COMPETENCY PROFILE:

ROBOTICS ENGINEER

ROLE OVERVIEW

Robotics engineers are technical specialists and designers of automation, intelligent systems, and robotics devices. Their expertise draws from a comprehensive understanding of mechatronics, computer science, mechanics, and electrical engineering. A robotics engineer's primary responsibility lies in the research and development, design, and integration of robotics automation systems that increase efficiency, performance, and safety. Their role entails effectively managing autonomous systems and robotics applications, emphasizing innovative solutions to enhance operational efficiency.

They find employment opportunities in various sectors, spanning multiple robotics disciplines, including operator interfaces, locomotion, manipulators, sensors, and programming. They are in demand in manufacturing facilities, automotive plants, aerospace companies, the defence and medical industries, and other industrial settings where automation and robotics are integral to operations. Robotics engineers work to understand the organization's or client's needs, conducting research and testing on the project's feasibility and examining the technical possibilities and potential risks and benefits of design.

To be successful in their role, robotics engineers need a combination of technical, personal and professional skills. The individual in this role must possess problem-solving skills, enabling them to discern the underlying causes of problems or system errors to produce a cognisant and comprehensive solution. Collaboration and communication skills with cross-functional teams and stakeholders are also essential for long-term success.

ALSO KNOWN AS:

- Automation Engineer
- Robotics Engineering Consultant
- Robotics System Engineer
- Robotic Technology Engineer

NATIONAL OCCUPATIONAL CLASSIFICATION:

- 21301 – Mechanical engineers

EDUCATION AND EXPERIENCE

- A bachelor's degree is required to enter the robotics engineering field, with degrees in robotics, mechatronics, mechanical engineering, or electrical engineering providing a comprehensive technical foundation. Coursework includes design, analysis, dynamics, control systems, programming, and materials science.
- Master's or doctoral degrees in mechatronics, electrical engineering, electronics, robotics, or automation technology are often pursued to explore areas like artificial intelligence, advanced control systems, sensor technology, and machine learning. These degrees offer enhanced technical knowledge, open leadership, and specialized project opportunities.
- Professional licensing is required to practice as a Professional Engineer (P.Eng.) and involves licensure by a provincial or territorial engineering association. This process ensures adherence to education, experience, and ethics standards and typically requires recognized engineering education, supervised work experience, and passing a professional practice exam.
- Success in robotics engineering demands a broad knowledge of mechanical and electrical engineering, computer science, and engineering; such an interdisciplinary approach facilitates the design, development, and implementation of robotic systems for diverse applications.
- With the field's fast pace, robotics engineers must continuously update their knowledge and skills through education, conferences, and workshops and stay informed on industry trends and technological advancements.

TECHNICAL

Prototype Development

Applying design and engineering principles, designers create prototypes or components of products to showcase the future product and test potential innovations to enhance market competitiveness.

- Applies working or theoretical models throughout the design, testing, and modification process to test against product prototypes.
- Conducts operational tests on models, prototypes, systems, and equipment to determine their capabilities under normal and extreme conditions.
- Simulates mechatronic design concepts by creating mechanical models and performing tolerance analysis.
- Integrates client feedback and test data to refine prototypes to improve end design.

Automation and Computer Programming

Develops code using specialized software to instruct a computer, application, or software program how to perform under specific conditions so that the application or software functions appropriately.

- Uses specialized tools and software to develop control schemas to program machine interactions in a specified environment.
- Applies specialized tools to create automation scripts, code, and processes to train neural nets for faster workflow.
- Employs robot control software to implement a set of commands to instruct a machine on what tasks to perform.

- Identifies error types, applies appropriate methods or techniques to debug software, and corrects errors to maintain system usability.
- Repairs defects identified in testing analysis to ensure accurate application outputs to maintain a functional product or system.
- Works with software developers to improve workflow automation and develop tools to reduce bottlenecks.

Engineering Design

Oversees the technical aspects of the planning and design of engineering projects to ensure each project is constructed safely, efficiently, and effectively.

- Designs automated robotic systems, including but not limited to automatic vehicle control, autonomous vehicles, advanced displays, advanced sensing, robotic platforms, computer vision, or telematics systems. These systems aim to improve production volume or precision in high-output operations.
- Design automated robotic systems for specific applications to increase efficiency and quality.
- Proposes technical design or process changes to improve the efficiency, quality, or performance of products, structures, systems, or facilities.
- Maintains, tests, and upgrades hardware and software systems installed on autonomous or robotics components to maintain efficiency and operational performance.
- Adjusts product designs to ensure that products or parts of a project meet organizational and regulatory requirements.
- Uses computer-aided design (CAD) systems to assist in creating, modifying, analyzing, or optimizing a design.

Engineering Review and Analysis

Reviews and analyzes relevant engineering information about technical designs and complex systems to develop appropriate solutions.

- Evaluate the potential to adopt or integrate autonomous systems or robotics solutions to improve a product, part, or system's efficiency, operations, quality, or performance.
- Gives consent to the finished engineering products so that products can be manufactured and assembled.
- Review the technical designs of junior engineers and other technical staff to ensure accuracy and provide quality control and feedback to improve products, parts, or systems.
- Processes and interprets signals or sensor data from various sources, ensuring data accuracy and relevance.

Feasibility Analysis

Produces a feasibility analysis of the practicality of a proposed project[s], including the economic viability, associated costs and benefits, and technical and time constraints, to ensure projects are completed on time and on budget.

- Conducts research into the feasibility, design, operation, or performance of robotic mechanisms, components, or systems, such as planetary rovers, multiple mobile robots, and reconfigurable robots, to ensure concepts can be transformed into real-world applications.

