Mechanical Engineering

Welcome to Options Night!

2024

Options Night

Tips

‘Unique’ Courses

Structure of Streams

- **Manufacturing**
- **Thermofluids & Energy Systems**
- **Smart Systems**
- **Mechanics & Design**

4M06 Project Planning

Graduate Studies

Options Night

Tips:

1. Check resources-undergrad-course info on mechanical website
   - Look at this year's course outlines!

2. Plan your entire year (and have a backup)

   -> don't sign up for winter courses in December!

3. Make sure you meet your graduation requirements (Advisement Report)

Options Night

Approved technical electives ~ 30

- grouped together based on technical area

Concept of “Streams”

- General Stream
- Mechanics and Design
- Manufacturing
- Smart Systems
- Thermofluids and Energy Systems

Just a grouping of courses. You don’t ‘register’ for a stream.

Which stream should I choose?

It all depends on what you enjoy the most!

The main objective of today is to *inform you*; and to answer any questions you may have.

NOTE: Your degree will NOT state a stream on it.
So, pick courses that INTEREST you, not that you feel obligated to take.

Streams

Note: # will depend on your program!

General: five of any approved technical electives

Mechanics and Design: two approved technical electives; plus three of CHEMENG 4T03, MATLS 4MS4, 4T03, MECHENG 4B03, 4BB3, 4BF3, 4CC3, 4E03, 4H03, 4I03, 4K03, 4N03, 4T03, 4X04, 4Y03, 4Z03, ENGINEER 4EX3

Manufacturing: two approved technical electives; plus three of CHEMENG 4X03, MATLS 3MF3, 4MS4, 4T03, MECHENG 4B03, 4C03, 4D03, 4DD3, 4E03, 4H03, 4K03, 4N03, 4T03, 4X04, 4Y03, 4Z03

Smart Systems: two approved technical electives; plus three of: MECHENG 4AI3, 4FM3, 4H03, 4I03, 4K03, 4SS3, 4X04, SMRTTECH 4ID3, 4AI3, PROCTECH 4MH3, SFWRTECH 4DA3, 4ES3, ENGTECH 4AI3

Thermofluids and Energy Systems: two approved technical electives; plus MECHENG 4S03; plus two of CHEMENG 4X03, ENGPHYS 3D03, 3SP3, 4D03, 4NE3, 4P03, MECHENG 4AA3, 4BF3, 4ES3, 4FM3, 4I03, 4J03, 4N03, 4O04, 4T03, 4U03, 4W03, 4X04, 4Y03

Approved Technical Electives: any of the required program option courses listed above, plus CIVENG 3K03, COMMERCE 4QA3, ELECENG 3N03

Electives

- CHEM ENG 4T03 Applications of Chemical Engineering in Medicine, 2nd term
- CHEM ENG 4X03: Polymer Processing, 1st term
- CIV ENG 3K03: Introduction to Transportation Engineering, 1st term
- COMMERCE 4QA3: Operations Modelling and Analysis, 1st or 2nd term
- ELECENG 3N03: Electronics and Instrumentation, 2nd term
- ENGINEER 4EX3: Experiential Engineering Design, both terms
- MATLS 3MF3: Materials Fabrication, 2nd term
- MATLS 4MS4: Materials Selection in Design and Manufacturing, 1st term
- MATLS 4T03: Properties and Processing of Composites, 2nd term
- ENG PHYS 3D03: Principles of Nuclear Engineering, 2nd term
- ENG PHYS 3SP3: Space Systems Engineering
- ENG PHYS 4D03: Nuclear Reactor Analysis, 1st term (Note: pre-req. is ENG PHYS 3D03)
- ENG PHYS 4NE3: Advanced Nuclear Engineering, 2nd term (Note: pre-req. is ENG PHYS 3D03)
- ENG PHYS 4P03: Nuclear Power Plant Systems & Operations, 2nd term
- SMRTTECH 4ID3: IoT Devices and Networks, 2nd term
- SMRTTECH 4AI3: Artificial Intelligence and Machine Learning, 1st term
- PROCTECH 4MH3: Machine Health & Remote Monitoring, 1st term
- SFWRTECH 4DA3: Data analytics and Big Data, virtual
- SFWRTECH 4ES3: Real-Time Systems, virtual

- ME 4AA3: Aerodynamics, 2nd term (Dr. Tullis)
- ME 4AI3: Applied Artificial Intelligence, 2nd term (Dr. Ahmed)
- ME 4B03: Topics in Product Development, 1st term (Dr. Hassan)
- ME 4BB3: Biomechanics, 1st term (Dr. Wohl)
- ME 4BF3: Biofluid Mechanics Systems (Dr. Motamed) (n/a in 2024-25)
- ME 4CC3: Experimental and Computational Biomechanics, 2nd term (Dr. Quenneville)
- ME 4D03: Manufacturing Processes (Metal Removal), 2nd term (Dr. Koshy)
- ME 4DD3: Introduction to Surface Engineering in Manufacturing, 2nd term (Dr. Aramesh)
- ME 4ES3: Energy Storage, 2nd term (Dr. Trowell)
- ME 4FM3: Advanced Instrumentation and Sensing for Fluid Mechanics, 2nd term (Dr. Morton)
- ME 4H03: Mechatronics, 2nd term (Dr. Bone)
- ME 4I03: Noise Analysis and Control, 1st term (TBD)
- ME 4J03: Intro to Computational Fluid Dynamics & Heat Transfer (Dr. Hamed) (n/a in 24-25)
- ME 4K03: Robotics, 1st term (Dr. Yan)
- ME 4N03: NanoBio Engineering (Dr. Didar) (n/a in 2024-25)
- ME 4O04: Sustainable Energy Systems, 2nd term (Dr. Cotton)
- ME 4SS3: Smart Systems, 1st term (Dr. Gadsden)
- ME 4S03: Incompressible flow, 1st term (Dr. Salaudeen)
- ME 4T03: Finite Element Applications, 1st term & 2nd term (Dr. Wu)
- ME 4U03: Compressible Flow and Turbomachinery, 1st term (Dr. Tullis)
- ME 4W03: Air Conditioning and Refrigeration Systems, 2nd term (Dr. Shankar)
- ME 4X04: Independent Research Project, both terms
- ME 4Y03: Internal Combustion Engines, 1st term (Dr. Yan)
- ME 4Z03: Computer Aided Design, 2nd term (TBD)

Some Unique Courses

- MME 4490: Engineering in Global Context: Advanced Manufacturing
  - Through Western U, held at Karlsruhe Institute of Technology, Germany
  - Topics: automated manufacturing systems, machining of fiber reinforced composites, modeling and simulation in mech eng, manufacturing of composite parts for automotive applications, functional composite films, thin film manufacturing
  - Runs in May of each year (take prior to final year, register in Feb)
  - Includes things like trip to Mercedes plant, Porsche Museum
  - Contact me for more info

Some Unique Courses

- MECHENG 4X04: Independent Project
  - A fun opportunity to get in depth experience in your area of interest
  - Good prep if you're considering a Master's
  - Recommended GPA of 9.5, need to secure a supervisor (any area of interest!)
  - Available through all streams, full year course
  - Evaluated based on two presentations and reports
  - Contact me for more info

- ENGINEER 4EX3: Experiential Engineering Design
  - For members of clubs/teams, full year course
  - Contact Dr Hassan for more info

Manufacturing

Dr. Maryam Aramesh

Manufacturing

Areas of Application

- Consumer Products
- Automotive
- Aerospace
- Electronics
- Pharmaceuticals and medical devices
- Materials development

Manufacturing

Typical Roles (Examples)

- Quality Engineer/Quality manager
- Production manager
- Project manager
- Process developer
- Supply chain professional
- Maintenance technician
- ... the list goes on …

