# ENG PHYS

Undergraduate Viewbook

Engineering Physics

McMaster University



# ENGINEERING PHYSICS STUDENTS

This could be you.



Engineering Physics is an interdisciplinary field of study where new and **advanced materials, devices and systems** are engineered based on our **fundamental understanding** of physics.

## What Makes Engineering Physics Different?

### Interdisciplinary by Design

Combine physics, electrical, mechanical and materials engineering

### Hands-On from Day One

Work in labs, build systems and test real devices early.

### Future-Focused Fields

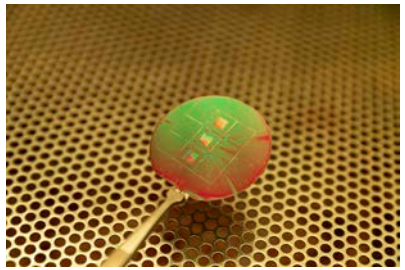
Quantum, space, photonics, nuclear, biomedical.

### Problem Solvers First

Learn how to think, not just what to memorize.

Our faculty and students are pushing the forefront of modern physics to better the world through **technological advancement.** We are developing today's and tomorrow's advanced technologies in fields as diverse as **Nano- and Micro- Devices Engineering, Nuclear Engineering, Photonics Engineering, Quantum Technologies, Space Systems Engineering, and Biomedical Engineering.**

## Students may choose from a wide range of cutting-edge specialties including...



### Nano- and Micro-Devices Engineering

Develop revolutionary nanotechnologies for information, communication, and sensing applications that enable tomorrow's technology



### Biomedical Engineering

Engineer biomedical sensors and systems to improve human health and well-being



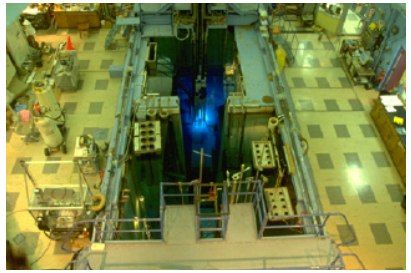
### Quantum Computing

Creating the next computing revolution



### Solar Photovoltaics

Harnessing the power of sunlight for a better future



### Nuclear Engineering

Innovate energy technologies for today and tomorrow to support a carbon-free future and a healthier world



### Photonics Engineering

Engineer the quantum particle of light for communications and manufacturing



### Space Systems Engineering

Develop revolutionary nanotechnologies for information, communication, and sensing applications that enable tomorrow's technology



### Interdisciplinary Engineering Physics

Engineer novel solutions by applying concepts from mechanical, chemical, materials, electrical and other disciplines

# EngPhys Level II: Build your foundation

## FALL

**ENGPHYS 2CD4**
Computational Mechanics: Dynamics

**ENGPHYS 2NE3**
Thermal Systems Design

**ENGPHYS 2E04**
Analog and Digital Circuits

**MATH 2Z03**
Engineering Mathematics III

**ENGPHYS 2NM3**
Numerical Methods for Engineering

## WINTER

**ENGPHYS 2QM3**
Introduction to Quantum Mechanics

**ENGPHYS 2P04**
Computational Mechanics: Statics

**ENGPHYS 2A04**
Electricity and Magnetism

**MATH 2ZZ3**
Engineering Mathematics IV

**ENGINEER 2PX3**
Engineering: Communications and Social Impact

## By the end of Level II, you will have a strong foundation in:

- **Computional Methods**
- **Core Physics Principles**
- **Engineering Design**
- **Mathematical Modelling**

# EngPhys Level III: Advanced Core

## FALL

- ENGPHYS 3MB4
- ENGPHYS 3PN3
- ENGPHYS 3W03
- ENGPHYS 3SM3

## WINTER

- ENGPHYS 3L04
- ENGPHYS 3CM4
- ENGPHYS 3SC3
- ENGPHYS 3E04
- ENGINEER 3PX3

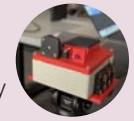
# EngPhys Level IV: Specialize your path

- ENGINEER 4A03
- 26-28 units of approved Electives
- ENGPHYS 4A06: Capstone

In their final year, students apply everything they have learned to a full year capstone project.



