Welcome to Options Night!

2023
Options Night

Introductions, Tips

Structure of Streams
- Smart Systems
- Manufacturing
- Thermofluids & Energy Systems
- Mechanics & Design

4M06 Projects

Graduate Studies
Options Night

Tips:

1. Check resources-undergrad-course info on mechanical website

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)
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.
**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

**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 4FM3, 4H03, 4I03, 4K03, 4SS3, 4X04, SMRTTECH 4ID3, 4AI3, PROCTECH 4MH3, SFWRTECH 4DA3, 4ES3

**Thermofluids and Energy Systems:** two approved technical electives; plus MECHENG 4S03; plus two of CHEMENG 4X03, ENGPHYS 3D03, 4D03, 4NE3, 4P03, MECHENG 4AA3, 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, ENGINEER 4EX3
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Term</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM ENG 4T03</td>
<td>Applications of Chemical Engineering in Medicine</td>
<td>2nd term</td>
<td></td>
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<tr>
<td>CHEM ENG 4X03</td>
<td>Polymer Processing</td>
<td>1st term</td>
<td></td>
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<tr>
<td>CIV ENG 3K03</td>
<td>Introduction to Transportation Engineering</td>
<td>1st term</td>
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<tr>
<td>COMMERCE 4QA3</td>
<td>Operations Modelling and Analysis</td>
<td>1st or 2nd term</td>
<td></td>
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<tr>
<td>ELECENG 3N03</td>
<td>Electronics and Instrumentation</td>
<td>2nd term</td>
<td></td>
</tr>
<tr>
<td>ENGINEER 4EX3</td>
<td>Experiential Engineering Design</td>
<td>both terms</td>
<td></td>
</tr>
<tr>
<td>MATLS 3MF3</td>
<td>Materials Fabrication</td>
<td>2nd term</td>
<td></td>
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<tr>
<td>MATLS 4MS4</td>
<td>Materials Selection in Design and Manufacturing</td>
<td>1st term</td>
<td></td>
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<tr>
<td>MATLS 4T03</td>
<td>Properties and Processing of Composites</td>
<td>2nd term</td>
<td></td>
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<tr>
<td>ENG PHYS 3D03</td>
<td>Principles of Nuclear Engineering</td>
<td>2nd term</td>
<td></td>
</tr>
<tr>
<td>ENG PHYS 4D03</td>
<td>Nuclear Reactor Analysis</td>
<td>1st term (Note: pre-req. is ENG PHYS 3D03)</td>
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<tr>
<td>ENG PHYS 4NE3</td>
<td>Advanced Nuclear Engineering</td>
<td>2nd term (Note: pre-req. is ENG PHYS 3D03)</td>
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<tr>
<td>ENG PHYS 4P03</td>
<td>Nuclear Power Plant Systems &amp; Operations</td>
<td>2nd term</td>
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<tr>
<td>SMRTTECH 4ID3</td>
<td>IoT Devices and Networks</td>
<td>2nd term</td>
<td></td>
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<tr>
<td>SMRTTECH 4AI3</td>
<td>Artificial Intelligence &amp; Machine Learning</td>
<td>1st term</td>
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</tr>
<tr>
<td>PROCTECH 4MH3</td>
<td>Machine Health &amp; Remote Monitoring</td>
<td>1st term</td>
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<tr>
<td>SFWRTECH 4DA3</td>
<td>Data analytics and Big Data</td>
<td>virtual</td>
<td></td>
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<tr>
<td>SFWRTECH 4ES3</td>
