



INDUSTRIAL - TECHNOLOGIST (INDTY 2021)

Preamble

The Canadian Technology Standards (CTS) are a collection of learning outcomes for Canada's engineering technology and applied science profession at the technician and technologist level.

Stakeholders

The CTS may be utilized by accreditation bodies, provincial professional associations, educational institutions, government agencies, industry and others for the purposes accreditation, certification and other applications.

Educational Programs

The Industrial CTS is relevant to programs including, but not limited to, manufacturing, production, management science, operations management, health systems management, quality engineering, supply chain management, and ergonomics engineering at the the technologist level.

Learning Outcomes

This CTS list Discipline Learning Outcomes (DLO) which describe the significant and essential learning that students have achieved and can reliably demonstrate at the time of graduation. Each DLO has a number of Learning Outcome Indicators (LOI), which are examples illustrating, defining and clarifying the level of performance expected. The list of LOI is not comprehensive and there may be other indicators which can be used to assess achievement of learning outcomes.

Graduate Capability

Students graduating from an accredited program have demonstrated achievement of all general learning outcomes, including a prescribed level of math, and discipline learning outcomes selected by the program.

Having completed a program that is based on applied mathematics and scientific and engineering theory, principles and practices and having acquired the knowledge, skills and attitudes to function in the work place, graduates are;

- able to evaluate assignments, establish objectives, set parameters and determine appropriate procedures and actions.
- able to exercise due diligence in the workplace and adhere to related practices, applicable laws and health and safety practices.
- able to work in accordance with labor-management principles and practices.
- able to work independently or interdependently as part of a discipline or multi-disciplinary team.
- prepared to assume responsibility for their work.

Graduate Career Opportunities

Graduates of Industrial Engineering Technology - Technologist programs have career opportunities in such areas as: business, industry, construction, government, health systems and public organizations. They may find employment in careers such as: design of systems and processes, infrastructure; maintenance of equipment or systems; operations research; interpretation or preparation of specifications, technical drawings, or instructions; quality management and inspection; project management and contract management; administration; systems analysis, manufacturing operations; field and customer service; estimating; technical sales; supervision of projects; and training activities.

Discipline Learning Outcomes (DLOs)

INDTY01 Business Process Analysis

- Resolve industrial/manufacturing and business problems through detailed analysis.

Learning Outcome Indicators include:

- 1.1 Resolve complex technical problems related to industrial/manufacturing environments by analyzing and applying the appropriate problem solving technique(s).
- 1.2 Analyze and solve complex business problems related to health care and similar environments through the application of industrial management principles.
- 1.3 Analyze and solve complex system problems related to office or business environments through application of recognized information technology and industrial management principles.
- 1.4 Resolve problems with work schedules, material inventories, and equipment allocations applying industrial management principles.
- 1.5 Analyze, design, and implement industrial/manufacturing projects.
- 1.6 Resolve product or process quality problems through application of formal problem solving techniques.
- 1.7 Resolve technical criteria necessary to design and construct components, processes, and systems.
- 1.8 Design, implement, monitor, and report on industrial/manufacturing processes in accordance with discipline and industry standards.

INDTY02 Production Management

- Plan and organize production management process.

Learning Outcome Indicators include:

- 2.1 Generate effective decisions based on statistical methods.
- 2.2 Design experiments, select sampling methods, and interpret appropriate tests to evaluate given hypotheses.
- 2.3 Resolve solutions to industrial/manufacturing problems by applying operations research techniques.
- 2.4 Resolve solutions to industrial/manufacturing problems by applying models such as queuing, Monte Carlo, and deterministic simulation techniques.
- 2.5 Generate industrial/manufacturing decisions involving complex choices and uncertain conditions through application of decision theory concepts.
- 2.6 Create variety of manufacturing systems from simple automated cells to full production line.
- 2.7 Evaluate productivity, quality, and cost-effectiveness of systems.
- 2.7.1 *Apply principles of continuous improvement.*
- 2.8 Create production plans and master production schedules.

INDTY03 Manufacturing Optimization

- Select analyze and specify requirements for product and manufacturing processes to optimize manufacturability.