**Levitask**
uses accoustic soundwaves to levitate particles for biomedical device assembly



**Beam-Enabled Acoustic Monitoring (BEAM)**
a laser microphone that lets first responders hear what's happening inside a building without stepping inside

## Flexible by design

Technical electives give you the freedom to explore your interests, combine disciplines and chape a degree that is unique to you.

### Nanotech Device Engineering

**Course Examples:**
ENGPHYS 3PN4, 4MD3, 4Z04
MATLS 4H03

### Photonics/Optical Engineering

**Course Examples:**
ENGPHYS 3E04, 3PD4, 3PN4, 4S04, 4Z04
ELECENG 3FK4, 4EM4

### Solar Photovoltaic Engineering

**Course Examples:**
ENGPHYS 3E04, 3ES3, 3PN4, 4MD3, 4X04, 4Z03
MATLS 4Q03

### Nuclear Engineering

**Course Examples:**
ENGPHYS 3ES3, 3O04,
NUCENG 3D04, 4D04, 4NE3, 4P03, 4PP3
MATLS 4O04, 4S03, 4U03, 4V03

### Biomedical Engineering

**Course Examples:**
EngPhys 3E04, 3PN4, 4B03, 4I03, 4S04, 4Z04
ELECENG 4BD4
MECHENG 4N03

### Quantum Computing

**Course Examples:**
EngPhys 4QC3, 4QM3
PHYSICS 3MM3, 3QI3, 4F03
DATASCI 2G03, 3ML3

### Space Systems

**Course Examples:**
ENGPHYS 3O04, 3SP3, 3E04, 4X03, 4QC3
NUCENG 3D04
ASTRON 2E03, 3X03, 3Y03
ELECENG 4TK4

### Interdisciplinary Engineering Physics

**Course Examples:**
ENGPHYS 3E04, 3ES3, 3O04,
3PD4, 3PN4, 4B03, 4I03, 4QC3, 4X03
NUCENG 3D04, 4PP3

Note: These are examples of technical electives for different specializations you can choose from, not fixed requirements

Did you know? Students will learn the tools to make integrated circuits and communication systems.

## What is nanotechnology?

Devices that are constructed on the nanometre scale.

## What role does nanotechnology play in the real world?

These devices are the technological backbone of the modern age of computers and high-tech communications.

## A combination of the theory and application of modern physics.

Students will gain an understanding of device science and engineering through a series of hands-on device fabrication courses.

**What can I learn?**

# Nanotech

## Top 3 Co-op Employers

- intel
- APPLIED MATERIALS
- AMD

## Nanotech-specific curriculum

1. Fundamentals of physical optics
2. Semiconductor device design
3. Microsystem device technologies
4. Applied physics laboratory

## Core curriculum

1. Electricity and magnetism, thermodynamics
2. Engineering and classical mechanics
3. Quantum mechanics and its applications
4. Electronic devices and circuit design
5. Computer modeling and signal processing
6. Mathematics and mathematical physics
7. Engineering design projects

Did you know? Students will design and fabricate a solar cell, which are the building blocks of solar panels.

## What is photonics engineering?

Photonics involves the generation, control, and detection of light to provide useful applications for society.

## What role does photonics play in the real world?

The application of light extends to industries including medicine, biophotonics, sensors, displays, nanotechnology, manufacturing, and traditional optical engineering.

## A combination of the theory and application of modern physics.

Courses that explore the science behind the application of light and considers this from a theoretical and an applied industrial perspective.