Manufacturing

1) Electives – choose 3 of the following:

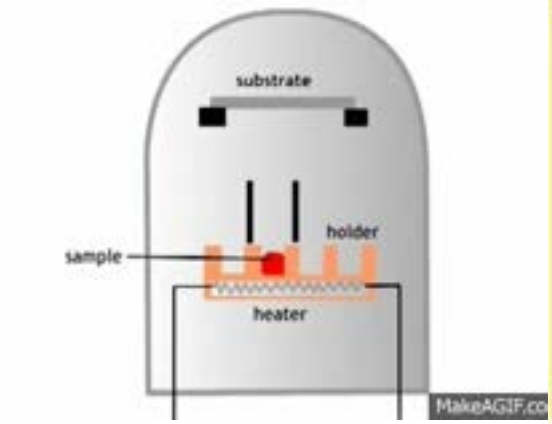
- MATLS 3MF3: Materials Fabrication, 2nd term
- MATLS 4MS4: Materials Selection in Design and Manufacturing, 1st term
- CHEM ENG 4X03: Polymer Processing, 1st term
- MATLS 4T03: Properties and Processing of Composites, 2nd term
- ME 4B03: Product Development, 1st term (Dr. Hassan)
- ME 4D03: Manufacturing Processes (Metal Removal), 2nd term (Dr. Koshy)
- ME 4DD3: Introduction to Surface Engineering in Manufacturing, 2nd term (Dr. Aramesh)
- ME 4H03: Mechatronics, 2nd term (Dr. Bone)
- ME 4K03: Robotics, 1st term (Dr. Yan)
- ME 4N03: NanoBio Engineering, 1st term (Dr. Didar) (n/a in 2024-25)
- ME 4T03: Finite Element Applications, 1st & 2nd term (Dr. Wu)
- ME 4Z03: Computer Aided Design, 2nd term (TBD)
- ME 4X04: Independent Project, both terms

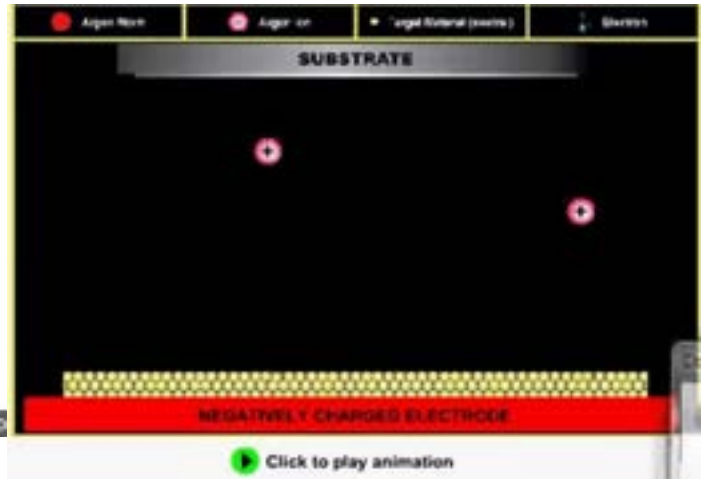
2) Plus 2 courses from the "full" list

ME 4DD3: Introduction to Surface Engineering in Manufacturing

Fundamentals of tribology and surface engineering in manufacturing

- **Surface engineering techniques**
- **Physical Vapour Deposition (PVD) Techniques for machining thin coatings**
- **Surface Engineering in Machining Operations**

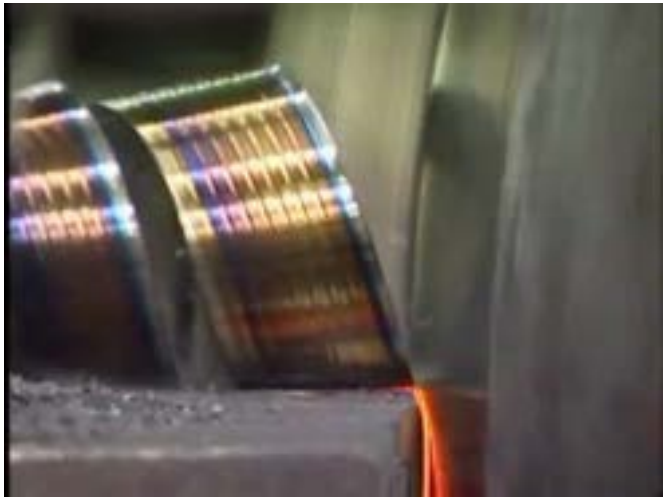


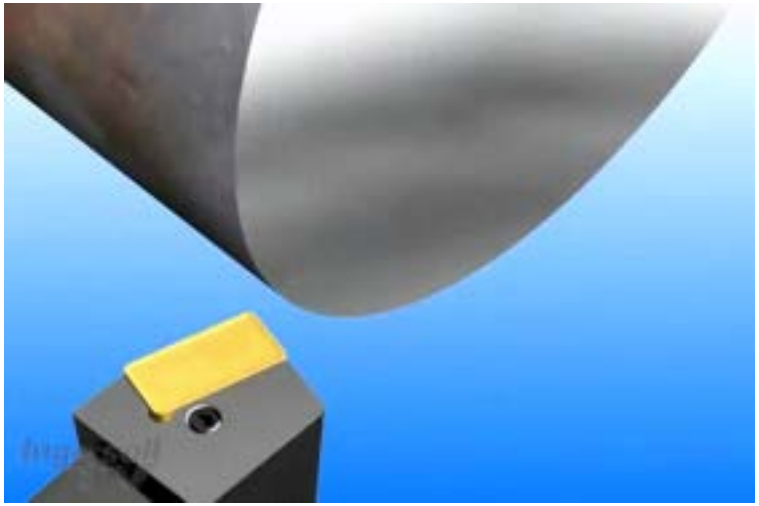


ME 4D03: Manufacturing Processes (Metal Removal)

Fundamentals of metal removing processes

- **Mechanics and tribological aspects of material removal**
- **Application of theory to practice of machining processes such as turning, milling, drilling and grinding**

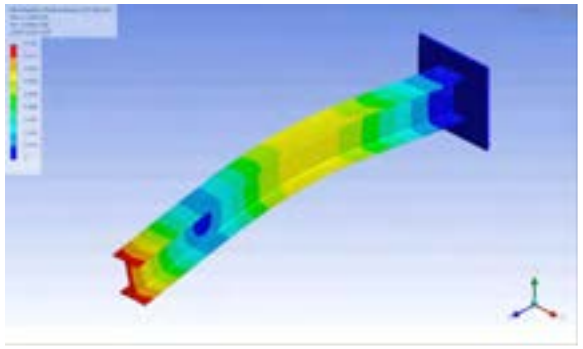


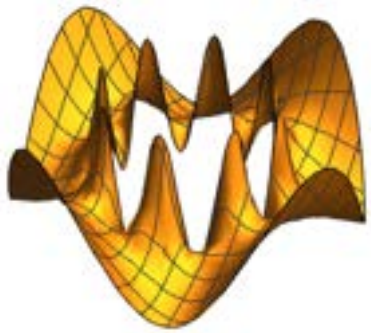


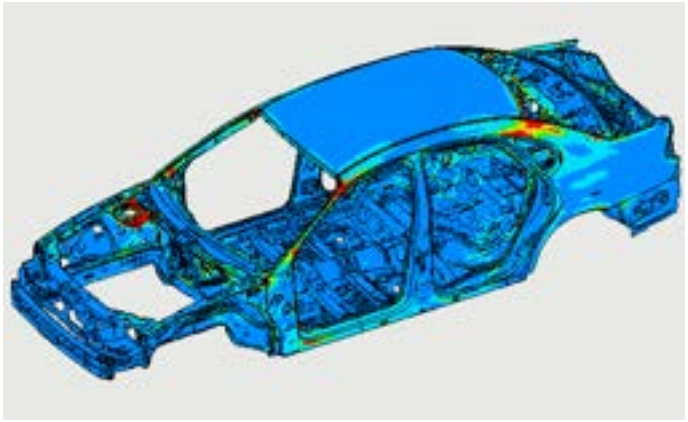
ME 4T03: Finite Element Applications

Fundamental understanding of the theory and applications of finite element methods for mechanical systems

