.

Please contact vsa@umes.mb.ca for any inquiries or concerns.

Additionally, if you would like to sign up as a tutor and get **paid**, you can do so by emailing vsa@umes.mb.ca or the application as well! Just go to the link from the following QR code to sign up.

Nimbus Learning

As university students, we know that times can be stressful, that is why UMES alongside UMSU has outlined and provided the following resources that students can use to help support the mental and physical strain long academic terms can cause to an individual. If you ever feel the need to use one of these resources follow the respective link or QR code below.

| | |
|---|---|
| **Student Counselling Center** | https://umanitoba.ca/student-supports/counselling-resources-students |
| **Health and Wellness Services** | https://umanitoba.ca/student-supports/student-health-and-wellness |
| **Province of Manitoba Virtual Therapy Program** | https://www.gov.mb.ca/covid19/bewell/virtualtherapy.html |

**For 24/7 Help:**

| | | |
|---|---|---|
| **Empower Me (free for U of M students)** | https://studentcare.ca/rte/en/IHaveAPlan_UniversityofManitoba_EmpowerMe_EmpowerMe<br><br>1-833-628-5589 | |
| **Klinic Crisis Support** | http://klinic.mb.ca/crisis-support/<br>(204) 786-8686 | |
| **Manitoba Suicide Prevention & Support Line** | Student Counselling Centre (SCC) \| University of Manitoba (umanitoba.ca)<br>1-877-435-7170 | |

## For any other inquiries related to the department, feel free to contact:

- Vice Stick Academic: email: vsa@umes.mb.ca
  - Kassem Harb

- Academic Advocacy Directorship: email: advocacy@umes.mb.ca
  - Rhyz Abella (Director)
  - Ashly Shalu
  - Smit Shah
  - Pankitjot Singh

- UMES Office: **E2-292 EITC**

# 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.

# Helpful Links

UMES Website: http://umes.mb.ca/
Important Dates and Deadlines: http://umanitoba.ca/student/records/deadlines/
Mechanical Department Homepage:
http://umanitoba.ca/faculties/engineering/departments/mechanical/index.html

Undergraduate Program Requirements:

https://umanitoba.ca/faculties/engineering/departments/mechanical/undergrad/mechprogcrs.html


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