<td>Real-Time Systems</td>
<td>virtual</td>
<td></td>
</tr>
<tr>
<td>ME 4AA3</td>
<td>Aerodynamics</td>
<td>2nd term (Dr. Tullis)</td>
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<tr>
<td>ME 4B03</td>
<td>Topics in Product Development</td>
<td>1st term (Dr. Hassan)</td>
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<tr>
<td>ME 4BB3</td>
<td>Biomechanics</td>
<td>1st term (Dr. Wohl)</td>
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<tr>
<td>ME 4BF3</td>
<td>Biofluid Mechanics Systems</td>
<td>2nd term (Dr. Motamed)</td>
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<tr>
<td>ME 4CC3</td>
<td>Experimental and Computational Biomechanics</td>
<td>2nd term (Dr. Quenneville)</td>
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<tr>
<td>ME 4D03</td>
<td>Manufacturing Processes (Metal Removal)</td>
<td>2nd term (Dr. Koshy)</td>
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<tr>
<td>ME 4DD3</td>
<td>Introduction to Surface Engineering in Manufacturing</td>
<td>1st term (Dr. Aramesh)</td>
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<tr>
<td>ME 4ES3</td>
<td>Energy Storage</td>
<td>2nd term (Dr. Trowell)</td>
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<tr>
<td>ME 4FM3</td>
<td>Advanced Instrumentation &amp; Sensing for Fluid Mechanics</td>
<td>2nd term (Dr. Morton)</td>
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<tr>
<td>ME 4H03</td>
<td>Mechatronics</td>
<td>2nd term (Dr. Bone)</td>
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<tr>
<td>ME 4I03</td>
<td>Noise Analysis and Control</td>
<td>1st term (TBD)</td>
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<tr>
<td>ME 4J03</td>
<td>Intro to Computational Fluid Dynamics and Heat Transfer</td>
<td>2nd term (Dr. Hamed)</td>
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<tr>
<td>ME 4K03</td>
<td>Robotics</td>
<td>1st term (Dr. Yan)</td>
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<tr>
<td>ME 4N03</td>
<td>NanoBio Engineering</td>
<td>1st term (Dr. Didar) (n/a in 2023-24)</td>
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<tr>
<td>ME 4O04</td>
<td>Sustainable Energy Systems</td>
<td>2nd term (Dr. Cotton)</td>
<td></td>
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<tr>
<td>ME 4SS3</td>
<td>Smart Systems</td>
<td>1st term (Dr. Gadsden)</td>
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<tr>
<td>ME 4S03</td>
<td>Incompressible flow</td>
<td>1st term (Dr. Salaudeen)</td>
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<tr>
<td>ME 4T03</td>
<td>Finite Element Applications</td>
<td>2nd term (Dr. Wu)</td>
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<tr>
<td>ME 4U03</td>
<td>Compressible Flow and Turbomachinery</td>
<td>1st term (Dr. Tullis)</td>
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<tr>
<td>ME 4W03</td>
<td>Air Conditioning and Refrigeration Systems</td>
<td>1st term (Dr. Shankar)</td>
<td></td>
</tr>
<tr>
<td>ME 4X04</td>
<td>Independent Research Project (full year)</td>
<td></td>
<td></td>
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<tr>
<td>ME 4Y03</td>
<td>Internal Combustion Engines</td>
<td>1st term (Dr. Yan)</td>
<td></td>
</tr>
<tr>
<td>ME 4Z03</td>
<td>Computer Aided Design</td>
<td>2nd term (TBD)</td>
<td></td>
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</table>
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)
  – Includes things like trip to Mercedes plant, Porsche Museum