- **Theoretical knowledge**
- **Proficiency in using a commercial finite element package (ANSYS)**



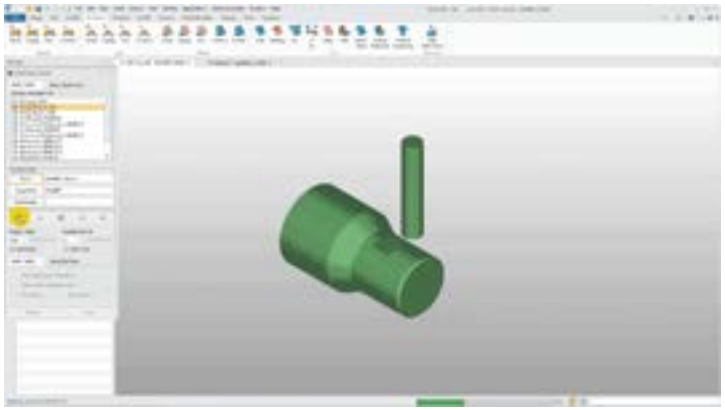


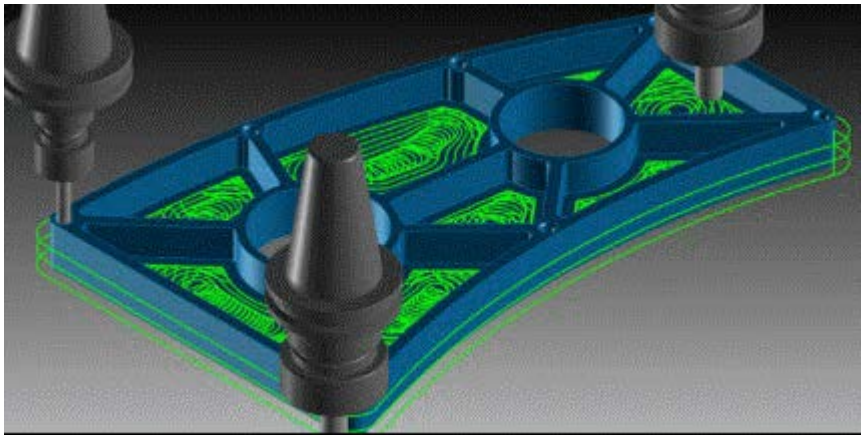


ME 4Z03: Computer Aided Design

Fundamental topics in CAD/CAM, including solid modeling, assemblies, mechanism simulation, CNC machining, additive manufacturing…

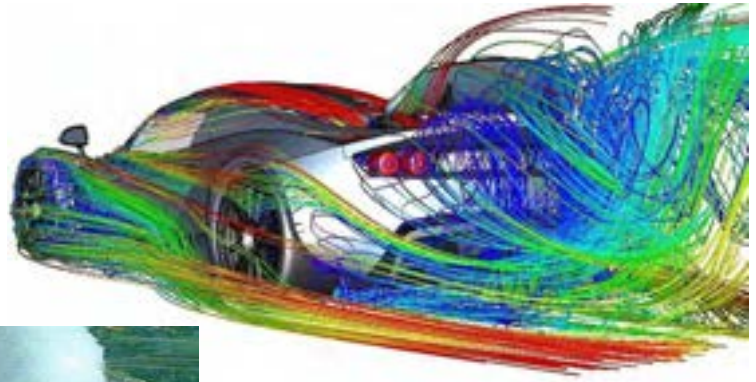
- **Drawing**
- **Creating, editing, and modifying features**
- **Basic geometric & surface modelling**
- **Basic simulation using Finite Element Analysis**
- **G-Code generation & interpretation**





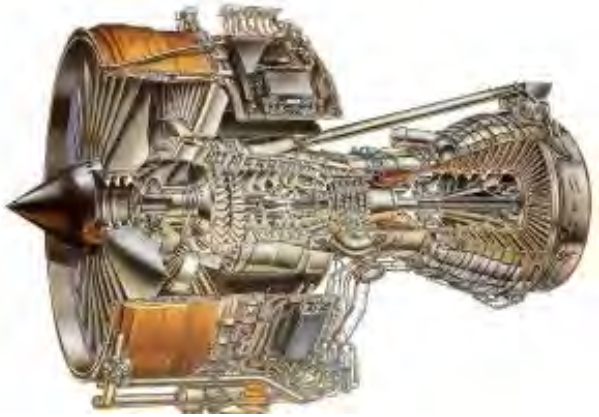
Fluids and Energy Systems

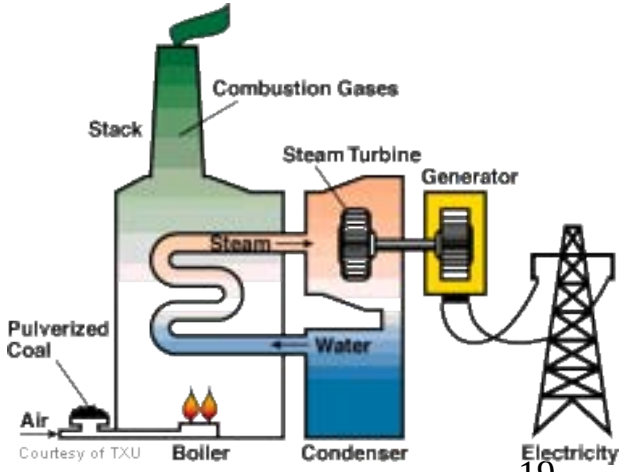
Dr. Stephen Tullis



Applications

- Automotive
- Aerospace
- Turbines, compressors, pumps
- Nuclear
- Power generation (hydro, gas, wind …)
- Propulsion systems for aircraft and rockets
- Combustion systems
- Thermal processing systems

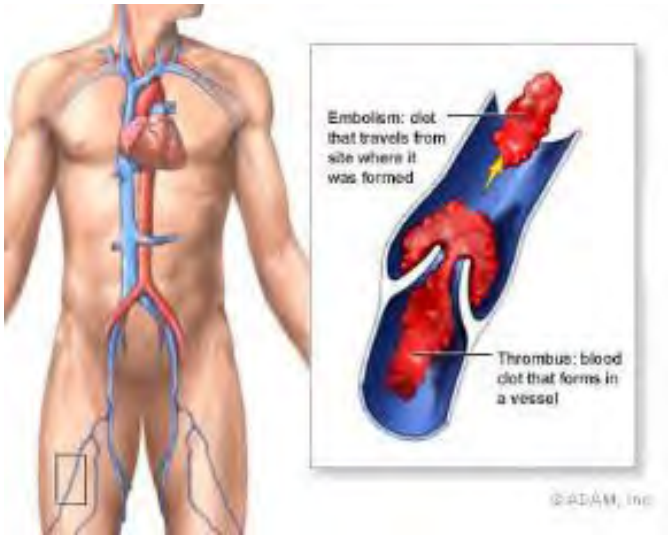


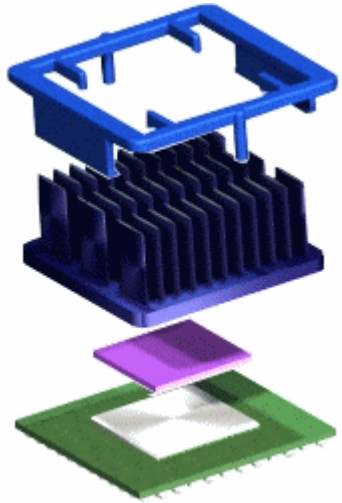


Applications

- Electronics cooling
- Heating, Ventilation and Air Conditioning (HVAC)
- Refrigeration systems
- Alternative energy systems
- Biomedical applications