Learning Outcome Indicators include:

- 3.1 Assess and identify factors affecting industrial/manufacturing decision-making by applying knowledge of machinery, tools, and other equipment in manufacturing and assembling components.
- 3.2 Justify, select, and specify manufacturing materials, methods, operations, and processes for given applications.
- 3.3 Select and specify manufacturing equipment or process, sequence of operations, tooling, and fixtures required to produce component for economic production by interpreting drawings and specifications of given components.
- 3.4 Evaluate manufacturing costs for each stage of production.
- 3.5 Create process plan for defined product including all processes that might apply, such as casting, welding and fabrication, machining, heat treatments, finishing, assembly, and inspection.
- 3.6 Specify tolerances for manufacturing, precision measuring equipment, and methods to ensure product conforms to design requirement.
- 3.7 Analyze relationship between product defects and equipment setting and alignment errors.
- 3.8 Specify and program machines and manufacturing processes applying computer-aided manufacturing techniques such as CNC.
- 3.9 Employ systematic approach to anticipate, identify, and resolve limitations of equipment, technical problems, and potential safety problems in manufacture of components and systems.

INDTY04 Quality Assurance

- Create and implement quality assurance programs, procedures, and evaluations.

Learning Outcome Indicators include:

- 4.1 Research and interpret elements in quality assurance manual.
- 4.2 Create and manage quality assurance records, procedures, and audits.
- 4.3 Analyze quality costs to develop and implement quality improvement strategies to reduce quality costs.
- 4.4 Analyze statistical data and assess its accuracy and precision.
 - 4.4.1 *Create reports concerning statistical data.*
- 4.5 Analyze sources of product quality variation to predict and prevent quality defects and control quality applying statistical processes.
- 4.6 Resolve quality problems by applying techniques such as failure mode effect analysis and 6D analysis.
- 4.7 Assess reliability of product and process capability using statistical methods.
- 4.8 Interpret drawing and specification to determine quality parameters.

4.8.1 *Create and specify inspection and testing plan with appropriate quality levels.*

4.9 Plan and organize programs for supplier approvals and supplier product acceptance.

INDTY05 Operations Design

- Design and implement economic and productive work operations.

Learning Outcome Indicators include:

- 5.1 Evaluate and design jobs and work operations, taking into account physiology, astrometric data, occupational health and safety, productivity, and quality.
- 5.2 Apply labour relations and human rights policies to comply with legislative requirements for workplace.
- 5.3 Interpret how strategic planning process is used to set goals and objectives, to promote employee participation, and to improve work group effectiveness.
- 5.4 Analyze job skill requirements and training requirements to optimize allocation of human resources.
- 5.5 Analyze characteristics of organizational structures, administrative practices, and personnel and organizational structure effectiveness.
- 5.6 Analyze relationships between work attitudes, job satisfaction, and conflicts between employee and organization needs, being aware of possible conflict resolution or work adjustment systems for removing such functional stressors.
- 5.7 Analyze operations and processes using analysis tools, such as flow diagrams, process charts, operations charts, work-study, and man/machine charts.
- 5.8 Plan, organize, implement, and monitor new methods and their effectiveness.
- 5.8.1 *Apply continuous improvement techniques to: simplify work activities; design workstations; maximize productivity; and improve worker health, safety, and working conditions.*

INDTY06 Industrial Machinery

- Design, organize, and implement industrial machinery and processes for manufacturing.

Learning Outcome Indicators include:

- 6.1 Resolve design criteria, such as mechanical strength and endurance, costs, weight, finish, maintainability, environment, and applicable codes and standards applying appropriate analytical techniques.
- 6.2 Select and appraise performance of materials based on their properties to meet design criteria in engineering environment.
- 6.3 Interpret and analyze technical drawings and other technical documents used in the design of components, processes, and systems.