• MECHENG 4X04: Independent Project
  – Like a mini-Master’s, experience at research
  – Recommended GPA of 9.5, need to secure a supervisor (any area of interest!)
  – Available through all streams, full year course

• ENGINEER 4EX3: Experiential Engineering Design
  – For members of clubs/teams, full year course
Smart Systems
Dr. S. Andrew Gadsden
Smart Systems

Areas of Application

• Transportation
• Healthcare
• Energy
• Safety and Security
• Manufacturing
• Aerospace & Space
Typical Roles (Examples)

- AI/ML expert
- Automation engineer
- Embedded systems programmer
- Electric vehicle designer
- Data scientist
- Mechanical engineer
- Project manager
- ... the list goes on ...
1) Electives – Choose 3 of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
<th>Term</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 4FM3</td>
<td>Advanced Instrumentation and Sensing for Fluid Mechanics <em>(New!)</em></td>
<td>2</td>
<td>Dr. Morton</td>
</tr>
<tr>
<td>ME 4H03</td>
<td>Mechatronics</td>
<td>2</td>
<td>Dr. Bone</td>
</tr>
<tr>
<td>ME 4I03</td>
<td>Noise Analysis and Control</td>
<td>1</td>
<td>TBD</td>
</tr>
<tr>
<td>ME 4K03</td>
<td>Robotics</td>
<td>1</td>
<td>Dr. Yan</td>
</tr>
<tr>
<td>ME 4SS3</td>
<td>Smart Systems <em>(New!)</em></td>
<td>1</td>
<td>Dr. Gadsden</td>
</tr>
<tr>
<td>ME 4X04</td>
<td>Independent Project</td>
<td>both</td>
<td>(specific to project)</td>
</tr>
<tr>
<td>SMRTTECH 4ID3</td>
<td>IoT Devices and Networks</td>
<td>2</td>
<td>Dr. Alavi</td>
</tr>
<tr>
<td>SMRTTECH 4AI3</td>
<td>Artificial Intelligence and Machine Learning</td>
<td>1</td>
<td>Dr. Mahyar</td>
</tr>
<tr>
<td>PROCTECH 4MH3</td>
<td>Machine Health and Remote Monitoring</td>
<td>1</td>
<td>Dr. Wanyama</td>
</tr>
<tr>
<td>SFWRTECH 4DA3*</td>
<td>Data Analytics and Big Data</td>
<td>1</td>
<td>Dr. Fortuna</td>
</tr>
<tr>
<td>SFWRTECH 4ES3*</td>
<td>Real-Time Systems</td>
<td>2</td>
<td>Dr. Alavi</td>
</tr>
</tbody>
</table>

2) Plus 2 courses from the ‘full’ list

- All courses above have outlines posted online except for ME 4FM3 and ME 4SS3
- Contact me for more information (*gadsden@mcmaster.ca*)
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 ...
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, 1st 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 2023-24)
- ME 4T03: Finite Element Applications, 1st 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
Fluids and Energy Systems
Dr. Stephen Tullis
Applications

• Automotive and 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
Courses

Required course:

• ME 4S03: Incompressible flow, 1st term (Dr. Salaudeen)

Plus choose 2 courses from this list (plus two courses from full list of approved technical electives):

• CHEM ENG 4X03: Polymer Processing, 1st term
• ENG PHYS electives (see next page for full list)
• ME 4AA3: Aerodynamics, 2nd term (Dr. Tullis)
• ME 4BF3: Biofluid Mechanics Systems, 2nd term (Dr. Motamed)
• ME 4ES3: Energy Storage, 2nd term (Dr. Trowell)
• ME 4FM3: Advanced Instrumentation and Sensing for Fluid Mechanics, 2nd term (Dr. Morton)
• ME 4I03: Noise Analysis and Control, 1st term (TBD)
• ME 4J03: Introduction to Computational Fluid Dynamics and Heat Transfer, 2nd term (Dr. Hamed)
• ME 4O04: Sustainable Energy Systems, 2nd term (Dr. Cotton)
• ME 4T03: Finite Element Applications, 1st term (Dr. Wu)
• ME 4U03: Compressible Flow and Turbomachinery, 1st term (Dr. Tullis)
• ME 4W03: Air Conditioning and Refrigeration Systems, 1st term (Dr. Shankar)
• ME 4Y03: Internal Combustion Engines, 1st term (Dr. Yan)
• ME 4X04: Independent Project, both terms
ME 4S03: Incompressible Flow

Internal and external laminar and turbulent flows

- Turbulent boundary layers
- Convective heat transfer
- Intro to aerodynamics
ME 4FM3: Advanced Sensing & Instrumentation in Thermo-Fluids

Theory and practice of experimental analysis in fluid mechanics and thermodynamics problems.

- Experimental facilities and planning experiments
- Pressure, strain, flow & temperature measurement
- Data acquisition, visualization, and advanced analysis techniques
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 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 4U03: Compressible Flow & Turbomachinery

- Compressible/high speed flows
- Shocks
- Supersonic airfoils
- Axial and radial turbo-machines (compressors, fans & turbines)
- Gas turbines
ME 4J03: Intro to Computational Fluid Mechanics & Heat Transfer

- Basics of CFD for fluid flow
- CFD for heat transfer
- Practicals
ME 4Y03: Internal Combustion Engines

Operations, thermodynamics, combustion, and characteristics of gasoline and diesel engines, as well as hybrid powertrains.
ME 4103: Noise Analysis & Control

- Noise measurements and analysis
- Noise standards
- Sound generation and propagation
- Noise control
ME 4004: Sustainable energy systems

- renewable and conventional energy systems
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
Areas of Application

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

Mechanics
- The fundamental background that is needed to make many critical design decisions
Typical Roles