15 ton outdoor chiller





Courses

1) Required Course

Course	Description	Term	Instructor
ME 4S03	Incompressible flow	1	Dr. Salaudeen

2) Electives – choose 2 of the following:

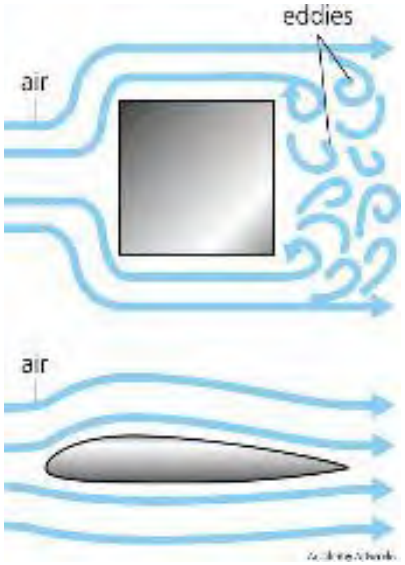
Course	Name	Term	Instructor
MechEng 4AA3	Aerodynamics	2	Tullis
4ES3	Energy storage systems	2	Trowell
4FM3	Advanced sensing & instrumentation in fluids	2	Morton
4I03	Noise analysis & control	1	TBD
4O04	Sustainable energy systems	2	Cotton
4T03	FEA	1&2	Wu
4U03	Compressible flow & turbomachinery	1	Tullis
4W03	Air conditioning & refrigeration systems	2	Shankar
4Y03	Internal combustion engines	1	Yan
4X04	Research project	both	choice
ChemEng 4X03	Polymer processing	2	
EngPhys 3D03	Principals of nuclear engineering	2	
4D03	Nuclear reactor analysis	1	
4NE3	Advanced nuclear engineering	2	
4P03	Nuclear power plant systems & ops	2	

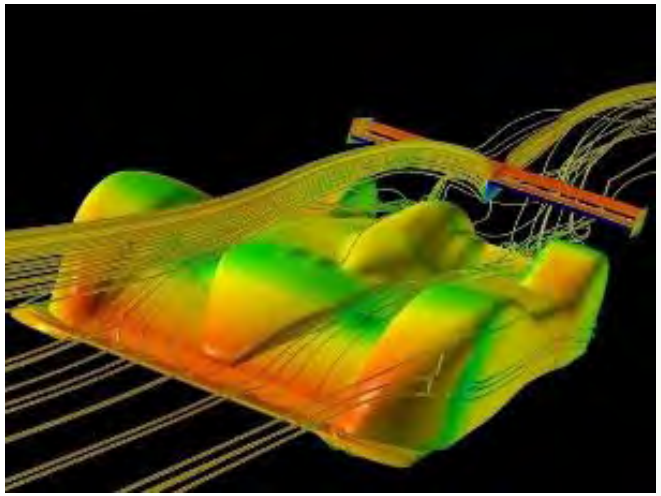
3) Plus 2 courses from the “full” list (which includes the above)

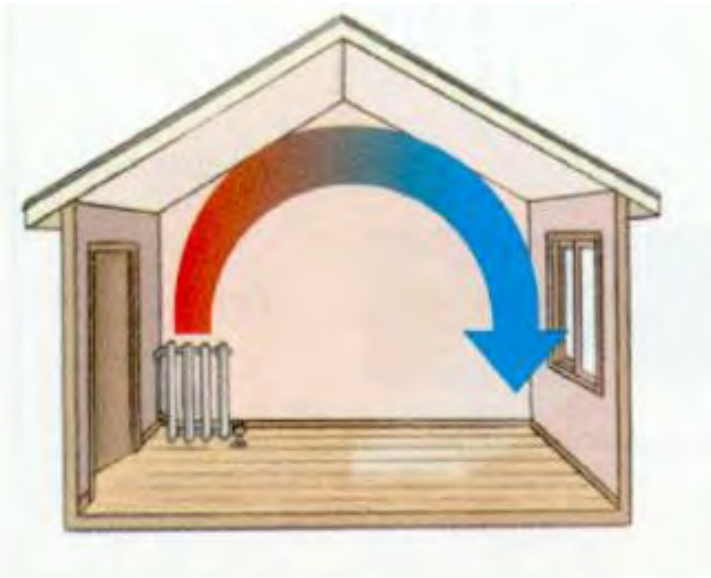
ME 4S03: Incompressible Flow

Internal and external laminar and turbulent flows

- **Turbulent boundary layers**
- **Convective heat transfer**
- **Intro to aerodynamics**



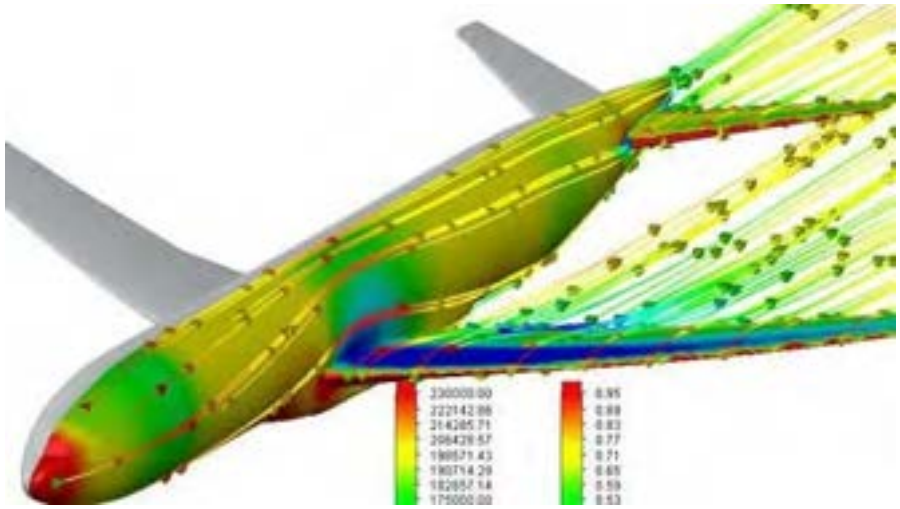


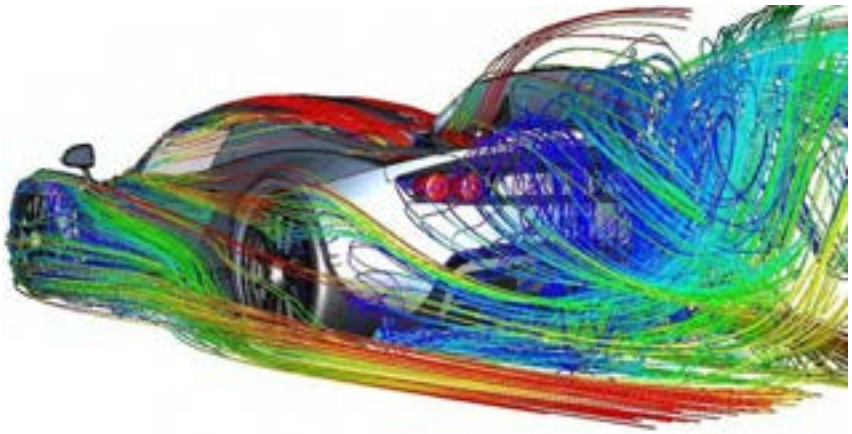


ME 4AA3: Aerodynamics

Airfoil and wing aerodynamics, application to aircraft (and some automotive)

