ENGINEERING PHYSICS
Industry Guide

Introduction

The Engineering Physics program at the University of British Columbia (UBC) is renowned for its interdisciplinary approach, combining physics, engineering, and mathematics to address complex technical challenges. Known for producing highly versatile graduates, the program emphasizes a rigorous curriculum and hands-on experience, supported by world-class faculty and facilities.

Engineering Physics graduates excel in industries that demand a strong foundation in scientific principles and innovative problem-solving, including aerospace, renewable energy, robotics, software development, quantum computing, and medical technologies. Their expertise drives advancements in cutting-edge fields and emerging technologies.

This document outlines potential industries and companies where Engineering Physics professionals can contribute and thrive. While not exhaustive, it highlights pathways for impactful careers in this unique and forward-looking discipline.

Key Areas of Study:

- Electronics and Instrumentation, Optics and Photonics, Control Systems, Robotics, Quantum Mechanics, Computational Physics, Nanotechnology, Renewable Energy Systems, Machine Learning, Software Development, Medical Imaging, and Aerospace Technologies.

Industries

Engineering Physics bridges the gap between fundamental science and engineering, playing a transformative role in industries that demand innovative solutions and interdisciplinary expertise. In aerospace, Engineering Physics professionals contribute to the development of advanced propulsion systems, spacecraft, and satellite technologies. The renewable energy sector benefits from their skills in optimizing solar, wind, and other sustainable power systems. In the rapidly evolving field of quantum computing, their deep understanding of physics drives breakthroughs in computation and information processing. Medical technologies, including imaging systems and precision instrumentation, rely on their ability to merge physics principles with engineering design. Robotics and automation systems benefit from their expertise in control systems and sensor integration. Additionally, nanotechnology and materials science open doors to developing cutting-edge materials with applications in electronics, healthcare, and energy. These industries demonstrate the significant and diverse contributions of Engineering Physics in advancing modern technology.

Industries

ENGINEERING CONSULTING

Engineering consulting applies interdisciplinary expertise and advanced tools to address complex challenges requiring physics and engineering insights. Consulting firms tackle problems beyond in-house capabilities, offering Engineering Physics graduates opportunities to apply their diverse skills in industries like aerospace, renewable energy, and advanced technologies.

ESSENTIAL SKILLS:

- Project Management
- Compliance and Standards Knowledge
- Data Analysis & Modeling
- Technical Expertise
- Communication Skills
- Problem-Solving Abilities

POSITIONS:

- Entry Level: Junior Consultant, Junior Design Engineer
- Mid-level: Consulting Engineer, Systems Integration Engineer
- Senior: Lead Project Engineer, Senior Consultant, Lead Design Engineer

EMBEDDED SYSTEMS

Embedded systems engineers with an Engineering Physics background specialize in designing and optimizing both hardware and software for systems that integrate physics principles, such as advanced sensors, robotics, and precision instruments. These systems are critical in applications ranging from medical devices to aerospace technologies, where efficiency, reliability, and real-time performance in complex, resource-constrained environments are paramount.

ESSENTIAL SKILLS:

- C/C++
- Hardware Knowledge
- Real-Time Operating Systems (RTOS)
- Debugging and Testing
- System Integration.
- Linux
- Version Control Systems (e.g., Git)
- Communication Skills (including technical writing)

POSITIONS:

- Junior: Junior Embedded Systems Engineer, Firmware Engineer, Member of Technical Staff (MTS)
- Mid-level: Associate Member of Technical Staff (AMTS), Systems Integration Engineer
- Senior: Senior Principal Firmware Engineer, Lead Firmware Engineer, Principal Embedded Systems Architect, Senior Member of Technical Staff (SMTS), Technical Director

MACHINE LEARNING

Machine learning engineers with an Engineering Physics background bring a unique perspective to AI, leveraging their expertise in mathematics, physics-based modeling, and computational problem-solving. They develop and train advanced algorithms for applications such as robotics, autonomous systems, and scientific simulations. This field focuses on transforming complex data into actionable insights, driving innovation in technology and improving decision-making processes across

ESSENTIAL SKILLS:

- Mathematics
- Programming Proficiency in Python and R
- Machine Learning Frameworks (PyTorch, TensorFlow)
- Data Preprocessing
- Model Evaluation
- Communication Skills

POSITIONS:

- Junior:
  - Junior Machine Learning Engineer
  - Data Analyst
- Mid-level:
  - Machine Learning Engineer
  - Data Scientist
- Senior:
  - Senior Machine Learning Engineer
  - Machine Learning Research Scientist
  - AI Solutions Architect

Industries

AEROSPACE AND DEFENSE

As an Engineering Physics graduate in the aerospace and defense industry, you will apply your knowledge of physics, mathematics, and engineering to design, test, and optimize systems like spacecraft, satellites, and defense technologies. This role involves solving complex problems in propulsion, materials science, and control systems to create advanced technologies for space exploration and national defense.