**What can I learn?**

# Photonics

## Top 3 Co-op Employers

- VIAVI
- LUMENTUM
- ZEISS

## Photonics-specific curriculum

1. Fundamentals of physical optics
2. Applications of photonics
3. Lasers and electro-optics
4. Optical instrumentation
5. Optical communication systems
6. Solar energy

## Core curriculum

1. Electricity and magnetism, thermodynamics
2. Engineering and classical mechanics
3. Quantum mechanics and its applications
4. Electronic devices and circuit design
5. Computer modeling and signal processing
6. Mathematics and mathematical physics
7. Engineering design projects

Private industry

Did you know? Students will do experiments in McMaster's Nuclear Reactor.

## What is nuclear engineering?

The application of scientific principles, engineering design and analysis, computer modeling and simulation, and government regulation for the peaceful use of nuclear energy.

## What role does nuclear engineering play in the real world?

The design of alternative energy sources; nuclear reactor physics, safety, and operation; the design of next generation nuclear reactors; the investigation of industrial and medical uses of nuclear materials.

## A combination of the theory and application of modern physics.

Courses cover a broad range of skills, which are transferable among all energy sectors. Principles of alternative energy sources such as photovoltaics, fuel cells, and wind power are explored in-depth.

**What can I learn?**

# Nuclear

## Top 3 Co-op Employers

- Canadian Nuclear Laboratories / Laboratoires Nucléaires Canadiens
- Ontario Power Generation
- Bruce Power — Innovation at work

## Energy-specific curriculum

1. Principles of nuclear engineering
2. Introduction to energy systems
3. Industrial monitoring and detection
4. Nuclear reactor analysis

## Core curriculum

1. Electricity and magnetism, thermodynamics
2. Engineering and classical mechanics
3. Quantum mechanics and its applications
4. Electronic devices and circuit design
5. Computer modeling and signal processing
6. Mathematics and mathematical physics
7. Engineering design projects

Did you know? Students will design and fabricate biosensors using state-of-the-art facilities.

## What is biomedical engineering?

The study of biological molecules, cells and tissues for disease detection, diagnosis, and treatment.

## What role does biomedical engineering play in the real world?

The development of biophotonics and biosensors in Engineering Physics is used for applications in medicine, life sciences, agriculture, and environmental science to improve human health.

## A combination of the theory and application of modern physics.

Courses cover the development and application of biophotonics and micro- and nano-sensors for the detection of DNA, proteins, viruses and other biological materials.

**What can I learn?**

# Biomedical

## Top 3 Co-op Employers

UHN

Boston Scientific

Baylis MEDICAL

## Biomedical-specific curriculum

1. Introduction to biophotonics
2. Biosensor fabrication
3. Semiconductor device manufacturing
4. Optical instrumentation
5. Fundamentals of physical optics

## Core curriculum

1. Electricity and magnetism, thermodynamics
2. Engineering and classical mechanics
3. Quantum mechanics and its applications
4. Electronic devices and circuit design
5. Computer modeling and signal processing
6. Mathematics and mathematical physics
7. Engineering design projects

Did you know? McMaster has a Quantum Club that runs a quantum hackathon every year

## What is quantum computing?

The application of quantum mechanics to process information, enabling new approaches to computation beyond classical systems.

## What role does quantum computing play in the real world?

Quantum computing is used to tackle complex problems in cryptography, materials science, and optimization, leveraging principles like superposition and entanglement to perform calculations that are intractable for classical computers.

## A combination of the theory and application of modern physics.

Courses integrate quantum theory with engineering applications, including quantum algorithms, quantum hardware, and nanoscale systems—bridging fundamental physics with emerging computing technologies.