- Assesses the requirements for a project, such as budget appraisal, expected turnover, and risk assessment, to determine its benefits and costs.
- Assists in evaluating the technical aspects of the project agreement and offers insights on its feasibility. Calculates the potential return on investment and determines whether the expected profits justify the financial risks involved.
- Analyze the efficiency of existing infrastructure and processes to determine where improvements could be implemented.

Research and Development

Applies scientific methods and techniques using empirical and/or measurable observation in their research to improve, correct, or increase knowledge in a field of study to solve specific problems.

- Research robotic technology to create new robotic systems or system capabilities.
- Research emerging aspects in robotics and technological applications to recommend new applications and procedures when available.
- Conducts comprehensive reviews of information and publications to ensure a complete understanding of a subject before development.
- Research advanced engineering designs or applications to improve the knowledge base and ensure design output meets industry standards.

Robotics Management

Oversees the planning, production, and integration of robotic machines, components, or autonomous systems to ensure adequate quality and performance according to engineered specifications.

- Measures the performance of the components, sensors, and devices to provide feedback to other departmental teams to improve product(s).
- Maintains, tests, and upgrades hardware and software systems installed on autonomous or robotic machinery to ensure optimal performance.
- Creates backups of robotics programs or sensor data to create a copy of sensitive information in case of a primary data failure.
- Measures output and compares results with reference data to adjust the reliability and function of a robotic instrument.
- Develops software tools to monitor the performance of components to document findings and troubleshoot issues.
- Investigate mechanical failures or unexpected maintenance problems to develop solutions for future issues.

Advanced Manufacturing Technology

Programs assembles, and installs advanced manufacturing technologies, devices, components, or systems according to engineering specifications to improve organization performance and competitiveness.

- Design robotics applications for manufacturers of green products to increase production time, eliminate waste, or reduce costs.

- Creates back-ups of AMT programs or parameters to prevent data loss and ensures settings can be restored in the event of a failure.
- Follows engineered designs and instructions to assemble robotic machines, devices, and components.
- Programs necessary components of robotic systems, such as robot controllers, conveyors, and end-of-arm tools, to integrate AMT into existing systems or equipment.
- Investigate new technologies and integrate AMT with existing processes to improve production rates, efficiencies, yields, and costs.
- Uses computer-aided manufacturing (CAM) programs to control machinery and machine tools in creating, modifying, analyzing, or optimizing computer hardware components.

PERSONAL & PROFESSIONAL

Problem-Solving

Identifies problems, uses logic, judgment, and evidence to evaluate alternative scenarios, and recommends solutions to achieve a desired goal.

- Analyzes operational data to evaluate operations, understand trends and potential areas of concern, and take appropriate action where required.
- Takes an unbiased stance on interpreting new information to solve a problem objectively.
- Considers all pieces of information when attempting to solve problems to produce a cognisant and comprehensive solution.
- Applies mathematical models and techniques to perform analysis and create solutions to specific problems.

Collaboration

Engages in professional collaborative efforts with other team members, including sharing information and expertise, utilizing input from others, and recognizing others' contributions to work towards a common goal.

- Liaises with intra-departmental teams to establish priorities and provide general engineering support.
- Encourages other team members to assist one another by expressing that others contribute their knowledge, expertise, or efforts to achieve objectives.
- Works cooperatively with multiple stakeholders, demonstrating a willingness to consider alternative approaches, ideas, or insights.
- Provides team members with constructive feedback and perspective to aid in completing a task or goal.

Attention to Detail

Delivers a concentrated concern, including monitoring and checking information, organizing tasks and resources efficiently, or all areas involved towards completing an objective.

- Provides accurate, consistent information on all pieces of work to ensure reliable results.
- Identifies and rectifies personal mistakes or oversights when possible, aiming to minimize future performance problems and ensure that software products, systems, interfaces, or applications function as intended.
- Routinely checks in with clients to consider changing priorities or expectations to produce results that improve relationships and business objectives.

Communication

Positively directs outcomes by delivering communication that results in a better understanding of goals and objectives, captures interest, and gains support for immediate action.

- Maintains communications with the team and external stakeholders to exchange information, assess progress, and reassign work as needed.
- Leads presentations to technical and non-technical colleagues and clients to convey project plans and progress.
- Provides clear instructions, information, and duties to supervised employees to ensure employees clearly understand their position.
- Explains novel or complex engineering concepts and related facts appropriately to an audience to explain aspects of the design process and/or proposal.

LEGAL, POLICY, AND REGULATORY

Health and Safety Procedures

Adheres to and advocates specific workplace safe operating procedures and occupational health and safety requirements within a defined jurisdiction to ensure the health and safety of others.

- Establishes safeguards and best practices within a project team to align with organizational health and safety plans to ensure the safety of all team members.
- Applies appropriate health and safety procedures in all aspects of work to ensure zero incidents.
- Documents any workplace incidents and accidents to ensure hazards are reduced.
- Identifies potential hazards in the workplace so that appropriate measures are taken to correct deficiencies.

Protecting Public Interest

Weigh the impacts of engineered designs on life, health, property, economic interests, and the environment to ensure that products or systems are in the best interest of public life.

- Assesses relevant regulations, legislation, and standards to ensure the project complies with them.
- Demonstrates knowledge of regulations, codes, standards, and safety, including local engineering procedures and practices to ensure the safe operation of facilities and systems.
- Applies engineering codes and statutes of a defined jurisdiction in the design process to ensure a safe workplace.
- Assesses the safety concerns and potential risks related to engineering activities to identify hazards and consider appropriate solutions to mitigate them.

This profile is a living document. If you have any feedback or would like to help us improve the profile, please reach out to research@eco.ca.

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