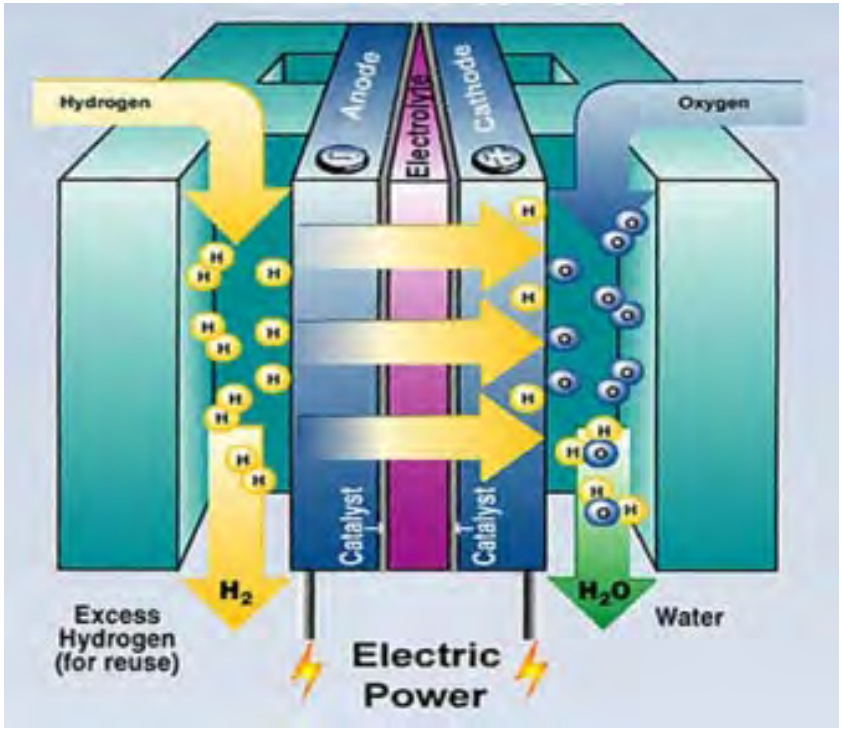
- **Airfoil & wing aerodynamics**
- **Aircraft performance**
- **Flight dynamics**
- **Aircraft stability and aeroelasticity**
- **Car and building (wind) aerodynamics**

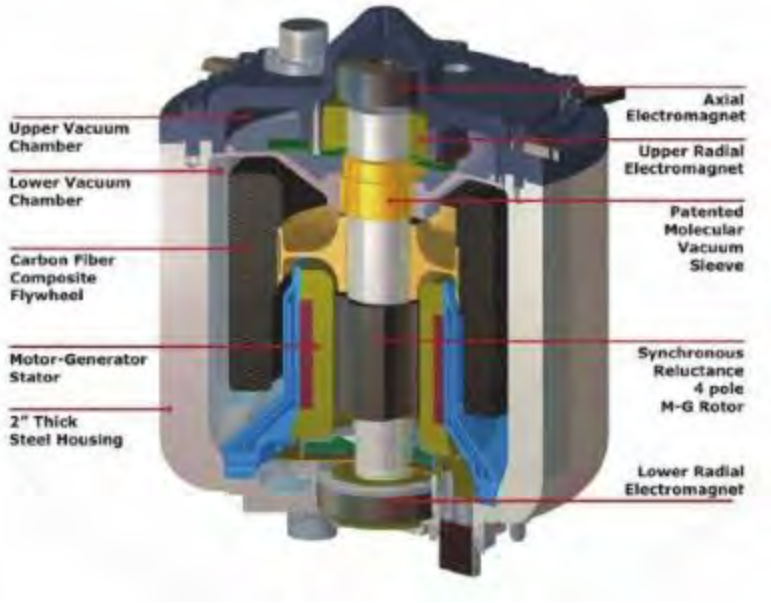




ME 4ES3: Energy storage

- *mechanical, thermal, electrochemical, and chemical energy storage*
- *kinetic & potential energy*
- *electrochemical batteries & supercapacitors*
- *fuels: hydrogen, biomass*



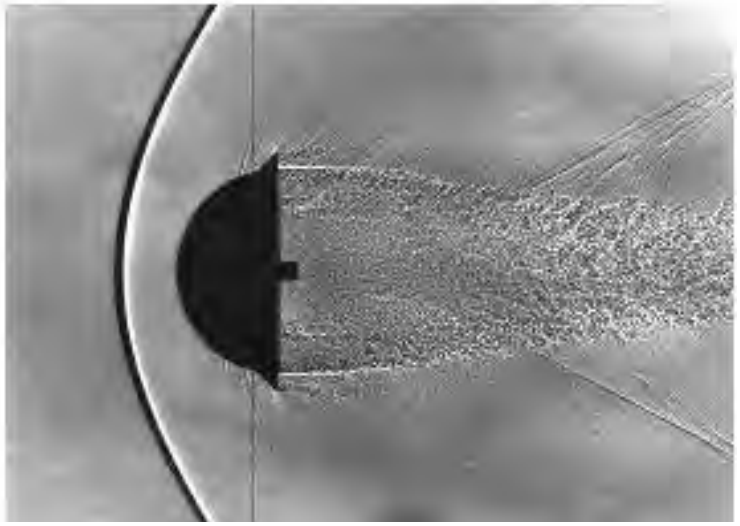


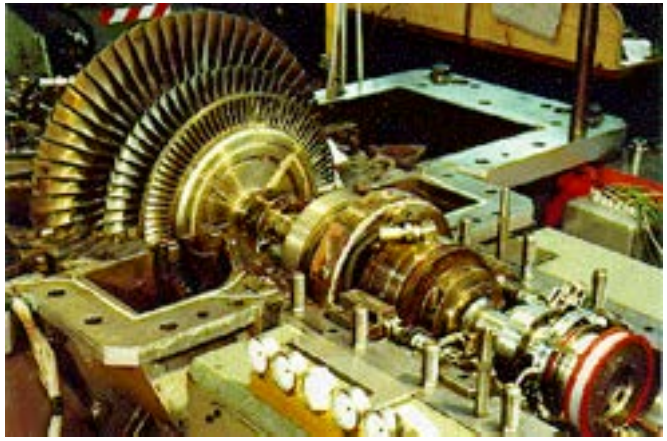
ME 4O04: Sustainable energy systems

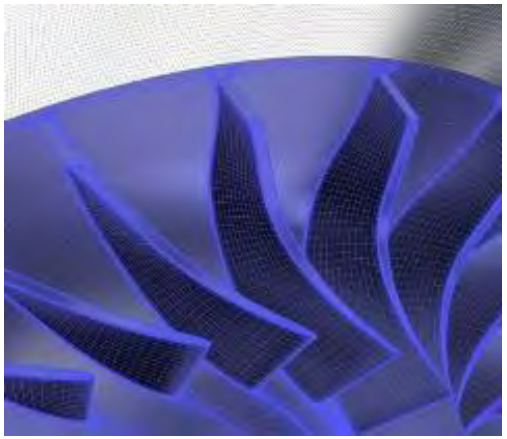
- *renewable and conventional energy technologies*
- *political, social, economic and environmental contexts*

ME 4U03: Compressible Flow & Turbomachinery

- *Compressible/high speed flows*
- *Shocks*
- *Supersonic airfoils*
- *Axial and radial turbo-machines (compressors, fans & turbines)*
- *Gas turbines*







ME 4W03: Air conditioning & Refrigeration Systems

Application of thermodynamic principles on thermal energy systems such as:

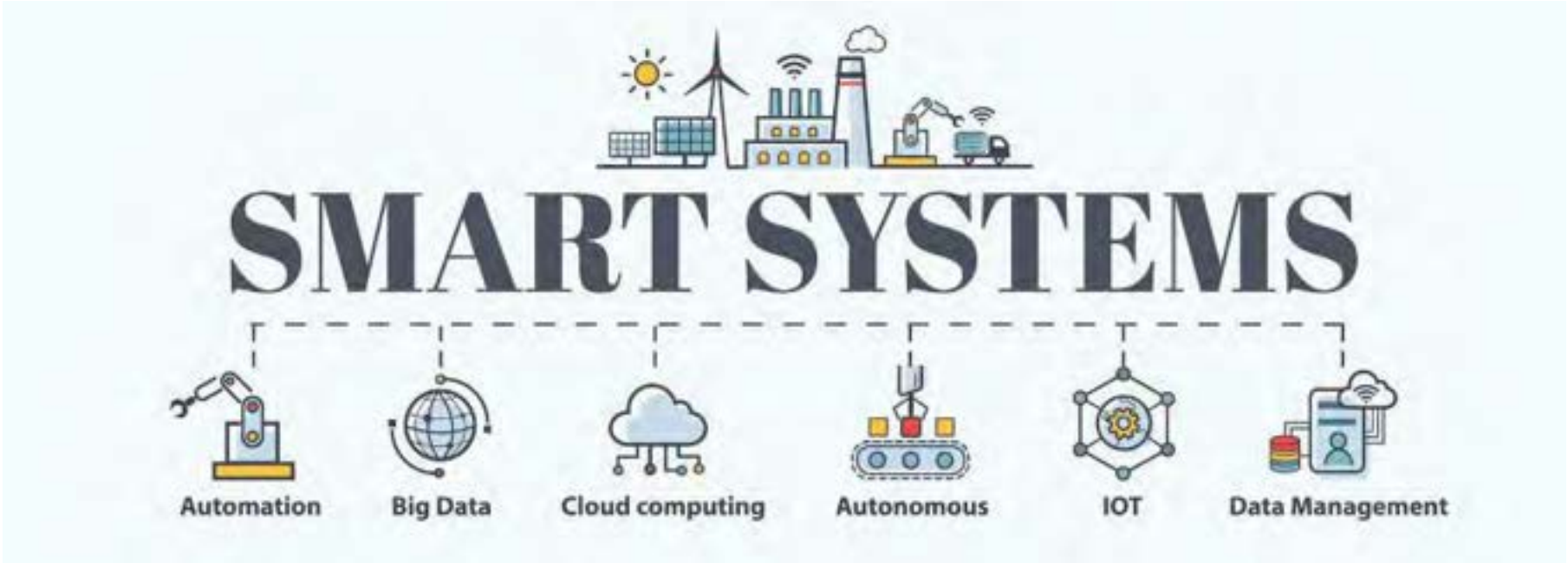
- ***HVAC Systems***
- ***Steam Power Systems***
- ***Micro-nano Systems***

Careers

- Automotive
- Aerospace
- Oil & Gas
- Steel & metals
- Chemicals
- Power Generation
- Nuclear
- Thermal Management
- Environmental Control
- Biotechnology
- Energy Conversion
- Process Engineering

Smart Systems

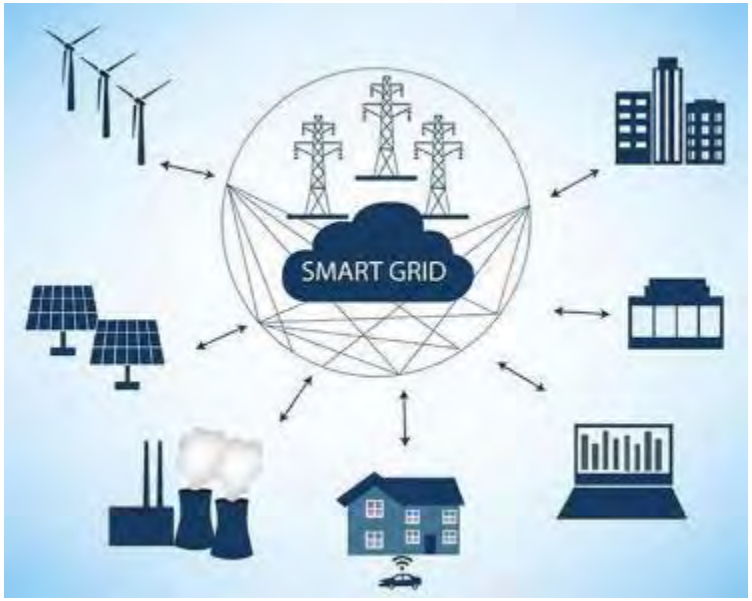
Dr. Chris Morton



Smart Systems

Areas of Application

- Transportation
- Healthcare
- Energy
- Safety and Security
- Manufacturing
- Aerospace & Space



Smart Systems

Typical Roles (Examples)

- AI/ML expert
- Automation engineer
- Embedded systems programmer
- Electric vehicle designer
- Data scientist
- Mechanical engineer
- Project manager
- ... the list goes on …

Smart Systems Curriculum

1) Electives – Choose 3 of the following:

Course	Description	Term	Instructor
ME 4FM3	Advanced Instrumentation and Sensing for Thermo-Fluids	2	Dr. Morton
ME 4H03	Mechatronics	2	Dr. Bone
ME 4I03	Noise Analysis and Control	1	TBD
ME 4K03	Robotics	1	Dr. Yan
ME 4SS3	Smart Systems	1	Dr. Gadsden
ME 4AI3	Applied Artificial Intelligence (New!)	2	Dr. Ryan Ahmed
ME 4X04	Independent Project	both	(specific to project)
SMRTTECH 4ID3	IoT Devices and Networks	2	Dr. Alavi
SMRTTECH 4AI3	Artificial Intelligence and Machine Learning	1	Dr. Mahyar
PROCTECH 4MH3	Machine Health and Remote Monitoring	1	Dr. Wanyama
SFWRTECH 4DA3*	Data Analytics and Big Data	1	Dr. Fortuna
SFWRTECH 4ES3*	Real-Time Systems	2	Dr. Alavi
ENGTECH 4AI3*	Artificial Intelligence	2	Dr. Gao

*P/F, Online Only

2) Plus 2 courses from the 'full' list

- All courses above have outlines posted online except ME 4AI3
- Contact me for more information (**mortoc5@mcmaster.ca**)

Course Info

- 4AI3: Applied Artificial Intelligence
- 4FM3: Advanced Instrumentation and Sensing for Fluid Mechanics
- 4H03: Mechatronics
- 4I03: Noise Analysis and Control
- 4K03: Robotics
- 4SS3: Smart Systems

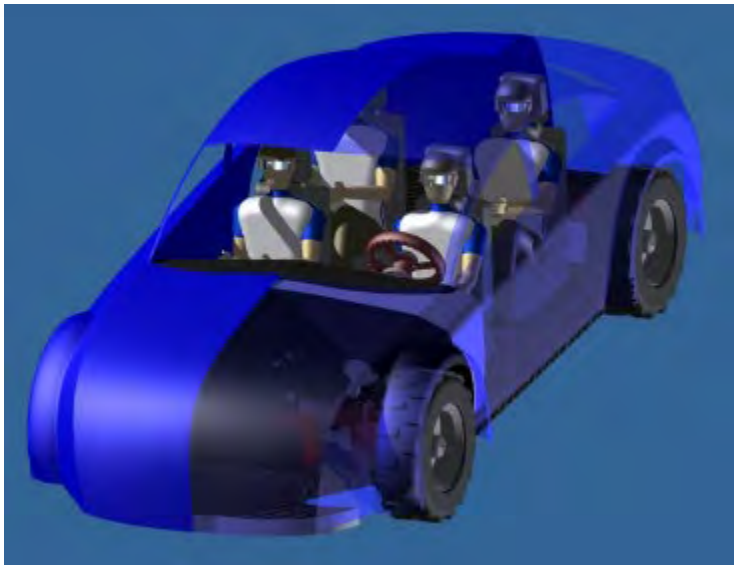
Mechanics and Design

Dr. Cheryl Quenneville

Areas of Application

Design

- A part of just about every company that makes something
  - look and feel
  - operation
  - materials



