

PROGRAM CRITERIA FOR ELECTRICAL ENGINEERING TECHNOLOGY

Scope

These program criteria apply to programs having titles involving Electrical Engineering Technology including: “electrical engineering”, “electrical power”, “industrial control”, “power and controls”, and similar modifiers in their titles.

Objective

An accredited program in Electrical Engineering Technology will prepare graduates with the technical skills necessary to enter careers in design, commissioning, engineering sales and support, operations and maintenance in the fields of electrical power system generation, distribution and protection, manufacturing, construction, machine and process control and electricity utilization systems.

Graduates of electrical engineering technology programs will be able to:

- a) apply their extensive laboratory experience in component/device operation, calibration and interconnection, to operate, maintain and install electrical systems;
- b) undertake the design and specification of electrical systems and management of their installation and operation;
- c) apply practical engineering skills to innovate and solve real-life problems;
- d) exercise due diligence in the workplace;
- e) adhere to applicable laws;
- f) prepare technical reports;
- g) carry out detailed inspections;
- h) adhere to health and safety practices; and
- i) determine appropriate procedures and actions.

Program Outcomes

The learning outcomes presented below are presented in two categories: Group A and Group B. *In order for a program to be accredited it must demonstrate that graduates have appropriate depth and breadth in the training they have received. For the Electrical discipline, it is **suggested** that a program must demonstrate **no fewer than five** learning outcomes, with **no fewer than two** from Group A.* Group A outcomes are broad and universal while Group B major outcomes are less universal and narrower in scope providing recognition for regional variations.

The field of Electrical Engineering Technology is heavily dependent on the application of in-depth fundamentals and the use of computers in the analysis, design, and operation of manufacturing and processing facilities.

The program must demonstrate that graduates have the ability to:

Group A:

Ei01-A Develop designs and specifications for interior and exterior electrical distribution and utilization systems up to 750V.

Indicators of Performance, such as:

- 1.1-A Design and specify interior and exterior power transmission and distribution systems up to 750V.
- 1.2-A Design interior and exterior lighting systems for residential, commercial, and industrial installations.
- 1.3-A Design auxiliary systems including fire-alarm installations, UPS, and basic communication systems.
- 1.4-A Design and specify electrical equipment installations, including electrical machines, machine control, motor-control centers, metering, and grounding systems.
- 1.5-A Apply Canadian Codes to the design of electrical systems.
- 1.6-A Design and specify medium-voltage installations for switchgear and substations.
- 1.7-A Apply project management principles to development and implementation of electrical installations.

Ei02-A Apply knowledge of power-system configurations, electrical equipment, and protection practices to the design and specification of electrical generation, transmission, distribution, and utilization systems above 750V.

Indicators of Performance, such as:

- 2.1-A Design, evaluate, and commission power transmission and distribution systems over 750V (medium and high voltage).
- 2.2-A Design and evaluate power-system grounding schemes.

- 2.3-A Employ MVA-base methods, symmetrical component, and per-unit methods in design and analysis of power systems and faults.
- 2.4-A Select, design, and evaluate protection and coordination schemes, utilizing zones of protection and protective relays for protection of machines and transmission and distribution systems.
- 2.5-A Apply dedicated software in the design and modeling of power systems, protection, and coordination.
- 2.6-A Select, test, program, and calibrate protective relays.
- 2.7-A Apply project management principles to development and implementation of electrical installations.
- 2.8-A Specify and design grounding and bonding schemes.

Ei03-A Commission, test, and maintain utility and industrial generation, transmission, and distribution systems, and equipment.

Indicators of Performance, such as:

- 3.1-A Conduct acceptance and maintenance tests on electrical equipment to NETA and IEEE standards.
- 3.2-A Commission electrical system and equipment installations.
- 3.3-A Perform maintenance testing and evaluation of cables, transformers, and circuit breakers.
- 3.4-A Incorporate arc-flash evaluation and protection in electrical installations to NFPA-70E standards.
- 3.5-A Use appropriate and standard safety equipment and practices in all fieldwork. Demonstrate a “safety-first” attitude.
- 3.6-A Write thorough evaluation reports on all commissioning and acceptance and maintenance testing.

Ei04-A Commission, and maintain transformers and rotating electrical machines.

Indicators of Performance, such as:

- 4.1-A Design and specify single-phase and three-phase transformer installations.
- 4.2-A Conduct open-circuit and short-circuit tests on transformers; interpret and apply test results.
- 4.3-A Evaluate and mitigate three-phase transformer harmonics.
- 4.4-A Design and specify DC motor and DC generator installations.
- 4.5-A Design and specify AC induction motor installations.
- 4.6-A Design and specify AC alternator and synchronous motor installations.

- 4.7-A Commission, test, and maintain electrical machines.
- 4.8-A Perform acceptance and maintenance tests to NETA or IEEE standards.

Ei05-A Design, commission, and maintain test equipment and instrumentation systems.