**What can I learn?**

# Quantum Computing

## Top 3 Co-op Employers

- IBM
- Microsoft
- TRIUMF

## Quantum Computing specific curriculum

1. Introduction to Quantum Mechanics
2. Introduction to Quantum Computing
3. Quantum Optics and Metrology
4. Fundamentals of Physical Optics

## Core curriculum

1. Electricity and magnetism, thermodynamics
2. Engineering and classical mechanics
3. Quantum mechanics and its applications
4. Electronic devices and circuit design
5. Computer modeling and signal processing
6. Mathematics and mathematical physics
7. Engineering design projects

Did you know? McMaster has a dedicated telescope for optical commincation with satellites

## What is Space Systems engineering?

The application of Engineering Physics to the design and analysis of spacecraft and satellite systems, combining fundamental physics with electrical, mechanical, and computational engineering.

## What role does Space Systems engineering play in the real world?

Space systems engineering applies core principles from electromagnetism, quantum mechanics, and thermodynamics to develop technologies used in satellite communications, Earth observation, navigation, and space exploration. These systems support global infrastructure and scientific discovery.

## A combination of the theory and application of modern physics.

Courses integrate fundamental physics with engineering applications, including orbital mechanics, radiation effects, communication systems, and space-based instrumentation—bridging theory with real-world space technologies.

**What can I learn?**

# SpaceSystems

## Top 3 Co-op Employers

- SPACEX
- Honeywell

## Space Systems specific curriculum

1. Space Systems Engineering
2. Signals and Systems
3. Fundamentals of Physical Optics
4. Engineering Physics Design Projects

## Core curriculum

1. Electricity and magnetism, thermodynamics
2. Engineering and classical mechanics
3. Quantum mechanics and its applications
4. Electronic devices and circuit design
5. Computer modeling and signal processing
6. Mathematics and mathematical physics
7. Engineering design projects

# CO-OP

## McMaster has one of the largest engineering co-op programs in Canada

Students have the freedom to design their own path enabling balance among academic interests, research opportunities, and workforce placements

Flexible co-op options allow students to complete terms of 4, 8, 12 or 16 months in a row.

Earn money and gain experience while working towards your degree

McMaster Engineering co-op students have worked in over **30** countries around the world

**96%** of students felt their company provided them with a rewarding work environment

**93%** of students graduate with co-op experience

Average wage for students **$35/h**

**4,700+** work terms completed annually

# THIS COULD BE YOU!

Michael completed 20 months of co-op work experience. His last co-op experience was at **AIRBUS Operations Limited** in Filton, Bristol, United Kingdom.



"Altogether, I have learned many skills from my co-op experiences. The concrete understanding of bringing an idea to fruition through research & development, iterative design, construction, and testing allowed me to replicate this practice in future projects and academic coursework. In addition to the business model, the combination of soft skills and heavy technical analysis allowed me to communicate to different audiences and see greater connections between different engineering functions, respectively. Altogether, the combination of my co-op experiences and support from McMaster Engineering Co-op Career Services has allowed me to build my professional career and attain proficiency in both technical and managerial skillsets."

- Michael Jobity, Engineering Physics & Management

Some of the

# COMPANIES

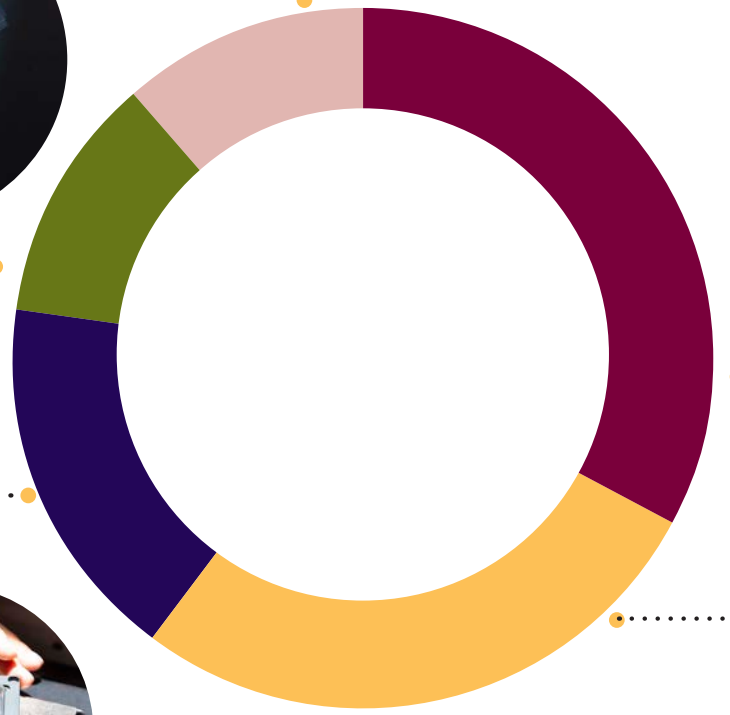
where our alumni and co-op students work