ESSENTIAL SKILLS:

- Systems Engineering
- Mathematical Modeling and Simulation
- Fluid Dynamics, Thermodynamics, and Structural Mechanics
- Control Systems
- CAD and Simulation Software (e.g., MATLAB, Simulink, COMSOL)
- Aerospace and Defense Standards

POSITIONS:

- Entry Level: Aerospace Engineer, Systems Engineer, Research Assistant
- Mid-level: Aerospace Systems Engineer, Propulsion Engineer, Test Engineer
- Senior: Senior Aerospace Engineer, Lead Systems Engineer, Aerospace R&D Manager, Chief Engineer

SOFTWARE DEVELOPMENT

As a software developer with an Engineering Physics background, you will solve complex challenges in areas like scientific computing, simulations, and data analysis. This role combines programming with physics principles to create solutions for industries such as aerospace and quantum computing. Pathways into this field include internships, co-op experiences, or building a development portfolio.

ESSENTIAL SKILLS:

- Python, Java, C++, Go, JavaScript
- Software Development Frameworks
- Problem-Solving Abilities
- Version Control Systems (e.g., Git)
- Understanding of Software Development Life Cycle
- Communication Skills (including technical writing)

POSITIONS:

- Entry Level: Junior Software Developer, Software Engineer Intern
- Mid-level: Software Developer II, Application Developer
- Senior: Senior Software Developer, Lead Software Engineer, Software Architect, Software Developer III/IV

PROJECT MANAGEMENT

Project Managers with an Engineering Physics background lead and oversee complex, multidisciplinary projects, ensuring they are planned, budgeted, and executed to meet both technical and strategic objectives. This role requires a combination of technical knowledge, strategic planning, and hands-on coordination to manage diverse teams and resources effectively.

ESSENTIAL SKILLS:

- Leadership and Team Management
- Effective Communication Skills
- Budgeting and Financial Acumen
- Risk Management and Problem-Solving
- Time Management and Prioritization
- Knowledge of Project Management Methodologies (e.g., Agile, Scrum)

POSITIONS:

- Entry Level: Project Coordinator, Assistant Project Manager
- Mid-level: Project Manager, Program Manager
- Senior: Senior Project Manager, Project Management Office (PMO) Director, Portfolio Manager

HARDWARE & DESIGN ELECTRONICS

Hardware engineers with an Engineering Physics background specialize in designing and optimizing electronic systems and components for advanced applications, such as robotics, aerospace systems, medical devices, and quantum technologies. They focus on ensuring the functionality, reliability, and efficiency of these systems, often collaborating with software engineers to develop integrated, physics-driven solutions that push the boundaries of technology.

ESSENTIAL SKILLS:

- Proficiency in Electronic Circuit Design
- Knowledge of Hardware Description Languages (e.g., VHDL, Verilog)
- Familiarity with PCB Design and Layout
- Understanding of Signal Integrity and Power Management
- Problem-Solving and Analytical Skills
- Reading and writing technical documentation

POSITIONS:

- Entry Level: Junior Hardware Engineer, Hardware Design Intern
- Mid-level: Hardware Design Engineer, Embedded Systems Engineer
- Senior: Senior Hardware Engineer, Lead Hardware Architect, Principal Hardware Engineer

Industries

RENEWABLE ENERGY & POWER SYSTEMS

As an Engineering Physics graduate in renewable energy and power systems, you will work on developing innovative solutions for sustainable energy generation and distribution. Your role will involve integrating renewable sources like solar and wind into power grids, optimizing energy storage systems, and enhancing efficiency through smart grid technologies. You will apply advanced principles of physics to improve energy conversion, design microgrids, and contribute to the development of technologies such as electric vehicle infrastructure and energy management systems

ESSENTIAL SKILLS:

- Power Systems Analysis
- Knowledge of Renewable Energy Technologies (e.g., solar, wind, hydro)
- Understanding of Energy Storage Systems
- Familiarity with Smart Grid Technologies
- Problem-Solving and Analytical Skills

POSITIONS:

- Entry Level: Junior Renewable Energy Engineer, Power Systems Analyst, Field Technician
- Mid-level: Renewable Energy Engineer, Power Systems Engineer
- Senior: Senior Renewable Energy Engineer, Lead Power Systems Engineer, Principal Energy Consultant

CONTROL SYSTEMS & ROBOTICS

Control Systems and Robotics engineers are at the forefront of designing automated systems and robotic solutions, developing control algorithms, sensors, and actuators that enable robots and systems to perform tasks autonomously and with precision. This field offers hands-on opportunities, such as joining UBC's Engineering Design Teams, where students can gain practical experience through robotics competitions, providing valuable exposure to real-world applications.

ESSENTIAL SKILLS:

- Proficiency in Control Theory and System Dynamics
- Knowledge of Sensors and Actuators
- Programming Skills (e.g., Python, MATLAB, C++)
- Familiarity with Robotics Frameworks (e.g., ROS)
- Analytical and Problem-Solving Abilities

POSITIONS:

- Entry Level: Control Systems Technician, Junior Robotics Engineer
- Mid-level: Control Systems Engineer, Robotics Engineer
- Senior: Senior Control Engineer, Lead Robotics Engineer, Automation Architect

MEDICAL TECHNOLOGY

As an Engineering Physics graduate in medical technology, you will apply your knowledge of physics and engineering to develop and improve medical devices and systems. You will work on designing diagnostic tools, medical imaging technologies, and therapeutic devices that improve patient care and healthcare delivery.