Mechanics

- How objects interact and move with respect to one another
- Relationship between motion and forces and an object's response

Mechanics and Design

Typical Roles

www.tecbond.com

- New product concepts
  - basic functionality
- New product design
  - establish look and feel
- Verification of applications
- Product modification and updating
- Customization for specific applications

Mechanics and Design

Choose 3 courses from this list (plus two courses from full list of approved technical electives):

- CHEM ENG 4T03*:* Applications of Chemical Engineering in Medicine, 2nd term
- ENGINEER 4EX3: Experiential Engineering Design, both terms
- MATLS 4MS4: Materials Selection in Design and Manufacturing, 1st term
- MATLS 4T03: Properties and Processing of Composites, 2nd term
- ME 4B03: Product Development, 1st term (Dr. Hassan)
- ME 4BB3: Biomechanics, 1st term (Dr. Wohl)
- ME 4BF3: Biofluid Mechanics Systems, 2nd term (Dr. Motamed)
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- ME 4T03: Finite Element Applications, 1st & 2nd term (Dr. Wu)
- ME 4Y03: Internal Combustion Engines, 1st term (Dr. Yan)
- ME 4Z03: Computer Aided Design, 2nd term (TBD)
- ME 4X04: Independent Project, both terms

ME 4B03: Product Development

Case studies using modern product development methods, value engineering, product specification, rapid product development, lean design and continuous improvement. Product liability and robust design.

Individual project:

Design a product with new functionality. Problem identification & concept drawings, part fabrication, testing, financial & manufacturing analysis.

Group project:

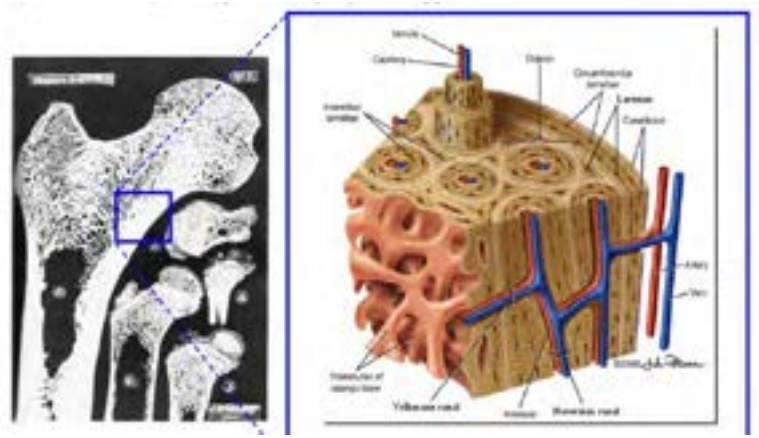
Replicates the process you would go through if you were seeking funding to further develop and commercialize a product. Customer insights, functions, pitch, business model.

ME 4BB3: Biomechanics

Introduction of engineering applied to biomechanics, including cellular biomechanics, hemodynamics, circulatory system, respiratory system, muscles and movement and skeletal biomechanics.

Examples:

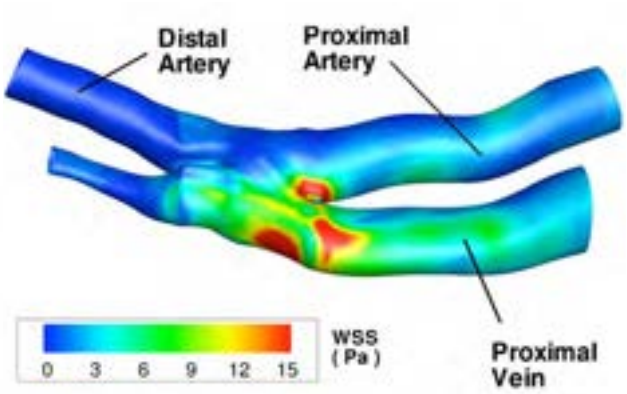
- Calculate loads across joints
- Tissue properties and how they affect mechanics
- Pressure-volume loop of the heart
- Mass transfer in capillaries
- The role of the cell in tissue adaptation
- Effect of implantable devices on the body

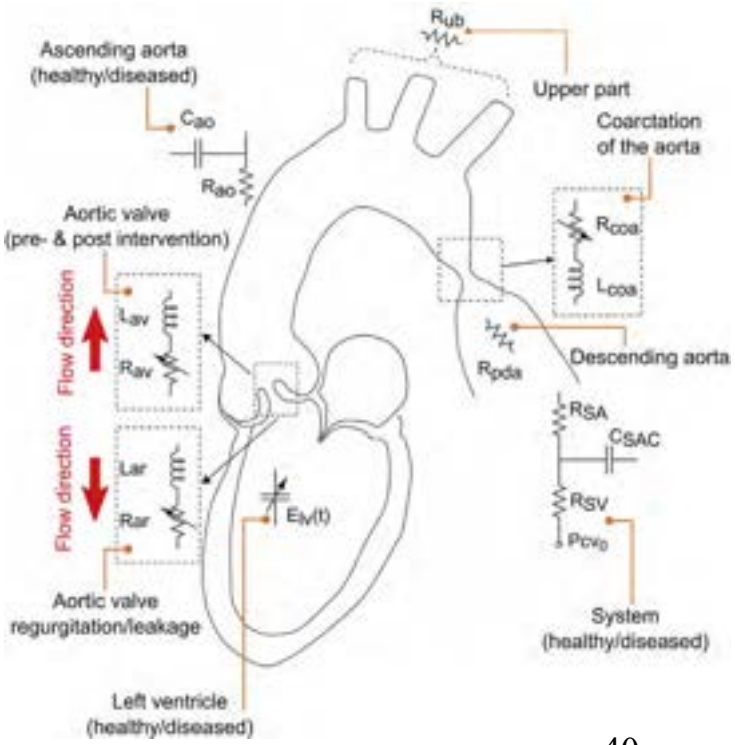


ME 4BF3: BioFluid Mechanics Systems

Blood flow mechanics through the circulatory system and its subsystems

- **mechanics of circulation,**
- **mechanobiology and biomechanics of the circulatory system,**
- **in-vivo and in-vitro techniques and their medical applications**



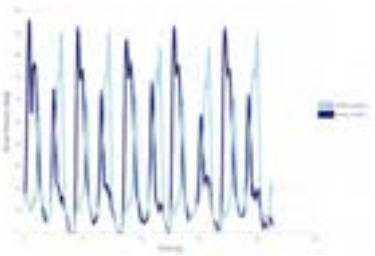


ME 4CC3: Experimental and Computational Biomechanics

Introduction to experimental & computational biomechanics including biomechanical testing concepts and application of finite element methods in simulations of biomechanical structures/systems.