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

www.tecbond.com
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)
- ME 4CC3: Experimental and Computational Biomechanics, 2nd term (Dr. Quenneville)
- ME 4H03: Mechatronics, 2nd term (Dr. Bone)
- ME 4I03: Noise Analysis and Control, 1st term (TBD)
- ME 4K03: Robotics, 1st term (Dr. Yan)
- ME 4T03: Finite Element Applications, 1st 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
Bio-related

ME 4BB3 – Biomechanics
ME 4CC3 – Experimental & Computational Biomechanics
ME 4BF3 – Biofluid Mechanics
Mechanics of Machines
ME 4K03 – Robotics
ME 4H03 – Mechatronics

Lego MINDSTORMS AlphaRex

Husky

Husky
Design Concepts

ME 4B03 – Product Development
ME 4I03 – Noise Analysis and Control
ME 4Y03 – Internal Combustion Engines
Design Tools

ME 4T03 – Finite Element Applications
ME 4Z03 – Computer Aided Design

Honda CVT Technology Modelled in Abaqus

Honda Insight Hybrid
Career Opportunities

Automotive
Aerospace
Mould and Die
Energy
Heavy Equipment
Consumer Goods
Home Appliances
Biomedical Components

Boeing
ME 4M06
Capstone Projects
4M06 Course Objectives

• To best simulate the environment a **mechanical design engineer** would typically experience in industry setting.

• 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.

• Encourage students to come up with their own project ideas **well in advance**.
• 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

• Lower and upper limits to the number of students per faculty (Faculty “load balancing”)

• Project types: faculty-proposed, industry-supported, student-initiated
4M06 Types of Projects

Student Initiated Project Submission Process

- Students form a project group well in advance
- Students approach a participating 4M06 faculty member well in advance to discuss their project idea and scope
- Participating faculty member agrees to take on the Project Supervision
- Students and participating faculty member collaboratively develop and refine the project idea and scope well in advance
- Participating faculty member formally submits the completed Project Submission Form to the Course Coordinator by the timeline (typically by July 31st)

Note: All projects must come via a participating faculty member and should already be on the Projects List posted on the course web site in early September
Project Allocation Process

- Project descriptions posted early September
  - Meet with supervisors to get more info if needed
- Students or groups rank their top 5
  - Must be from five different supervisors
- Algorithm to maximize preferences
  - Ties broken by GPA
Graduate School
Dr. Ching, Associate Chair Graduate Studies
discovery

ability to integrate

critical thinking

communication

create  learn  share

The Knowledge Loop
Master’s degree

breadth & depth of knowledge

technical leadership & specialization in industry
Master’s degree

- Course based MEng
  - Working professionals

- Thesis-based MASc
  - Tuition & living costs
  - ~2 years
  - Continue/switch to PhD
Accelerated MASc Program Option

MASc in 12 to 16 Months

Undergraduate research counted towards MASc Thesis

One Class counts for both BEng and MASc
<table>
<thead>
<tr>
<th>TIMELINE</th>
<th>MILESTONE</th>
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</thead>
<tbody>
<tr>
<td>Year 3 of BEng</td>
<td>Seek Faculty Supervisor for MASc Thesis. Preferably apply for NSERC USRA</td>
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<tr>
<td></td>
<td>Summer at end of Year 3 of BEng</td>
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<tr>
<td></td>
<td>Perform research with Faculty Supervisor.</td>
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<td></td>
<td>Apply to Accelerated MASc option through department.</td>
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<tr>
<td>Year 4 of BEng</td>
<td>Take ONE 600 level course. Inform course instructor that 400 level course</td>
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<td></td>
<td>will be used for U/G credit.</td>
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<td></td>
<td>Take ME 4X04 course and continue MASc research.</td>
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<td></td>
<td>Apply to SGS for admission to MASc program.</td>
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<tr>
<td>Year 1 of MASc</td>
<td>Continue MASc research in summer/fall/winter</td>
</tr>
<tr>
<td></td>
<td>Petition SGS for credit of completed 600 level course.</td>
</tr>
<tr>
<td></td>
<td>Complete THREE additional 700 level courses</td>
</tr>
<tr>
<td>Summer following Year 1 of MASc</td>
<td>Complete and defend MASc Thesis</td>
</tr>
</tbody>
</table>
Doctoral degree → ~4 years

- teaching
- R & D in industry/government
prerequisites

creativity

Don't Quit

perseverance

passion

curiosity
you also need a supervisor …

… everything else is (pretty much) negotiable!
Questions?