ESSENTIAL SKILLS:

- Medical Imaging Technologies (e.g., MRI, CT, X-Ray)
- Signal Processing and Data Analysis
- Biomedical Instrumentation
- Control Systems for Medical Devices
- Regulatory Standards (e.g., FDA, ISO)
- Programming (e.g., MATLAB, Python)
- Problem-Solving Abilities
- Communication Skills (including technical writing)

POSITIONS:

- Entry Level: Biomedical Engineer, Medical Device Design Engineer, Research Assistant
- Mid-level: Medical Imaging Engineer, Device Development Engineer, Regulatory Affairs Specialist
- Senior: Senior Biomedical Engineer, Lead Medical Device Engineer, Medical Technology Manager

QUANTUM COMPUTING

As an Engineering Physics graduate in quantum computing, you will apply principles of quantum mechanics and advanced computational techniques to design and optimize quantum processors. This industry focuses on developing new computational paradigms that have the potential to revolutionize fields such as cryptography, machine learning, and materials science.

ESSENTIAL SKILLS:

- Quantum Mechanics
- Quantum Computing Algorithms
- Mathematical Modeling and Simulation
- Programming (e.g., Python, C++, Qiskit)
- Control and Measurement of Quantum Systems
- Data Analysis and Computational Techniques

- Positions:
- Entry Level: Quantum Computing Engineer, Research Scientist, Quantum Algorithm Developer
- Mid-level: Quantum Systems Engineer, Quantum Hardware Engineer, Quantum Software Developer
- Senior: Senior Quantum Engineer, Lead Quantum Algorithm Scientist, Quantum R&D Manager

Technical Skills

CORE SKILLS

CIRCUIT ANALYSIS & DESIGN:
Proficiency in analyzing and designing electrical circuits, including AC/DC circuit fundamentals, analog and digital circuit design, and an understanding of passive and active components.

MECHANICAL DESIGN:
Knowledge of mechanical principles, including material science, kinematics, and mechanical system design. This includes experience with CAD tools, stress analysis, thermodynamics, and mechanical components.

EMBEDDED SYSTEMS:
Familiarity with microcontrollers, real-time operating systems (RTOS), and firmware development. This includes hands-on experience with peripherals, I/O management, and low-level programming.

PROGRAMMING & ALGORITHMS:
Proficiency in key programming languages (e.g., C, C++, Python, Java, JavaScript) and a strong foundation in algorithms, data structures, and problem-solving relevant to embedded and computational applications.

CONTROL SYSTEMS:
Understanding control theory, including feedback loops, PID controllers, and stability analysis, which are foundational for robotics and automation.

POWER ELECTRONICS:
Familiarity with power systems, including transformers, converters, inverters, and renewable energy systems, relevant to high-power and energy-efficient systems.

COMPUTATIONAL PHYSICS:
Experience with simulation tools, numerical methods, and software like MATLAB, Simulink, or Python to simulate and solve physics-based problems.

SYSTEMS THINKING:
Ability to analyze and design complex systems by understanding how different components interact and impact the overall performance of the system.

SOFTWARES AND TOOLS

SIMULATION & DESIGN SOFTWARE:

- MATLAB/Simulink: For numerical computation, data visualization, and simulation of control systems, signals, and RF models.
- Altium, KiCad, Multisim: For circuit simulation and PCB design, enabling prototyping and testing of circuits.

EMBEDDED DEVELOPMENT ENVIRONMENTS:

- Arduino IDE: For embedded system development, commonly used with microcontrollers like Arduino, ARM-based controllers, and PIC microcontrollers.
- PlatformIO: An open-source ecosystem for IoT and embedded development, supporting a range of hardware.

PROGRAMMING & SCRIPTING TOOLS:

- Visual Studio Code, and PyCharm: IDEs commonly used for C/C++, Python, and other programming tasks.
- Terminal, SSH, Bash scripting, Linux

VERSION CONTROL & COLLABORATION:

- Git/GitHub for source code management and collaborative projects.

TESTING & MEASUREMENT:

- Oscilloscopes, Multimeters, and Signal Generators: Proficiency in using essential lab equipment for debugging and measurement.

CAD SOFTWARE:

- AutoCAD: 2D/3D design and drafting.
- SolidWorks: 3D modeling and simulation.

DATA ANALYSIS & VISUALIZATION:

- Python (Pandas, Matplotlib, NumPy)
- Excel: Basic data organization and analysis.

How to get Involved

- Engineering Design Teams
- MANU Undergraduate Student Association
- EUS
- UBC Clubs
- Personal Projects
- UBC Work Learn Program

Other Resources

- IEEE
- UBC IEEE
- https://www.engphys.ubc.ca/fizz/
- About your degree :
  - Engineering Physics