What do Electrical and Computer Engineers do?

Electrical and Computer Engineers work at the heart of new electronics and computing technologies. Almost everything we use and rely on in our everyday life relies on electricity and electronics, making Electrical and Computer Engineers in high demand. In fact, Electrical Engineering is the largest branch of engineering worldwide.

- They develop the electronics and computing technologies that are behind the electronic devices we use every day, such as televisions, cell phones, microwave ovens, video game systems, and more.
- They work in transportation industries, and their skills are essential for the design of modern automobiles and aircraft.
- They work in healthcare industries, designing instruments and diagnostic systems such as prosthetic limbs, hearing aids, MRI, and ultrasound.
- They work in communication industries, developing advanced antenna technologies, software systems, satellite systems, and networking technologies.
- They work in energy industries, developing systems for electric power generation (hydroelectric, wind, solar, and more), electric power delivery, and power electronic devices to control and convert electric power (motors, ac/dc converters, hybrid vehicle drive systems, and more).
- They are involved in diverse research areas such as nanotechnologies, quantum computing, nano-medicine, photonics, and computational intelligence.
- Many work in the business world where their knowledge of technology and their problem-solving and team-building skills are highly valued. Many apply their mathematics and analysis skills in the banking and finance sectors.

What are the Typical Courses?

Electrical Engineering and Computer Engineering students have many courses in common. Common courses include mathematics, modern physics, circuits and electronics, computer programming, microprocessors, digital systems, economics and engineering law. However, each program provides students with additional advanced study in their respective areas.

- Electrical Engineering students take courses in electromagnetics, electric power and machines, communication systems, control systems, and the physics of electronic materials. They can select from elective courses covering antenna systems, electric power systems, photonic systems, biomedical technologies, microelectronic fabrication, computer vision, and advanced mathematics.
- Computer Engineering students take courses in software engineering, digital system design, computer programming, and telecommunication networks. They can select from elective courses such as communication systems, control systems, computer vision, parallel processing, wireless networks, and advanced Computer Science courses such as computer graphics, user interfaces, human-computer interaction, and artificial intelligence.

In many cases, the elective courses in both Electrical Engineering and Computer Engineering are available to students in either program. This enables students to study aspects of either program area.

Computer Engineering or Computer Science?

Computer Science is primarily concerned with the programming side of computers, as well as computational theory and artificial intelligence. Computer Engineering focuses on the entire system – and offers students both a computing background and an electronic hardware background. Therefore, they learn how to integrate digital technologies in industrial systems. Also, an Engineering degree leads to professional registration.
Areas of Focus in Electrical and Computer Engineering:

Students can choose to focus their technical elective courses in the following areas, and this advanced study will be indicated on their final degree.

- Power and Energy Systems (Elec. Eng.)
- Wireless Communication Devices (Elec. Eng.)
- Engineering Physics (Elec. Eng.)
- Biomedical (Elec. Eng.)
- Communication Networks (Comp. Eng.)
- Embedded Systems (Comp. Eng.)
- Machine Vision (Comp. Eng.)

1 Students in the Biomedical area can complete courses required for admission to the Faculty of Medicine if desired.

Is There Practical or Work Experience?

Courses are geared toward continuous learning and industrial technologies. Engineering design concepts are part of many courses, including a team-based group design project course in the final year.

Students can also choose to add valuable work experience to their undergraduate degree by participating in an industry internship program between the final two years of course work. This is a paid work experience, and most internship students have offers of full-time jobs after graduation or subsidized education for their final year of study.

How Do I Get In?

Students are accepted each year from University 1, or following the 1st year of direct entry to Engineering. For more information, refer to The University of Manitoba General Calendar.

Contact Information:
Dept. of Electrical and and Computer Engineering
Room E2-390 EITC Building
75A Chancellor’s Circle
University of Manitoba
Winnipeg, MB, R3T 5V6, Canada
Tel: 204-474-9099
Web: www.ece.umanitoba.ca
### Computer Engineering Program Technical Electives