# Where do our graduates end up?



**11%**
Space/
Quantum



**14%**
Education/
Research



**31%**
Data Scientist



**20%**
Conductor
Manufacturing



**24%**
Energy Industry



*Honouring our Laureate*

# DONNA STRICKLAND

## 2018 NOBEL PRIZE LAUREATE

For her work on Chirped Pulse Amplification

McMaster
Engineering Physics
Alumni
Class of 1980



@macengphys

eng.mcmaster.ca/engphys

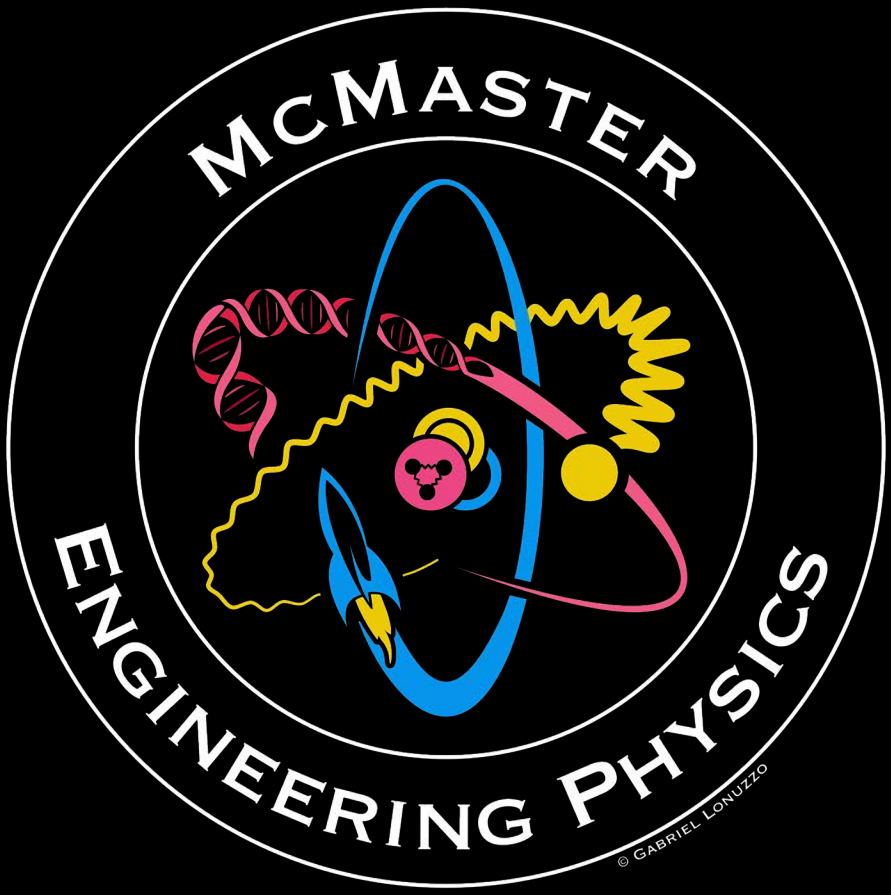
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# NOTES:

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