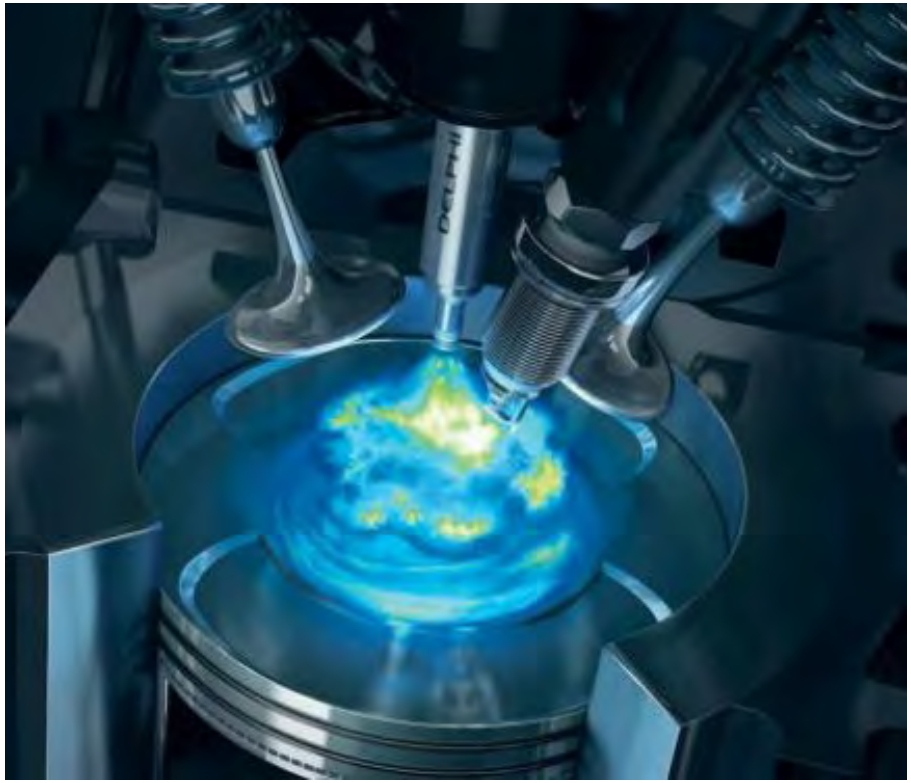
Examples:

- Kinematic tracking of body segments
- Kinetics to estimate loads across joints
- Injury metrics and design of protective equipment
- Numerical musculoskeletal models
- Finite element and statistical models of the body



ME 4Y03: Internal Combustion Engines

Operations, thermodynamics, combustion, and characteristics of gasoline and diesel engines, as well as hybrid powertrains.



ME 4M06
Capstone Projects

4M06 Capstone

- Provide students with projects that involve developing a solution to an "**open ended**" mechanical engineering design problem in the context of a senior year 2-term project course.

- Projects can be either faculty-proposed or student-proposed
  - Come up with your own project ideas **well in advance!**

- Think about who you want to work with

Proposing a Project

Requirements:

- Major emphasis on **design** in every project
- Most projects involve not only design but build and test phases (department has budget for prototyping!)
- Only group projects (no solo), typically 2 – 4 students

Process (must complete by July 31st):

- Form a group, develop your idea
- Reach out to either Dr Bone (coordinator) or a faculty member who would be appropriate to advise (based on expertise)
- Work together to complete a full proposal, which advisor will submit

Graduate Studies

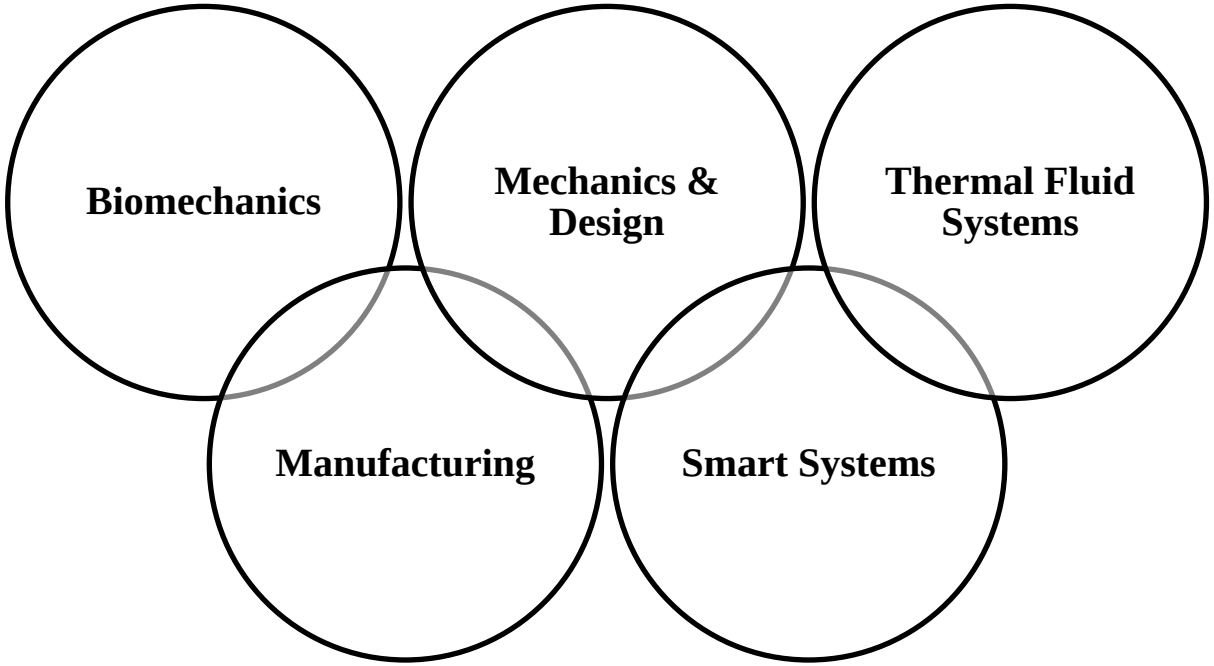
Dr. Cheryl Quenneville on behalf of Dr. Andrew Gadsden

Mechanical Engineering

Offers both an M.A.Sc. and Ph.D. option for graduate studies.

Both options can be done full-time or part-time.

Research Areas



It is recommended that you review the bios and research of our faculty members before applying to identify alignment of interest!

M.A.Sc. Option

- Thesis-based
- 2 years full-time (can be less!)
- Can continue or transfer to Ph.D. studies
- Degree Requirements:
  - 4x Level 700 courses (1 Level 600 course is allowed)
  - 4x Seminar ‘courses’ & 1 presentation
  - Supervisory Committee Meeting
- Funding comprises of a research scholarship, a graduate scholarship, and a teaching assistantship (International students funding also includes visa bursaries to cover the higher cost of tuition for international students)
  - Minimum funding in the 2023-2024 academic year is $24,300

Accelerated M.A.Sc. Option

- M.A.Sc. in 12 to 16 months
- Undergraduate research counted towards M.A.Sc. Thesis
- One Class counts for both B.Eng and M.A.Sc.
- Same academic requirements & funding as regular, full-time M.A.Sc. students

Ph.D. Option

- Thesis-based
- ~4 years full-time
- Degree Requirements:
  - 2x Level 700 courses
  - 8x Seminar ‘courses’ & 1 presentation
  - 4x Supervisory Committee Meetings
  - Comprehensive exam
- Funding comprises of a research scholarship, a graduate scholarship, and a teaching assistantship (International students funding also includes visa bursaries to cover the higher cost of tuition for international students)
  - Minimum funding in the 2023-2024 academic year is $27,300
- Industrial PhD option as well

Direct-to-Ph.D. Option

- Outstanding students with a B.Sc./B.Eng. may be admitted directly into the Mechanical Engineering Ph.D. program.
- Degree Requirements:
  - 4x Level 700 courses
  - 8x Seminar ‘courses’ & 1 presentation
  - 4x Supervisory Committee Meetings
  - Comprehensive exam
- Same funding as regular, full-time Ph.D. students

Questions?