**Dept. of Electrical and Computer Engineering**  
University of Manitoba

#### Computer Engineering Electives: **must take 1**

<table>
<thead>
<tr>
<th>Year</th>
<th>Term</th>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>Term 1</td>
<td>ECE 3750</td>
<td>System Engineering Principles 2</td>
</tr>
<tr>
<td>Year 1</td>
<td>Term 2</td>
<td>ECE 3770</td>
<td>Digital Systems Design 2</td>
</tr>
<tr>
<td>Year 1</td>
<td></td>
<td>ECE 4250</td>
<td>Digital Communications</td>
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<tr>
<td>Year 1</td>
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<td>ECE 4420</td>
<td>Digital Control</td>
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<tr>
<td>Year 1</td>
<td></td>
<td>ECE 4440</td>
<td>Computer Vision</td>
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<tr>
<td>Year 1</td>
<td></td>
<td>ECE 4520</td>
<td>Simulation &amp; Modelling</td>
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<tr>
<td>Year 1</td>
<td></td>
<td>ECE 4530</td>
<td>Parallel Processing</td>
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<tr>
<td>Year 1</td>
<td></td>
<td>ECE 4540</td>
<td>Wireless Networks</td>
</tr>
<tr>
<td>Year 2</td>
<td>Term 1</td>
<td>ECE 4850 - 4880</td>
<td>Performance Evaluation for Communications and Computer Engineering</td>
</tr>
<tr>
<td>Year 2</td>
<td></td>
<td>ECE 4850</td>
<td>Contemporary Topics in ECE</td>
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#### Computer Science Electives: **must take 1**

<table>
<thead>
<tr>
<th>Year 2</th>
<th>Term 2</th>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>Year 3</td>
<td>Term 1</td>
<td>COMP 2150</td>
<td>Object Orientation</td>
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<tr>
<td>Year 3</td>
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<td>COMP 2160</td>
<td>Programming Practices</td>
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<tr>
<td>Year 3</td>
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<td>COMP 3010</td>
<td>Distributed Computing</td>
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<tr>
<td>Year 3</td>
<td></td>
<td>COMP 3020</td>
<td>Human Computer Interaction 1</td>
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<td>Year 3</td>
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<td>COMP 3190</td>
<td>Intro. Artificial Intelligence</td>
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<tr>
<td>Year 3</td>
<td></td>
<td>COMP 3290</td>
<td>Intro. Compiler Construction</td>
</tr>
<tr>
<td>Year 3</td>
<td></td>
<td>COMP 3380</td>
<td>Database Concepts &amp; Usage</td>
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<tr>
<td>Year 3</td>
<td></td>
<td>COMP 3490</td>
<td>Computer Graphics 1</td>
</tr>
<tr>
<td>Year 3</td>
<td></td>
<td>COMP 3710</td>
<td>User Interfaces</td>
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<tr>
<td>Year 3</td>
<td></td>
<td>COMP 4020</td>
<td>Human Computer Interaction 2</td>
</tr>
<tr>
<td>Year 3</td>
<td></td>
<td>COMP 4300</td>
<td>Computer Networks</td>
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<tr>
<td>Year 3</td>
<td></td>
<td>COMP 4360</td>
<td>Machine Learning</td>
</tr>
<tr>
<td>Year 4</td>
<td>Term 1</td>
<td>COMP 4490</td>
<td>Computer Graphics 2</td>
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<tr>
<td>Year 4</td>
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<td>ECE 3580</td>
<td>Foundations of Electromagnetics</td>
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<td>ECE 3600</td>
<td>Physical Electronics</td>
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<td>ECE 3720</td>
<td>Electric Power &amp; Machines</td>
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<td>ECE 4100</td>
<td>Microelectronic Fabrication</td>
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<td>ECE 4150</td>
<td>Control Systems</td>
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<td>Year 4</td>
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<td>ECE 4260</td>
<td>Communication Systems</td>
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<td>Year 4</td>
<td></td>
<td>ECE 4390</td>
<td>Engineering Computations 4E</td>
</tr>
<tr>
<td>Year 4</td>
<td></td>
<td>ECE 4610</td>
<td>Biomedical Instrumentation &amp; Signal Processing</td>
</tr>
</tbody>
</table>

#### Electrical Engineering Electives: **must take 1**

<table>
<thead>
<tr>
<th>Year 4</th>
<th>Term 2</th>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
</table>

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**Technical Electives:**

- 1 Electrical Engineering elective is required.  
- 1 Computer Engineering elective is required.  
- 1 Computer Science elective is required.  
- Technical electives or Science Course 4 can be taken in any term.
Computer Engineering Areas of Focus

**Embedded Systems Area:**
This subject area involves the analysis, design, and implementation of algorithms, hardware, and software to form subsystems capable of performing one or many dedicated functions, often in real time, in many applications.