Indicators of Performance, such as:

- 5.1-A Design, specify, commission, and maintain line-voltage control systems, including field devices, relays, starters, and speed controllers.
- 5.2-A Use instrumentation, metering, and computer-based equipment to analyze and troubleshoot circuits.
- 5.3-A Apply a variety of data communication protocols linking PLCs with field devices and other controllers.
- 5.4-A Specify and select programmable logic controller systems including processors, I/O modules, controller networks, and I/O networks.
- 5.5-A Design, test, debug, commission, and maintain programs for programmable logic controllers.
- 5.6-A Design, test, debug, commission, and maintain graphics for human machine interface applications.
- 5.7-A Specify power supply, protection, enclosure, cooling, and other installation requirements for industrial automations systems.
- 5.8-A Specify and select distributed control systems (DCS), including processors, I/O modules, controller networks, and I/O networks.
- 5.9-A Design, test, debug, commission. and maintain programs for distributed control systems.
- 5.10-A Specify and select industrial instrumentation equipment, including process variable sensors, transmitters, signal conditioners, recorders, and controllers.
- 5.11-A Apply principles of process control to configure feedback control loops, tune common control loops, and analyze their performance.
- 5.12-A Specify, commission, and troubleshoot solid-state and soft starters for motors and associated wiring and equipment.
- 5.13-A Specify, install, program, and maintain variable-frequency drives.
- 5.14-A Evaluate and mitigate power-quality and harmonic content.

Ei06-A Plan, direct, and manage electrical engineering projects.

Indicators of Performance, such as:

- 6.1-A Apply project management principles and software to organization and management of all aspects of project development.

- 6.2-A Supervise the installation and commissioning of electrical systems for power distribution in buildings and industrial facilities.
- 6.3-A Supervise the installation and commissioning of automation systems in buildings and industrial facilities.
- 6.4-A Supervise the installation and commissioning of industrial data communications networks.
- 6.5-A Develop and maintain project documentation including drawings, specifications, procedures, and reports.

Group B:

Ei01-B Analyze, specify, design and install renewable and sustainable energy resource systems.

Indicators of Performance, such as:

- 1.1-B Analyze a given site for solar energy with respect to geographical coordinates, weather patterns, physical parameters and available electrical supply.
- 1.2-B Design a solar photovoltaic system for a given geographic site.
- 1.3-B Design and install a ground source heat pump system.
- 1.4-B Analyze a site and/or house for passive solar heating.
- 1.5-B Design and install a solar water heating system.
- 1.6-B Analyze a given site for wind energy with respect to geographical coordinates, weather patterns, physical parameters, and available electrical supply.
- 1.7-B Design and install a wind energy system.
- 1.8-B Evaluate the short and long-term financial and environmental costs and benefits of a sustainable energy resource proposal.

Ei02-B Design, analyze, troubleshoot, and specify computer aided/integrated manufacturing systems, robotic systems, and associated controls and work cells; plan and evaluate layouts of automated industrial/robotic systems.

Indicators of Performance, such as:

- 2.1-B Prepare specifications for robot applications.
- 2.2-B Specify hydraulic and pneumatic system requirements for robotics systems.
- 2.3-B Select electrical motor drives for robotic systems.
- 2.4-B Analyze manufacturing work cell environments.
- 2.5-B Evaluate safety, performance and efficiencies of robotic systems.
- 2.6-B Specify programmable controllers in automated systems.

- 2.7-B Justify Computer Integrated Systems for manufacturing applications.
- 2.8-B Apply control theory and principles to analyze and develop control systems for industrial automation.
- 2.9-B Plan and evaluate layouts of automated industrial/manufacturing systems.
- 2.10-B Interpret technical literature dealing with industrial automation technologies.

Ei03-B Specify, select, design, build, and troubleshoot microprocessor or microcontroller-based systems for engineering applications.

Indicators of Performance, such as:

- 3.1-B Given a specific application, create a clear functional specification document for a microprocessor or microcontroller-based system.
- 3.2-B Select and specify computer-related hardware and software to meet design specifications.
- 3.3-B Design microprocessor or microcontroller-based systems using knowledge of computer-related hardware and software.
- 3.4-B Construct, test, and evaluate microprocessor or microcontroller-based systems.
- 3.5-B Analyze and solve microprocessor or microcontroller-based system design and functionality issues.
- 3.6-B Using an appropriate debug and compile environment, design, code, and debug both high-level and assembly language programs for use in microprocessor or microcontroller applications.
- 3.7-B Select and use test or measurement instrumentation, including logic analyzers and oscilloscopes, to characterize and troubleshoot microprocessor or microcontroller-based systems.
- 3.8-B Assess, design, and install interfaces, including A/D and D/A converters, between microprocessor or microcontroller-based systems, and with supporting I/O devices.
- 3.9-B Use appropriate hardware emulation tools to model the expected behaviour of microprocessor or microcontroller-based systems.

Ei04-B Design, manufacture, or overhaul electrical equipment, including transformers and rotating electrical machines.