**Required Courses**
- ECE 3740 Systems Engineering Principles 1
- ECE 3760 Digital System Design 1
- ECE 4240 Microprocessor Interfacing
- ECE 4740 Digital System Implementation
- COMP 3430 Operating Systems

**Elective Courses** (take one from the list)
- COMP 2160 Programming Practices
- COMP 3020 Human-Computer Interaction 1

**Machine Vision Area:**
This subject area involves the specification, analysis, design, and optimization of architectures, algorithms/protocols, and operation/maintenance/management of systems and networks, dealing with digital images.

**Required Courses**
- ECE 3790 Engineering Algorithms
- ECE 4440 Computer Vision
- ECE 4830 Signal Processing II
- COMP 3490 Computer Graphics I

**Elective Courses** (take two from the list)
- ECE 4610 Biomedical Instrumentation and Signal Processing
- COMP 3020 Human-Computer Interaction 1
- COMP 4020 Human-Computer Interaction 2
- COMP 4360 Machine Learning

**Communication Networks Area:**
This subject area involves the specification, analysis, design and optimization of architectures, algorithms and protocols, and operation/maintenance/management of communications systems and networks, including both wired and wireless networks.

**Required Courses**
- ECE 3700 Telecommunications Network Engineering
- ECE 3790 Engineering Algorithms
- ECE 4240 Microprocessor Interfacing
- ECE 4260 Communications Systems

**Elective Courses** (take two from the list)
- ECE 4250 Digital Communications
- ECE 4520 Simulation and Modeling
- ECE 4750 Wireless Networks
- ECE 4xxx Performance Evaluation for Communications and Computer Engineering
Electrical Engineering Program Technical Electives
Dept. of Electrical and Computer Engineering
University of Manitoba

7 technical electives are required:
- At least 4 technical electives must be taken from Group A technical elective courses.

**Group A technical elective courses:**

<table>
<thead>
<tr>
<th>Year</th>
<th>Term</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>ECE 3650 Electric Machines</td>
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<tr>
<td>1</td>
<td>2</td>
<td>ECE 4110 Microelectronic Fabrication</td>
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<tr>
<td>2</td>
<td>1</td>
<td>ECE 4140 Power Transmission Lines</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>ECE 4160 Control Engineering</td>
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<td>2</td>
<td>2</td>
<td>Year 2</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>ECE 4200 Electric Filter Design</td>
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<td>2</td>
<td>2</td>
<td>ECE 4250 Digital Communications</td>
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<tr>
<td>2</td>
<td>2</td>
<td>ECE 4270 Antennas</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>ECE 4280 Engineering Electromagnetics</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>ECE 4290 Microwave Engineering</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>ECE 4300 Electrical Energy Systems 1</td>
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<tr>
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<td>ECE 4310 Electrical Energy Systems 2</td>
</tr>
<tr>
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<td>2</td>
<td>ECE 4350 Power Electronics</td>
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<td>2</td>
<td>2</td>
<td>ECE 4390 Engineering Computations 3E</td>
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<tr>
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<td>ECE 4420 Digital Control</td>
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<td>1</td>
<td>ECE 4580 Optoelectronics</td>
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<tr>
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<td>1</td>
<td>ECE 4610 Biomedical Engineering and Instrumentation</td>
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<tr>
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<tr>
<td>3</td>
<td>1</td>
<td>ECE 4xxx Biomedical Optics</td>
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<tr>
<td>3</td>
<td>1</td>
<td>ECE 4xxx Design of RF Devices and Wireless Systems</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>ECE 4xxx High Voltage Equipment Testing, Measurement, and Diagnosis</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>ECE 4850 - 4880 Contemporary Topics in ECE</td>
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</table>

**Group B technical elective courses:**

<table>
<thead>
<tr>
<th>Year</th>
<th>Term</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>1</td>
<td>ECE 3700 Telecom Networking</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>ECE 3760 Digital System Design 1</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>ECE 3770 Digital System Design 2</td>
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<tr>
<td>4</td>
<td>2</td>
<td>ECE 4240 Microprocessor Interfacing</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>ECE 4440 Computer Vision</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>ECE 4530 Parallel Processing</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>ECE 4540 Wireless Networks</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>ECE 4740 Digital System Implementation</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>ECE 4xxx Performance Evaluation for Communications and Computer Engineering</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>COMP 2140 Data Structures and Algorithms</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>MATH 3120 Applied Discrete Mathematics</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>MATH 3700 Applied Complex Analysis</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>or MATH 3710 Complex Analysis 1</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>MATH 3810 Partial Differential Equations</td>
</tr>
</tbody>
</table>

March 15, 2011
Electrical Engineering - Power & Energy Systems Area

This subject area focuses on concepts and systems used in the generation, transmission, delivery, utilization, storage, and control of electric power and energy. Topics include electrical power generation and transmission; electric machines, drives and power electronics; high voltage systems; planning, operation, security, and protection of power and energy systems; renewable energy systems.

In place of 5 Technical Electives in the EE program, students are to take the following courses:

1 ECE 3650 Electric Machines
PES Technical Elective Group 1 course
PES Technical Elective Group 1 course
PES Technical Elective Group 1 course
PES Technical Elective Group 1 or Group 2 course

1 This course is prerequisite for some technical electives in this Area. It is recommended that students take ECE 3650 prior to their final year, so as to not prevent them from taking other desired courses in their final year.

Group 1 Power and Energy System (PES) Technical Elective Courses:

- ECE 4140 Power Transmission Lines
- ECE 4300 Electrical Energy Systems I
- ECE 4310 Electrical Energy Systems II
- ECE 4370 Power Electronics
- ECE 4xxx High Voltage Equipment Testing, Measurement, and Diagnosis

Group 2 Power and Energy System (PES) Technical Elective Courses:

- ECE 3760 Digital System Design 1
- ECE 4160 Control Engineering
- ECE 4240 Microprocessor Interfacing
- ECE 4280 Engineering Electromagnetics
- ECE 4390 Engineering Computations 3E
- ECE 4420 Digital Control
- ECE 4530 Parallel Processing
- ECE 4830 Signal Processing 2
- MATH 3700 Applied Complex Analysis
- MATH 3810 Partial Differential Equations

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Electrical Engineering - Wireless Communication Devices Area

This subject area focuses on devices and components used in wireless communication systems. Applications include personal communication systems, wireless devices, vehicular and aircraft communications and radar, satellite systems, and remote sensing and sub-surface imaging. Topics range from fiber optics, lasers, antenna systems, microwave circuitry, and microelectronic devices.

In place of 5 Technical Electives in the EE program, students are to take the following courses:

Group 1 Wireless Communication Devices (WCD) Technical Elective Courses:

- ECE 4270 Antennas
- ECE 4290 Microwave Engineering
- ECE 4100 Microelectronic Fabrication
- ECE 4280 Engineering Electromagnetics
- ECE 4580 Optoelectronics
- ECE 4xxx Design of RF Devices and Wireless Systems

Group 2 Wireless Communication Devices (WCD) Technical Elective Courses:

- ECE 3700 Telecom Networking
- ECE 4200 Electric Filter Design
- ECE 4250 Digital Communications
- ECE 4390 Engineering Computations 3E
- ECE 4540 Wireless Networks
- ECE 4740 Digital Systems Implementation
- ECE 4830 Signal Processing 2
- MATH 3700 Applied Complex Analysis
  or MATH 3710 Complex Analysis 1
- MATH 3810 Partial Differential Equations

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March 15, 2011
This subject area focuses on the application of engineering techniques to medicine and life sciences. Biomedical Engineers advance medical technology by developing instrumentation and methods for diagnosis of diseases, models of biological mechanisms, prosthetic devices, rehabilitation techniques, imaging systems, and improvement of patient healthcare.