Indicators of Performance, such as:

- 4.1-B Analyze each application to determine the operating and environmental requirements, and with consideration for ease of manufacture and cost effectiveness, design the equipment or machine to meet the specified output, selecting the materials, component dimensions, cooling provisions, winding plans, conductor sizes, pole arrangements, and enclosures in accordance with standard handbook procedures and data tables.

- 4.2-B Plan, execute, and document batteries of tests on manufactured or rebuilt electrical equipment and machines to determine their operating characteristics, compliance with specifications, codes and standards, and acceptability for the intended applications.
- 4.3-B Plan and/or direct the manufacture or re-manufacture of electrical equipment and machines, liaising with technologists and other specialists in mechanical and industrial engineering to develop procedures and Quality Management criteria.
- 4.4-B Plan, direct and/or execute preventive and breakdown maintenance and repair of electrical equipment and machines, liaising with mechanics, electricians, and other specialists to develop appropriate procedures, schedules, performance, cost and mortality monitoring systems, and inventories of tools, spare parts and supplies.

Ei05-B Apply electrical engineering expertise to provide technical support, applications engineering and technical sales solutions within the electrical industry.

Indicators of Performance, such as:

- 5.1-B Specify electrical components, equipment, and software given technical requirements.
- 5.2-B Prepare cost estimates and quotations for electrical engineering projects.
- 5.3-B Size and select electrical components and equipment.
- 5.4-B Provide technical product information, customer training, and education.
- 5.5-B Analyze and interpret technical literature, engineering specifications, applications data, and other technical documentation.
- 5.6-B Advise customers on installation, configuration, programming, testing, and maintaining electrical equipment.
- 5.7-B Diagnose and troubleshoot electrical equipment installation and commissioning problems.
- 5.8-B Analyze customer applications and determine solutions utilizing electrical hardware and software products and services.

Ei06-B Design, select, commission, and maintain power electronics equipment and systems.

Indicators of Performance, such as:

- 6.1-B Design power converter circuits including rectifiers, choppers, inverters, and voltage controllers.
- 6.2-B Analyze, troubleshoot, and maintain power converter circuits in machine and process power supplies and control systems.
- 6.3-B Select, commission, and maintain electronic variable speed drives and soft starters.
- 6.4-B Select, commission, and maintain uninterruptible power supplies (UPS), back up, and auxiliary power supplies and associated equipment.

Ei07-B Design, test, commission, and maintain industrial data communications networks, equipment, media, and software.

Indicators of Performance, such as:

- 7.1-B Specify and select data communications media including cables, couplers, terminations, support structures, enclosures, junction boxes, etc.
- 7.2-B Determine network topologies and configurations.
- 7.3-B Specify and select data communications equipment including communications adapters, bridges, gateways, switches, routers, modems, RTUs, and power supplies.
- 7.4-B Specify, select, and maintain data communications network software applications
- 7.5-B Calculate maximum limits for data transfer rates, network, segment, and drop line lengths, and power supply.
- 7.6-B Apply a variety of data communications protocols linking controllers with field devices, other controllers, and industrial data management systems.
- 7.7-B Specify, select, and apply data management software and equipment to collect plant floor data for analysis by business software systems.

Ei08-B Use advanced computer operations to support the electrical environment.

Indicators of Performance, such as:

- 8.1-B Use computers to resolve technical problems.
- 8.2-B Apply and create appropriate software to resolve technical problems.
- 8.3-B Select, install, create, and use appropriate software.
- 8.4-B Integrate control and data collection components and systems.
- 8.5-B Use appropriate software to create, test, evaluate, simulate, and document electrical and electronic circuits.
- 8.6-B Use computer programming languages to analyze and solve complex engineering problems.

Ei09-B Conduct Quality Control and Quality Assurance procedures.

Indicators of Performance, such as:

- 9.1-B Review and/or suggest modifications to specifications applicable to electrical circuits, equipment, and systems.
- 9.2-B Monitor, assess, interpret, and report test results in accordance with organizational quality assurance procedures and specifications.
- 9.3-B Conduct quality assurance testing by utilizing appropriate equipment and apply the results to suggest modifications.

9.4-B Apply knowledge of relevant QA programs to products and processes.

Ei10-B Apply knowledge of relevant safety procedures and standard practices to electrical workplaces.

Indicators of Performance, such as:

- 10.1-B Recommend, select, and use protective equipment and clothing to ensure personal health and safety in the workplace.
- 10.2-B Select, operate, and maintain hand and power tools.
- 10.3-B Prepare common wire and cable lists and assemblies.
- 10.4-B Interpret and apply safety codes, policies and practices, and accident prevention procedures.
- 10.5-B Conduct safety inspections of shop environments to detect and correct hazardous conditions.
- 10.6-B Apply regulatory and licensing requirements when completing installations, maintenance, and repairs of electrical equipment.
- 10.7-B Create and apply procedures for the safe handling, storage, and disposal of hazardous materials such as Workplace Hazardous Materials Information System (WHMIS) and Transporting of Dangerous Goods (TDG).