In place of 4 Technical Electives and Science Course 4 in the EE program, students are to take the following courses:

**Electrical Engineering - Biomedical Area**

**Group 1 Biomedical (BME) Technical Elective Courses:**
- ECE 4610 Biomedical Instrumentation and Signals
- BIOL 1410 Anatomy of the Human Body
- BIOE 2590 Biology for Engineers
- or BIOL 1030 Biology 2: Biological Diversity, Function & Int.
- BIOL 1412 Physiology of the Human Body
- or MBIO 1220 Essentials of Microbiology
- BME Technical Elective Group 1 course
- BME Technical Elective Group 1 or Group 2 course

**Group 2 Biomedical (BME) Technical Elective Courses:**
- BIOL 1412 Physiology of the Human Body
- MBIO 1220 Essentials of Microbiology
- BIOE 3320 Engineering Properties of Biological Materials
- BIOE 4610 Design of Assistive Technology Devices
- CHEM 1310 Introduction to Physical Chemistry
- CHEM 2210 Intro. Organic Chemistry 1: Structure and Function
- CHEM 2360 Biochemistry 1: Biomolecules & Intro to Metabolic Energy

**Notes:**
- With permission of the Department, students can substitute BME Group 1 or 2 Elective courses for any of their remaining 3 Electrical Engineering Technical Elective courses.
- The ECE department cannot guarantee space or ensure against time slot conflicts regarding courses taught by other Departments/Faculties.

**Admission into the Faculty of Medicine:**

Eligibility requirements towards admission into the Faculty of Medicine can be achieved from within the Biomedical Area program if students substitute their remaining 3 Electrical Engineering Technical Electives with appropriate courses from BME Group 1 and Group 2 lists. The following courses must be taken:

- BIOL 1410 Anatomy of the Human Body
- BIOL 1412 Physiology of the Human Body
- MBIO 1220 Essentials of Microbiology
- CHEM 1310 Introduction to Physical Chemistry
- CHEM 2210 Intro. Organic Chemistry 1: Structure and Function
- CHEM 2360 Biochemistry 1: Biomolecules & Intro to Metabolic Energy
- CHEM 2370 Biochemistry 2: Catabolism, Synthesis, Info. Pathways

**Notes:** This information is valid for the 2009-2010 academic year. Entrance requirements for the Faculty of Medicine may change in subsequent years.
Electrical Engineering - Engineering Physics Area

This subject area offers students advanced courses in Physics, in addition to the core and elective courses in Electrical Engineering. The additional content provides students with greater understanding of Physics fundamentals. The range of applications overlap with many Electrical Engineering specialties, and also may include optics and lasers, solid state physics and microelectronic devices, quantum physics, and nanotechnology.

In place of 5 Technical Electives and Science Course 4 in the EE program, students are to take the following courses:

**ECE 4580** Optoelectronics
**PHYS 2380** Quantum Physics 1
**PHYS 2650** Classical Mechanics 1
**PHYS 3670** Classical Thermodynamics
**PHYS 3680** Statistical Mechanics

**ECE** Technical Elective Group 1 course
**EPHY** Technical Elective Group 1 or Group 2 course

**Group 1 Engineering Physics (EPHY)** Technical Elective Courses:
- **PHYS 3380** Quantum Physics 2
- **PHYS 3430** Honours Physics Laboratory
- **PHYS 3570** Physics of Materials 1
- **PHYS 3650** Classical Mechanics 2
- **PHYS 4520** Introduction to Solid State Physics
- **PHYS 4590** Advanced Optics

**Group 2 Engineering Physics (EPHY)** Technical Elective Courses:
- **ECE 4270** Antennas
- **ECE 4280** Engineering Electromagnetics
- **ECE 4xxx** Biomedical Optics
- **PHYS 2260** Optics
- **PHYS 3320** Medical Physics and Physiological Measurement

**Note:** The ECE department cannot guarantee space or ensure against time slot conflicts regarding courses taught by other Departments/Faculties.

**Recognized Physics/Math Course Equivalencies for Transfer Students From Physics:**

**Recognized Physics Courses:**
- **MATH 1300** Vector Geometry & Linear Algebra
- **MATH 2720** Multivariable Calculus
- **PHYS 1070** Waves & Modern Physics
- **PHYS 2600** Electromagnetic Field Theory
- **PHYS 2390** Theoretical Physics 1
- **PHYS 2490** Theoretical Physics 2

Students having completed the above recognized courses, will be considered to have achieved content equivalencies provided by the following required courses in the Electrical Engineering Program.

- **MATH 1210** Classical and Linear Algebra
- **MATH 2130** Engineering Mathematical Analysis 1
- **MATH 2132** Engineering Mathematical Analysis 2
- **MATH 3132** Engineering Mathematical Analysis 3
- **PHYS 2152** Modern Physics for Engineers

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**March 15, 2011**