- 6.4 Design and analyze components, machinery, processes, and systems applying principles, such as mechanics and strength of materials, electrical and electronic control, hydraulics and pneumatics, and ergonometics.
- 6.5 Evaluate strength and stability of structures and components addressing stress factors, such as fatigue, temperature, fluctuating and reversing loads, torque vibration energy, and other external and internal forces.
- 6.6 Calculate basic stress analysis on designed parts applying appropriate computer software program.
- 6.7 Justify preferred designs by appraising design alternatives.
- 6.8 Analyze action of machines and machine elements with respect to work, energy, power, efficiency, safety, and liability.
- 6.9 Specify linear and geometric dimensions and tolerance for machine components, assemblies, and processes.

INDTY07 Plant Layout Design

- Analyze and prepare plant layouts for effective and economic plant operations.

Learning Outcome Indicators include:

- 7.1 Evaluate and select locations for industrial/manufacturing sites in terms of criteria, such as labour, transportation, utilities, climate, environmental, quality of life, and local political factors.
- 7.2 Assess theoretical and actual capacities for given facility, and apply data to predict and/or develop long-term capacity requirements and/or plans.
- 7.3 Design plant layouts and prepare layout drawings for cost-effective facilities using technical design process and applying principles of economic and statistical analysis and project management.
- 7.4 Create operation strategies for industrial/manufacturing organizations.
- 7.5 Assess maintenance inspection and service requirements for equipment, buildings, and plant services to ensure reliable and adequate performance of physical plant.
- 7.6 Plan and maintain facility registers and equipment records.
- 7.7 Evaluate the benefits of preventative maintenance programs.
- 7.8 Manage plant utilities, energy consumption, fire, security, and disposal of plant wastes.
 - 7.8.1 *Create emergency response plans.*
- 7.9 Organize auditing plant systems for compliance with applicable acts, codes, and standards.
- 7.10 Interpret drawings and schematics for equipment installation to develop installation plan, including schedule, services required, safe work practices plan, and benchmarks for monitoring progress, commissioning, and final completion.
- 7.11 Plan, estimate and coordinate maintenance and installation labour requirements for specific skills, trades, and equipment operation.

INDTY08 Financial and Managerial Accounting

- Apply financial and managerial accounting practices and management information systems in decision-making process.

Learning Outcome Indicators include:

- 8.1 Analyze viability and priority of capital expenditures.
- 8.2 Evaluate financial consequences of business decisions.
- 8.3 Create cost-benefit and rate of return analyses to compare economic alternatives and to select best alternative.
- 8.4 Create budget and cash flow forecast for given set of data.
- 8.5 Evaluate and select costing system for given operation and organization.
- 8.6 Create unit cost analysis, overhead analysis, and break-even analysis.
- 8.7 Analyze components of information systems and evaluate their functional relationships to determine information needs of an organization.
- 8.8 Design, organize, and implement information system plan or strategy for specified organization.

INDTY09 Manufacturing Automation

- Select, specify, program, and manage manufacturing automation.

Learning Outcome Indicators include:

- 9.1 Analyze and apply principles of industrial automation and control systems.
- 9.2 Analyze capabilities and applications of different control technologies and select appropriate level of automation for application.
- 9.3 Design, commission, and maintain automated systems including drives, actuators, mechanical controls, and control systems.
- 9.4 Design and program control system interfaces, human machine interfaces (HMI), and graphical interfaces.
- 9.5 Diagnose select, install, program, configure, and commission PLC control systems.
- 9.6 Select, install, and configure sensors, applications software, and communication protocols to monitor and control machines and processes.
- 9.7 Plan, install, configure, and program supervisory control and data acquisition systems.
- 9.8 Plan and implement plant floor web-enabled application with dynamic data exchange (DDE) between plant floor processes and Microsoft applications.
- 9.9 Create graphical model of plant floor process and integrate with SCADA system.
- 9.10 Select, apply, and program (offline and online) robotic system for given task.

INDTY10 Material Science

- Apply principals of physical chemistry, material science, and metallurgy in design, implementation, and testing of joined metals, alloys, and plastics.

Learning Outcome Indicators include:

- 10.1 Interpret knowledge of fundamental differences between metals and non-metallic materials in terms of their composition microstructure and properties.
- 10.2 Interpret knowledge of fundamental principles of physical metallurgy in welding of commonly used metals and alloys.
- 10.3 Select and specify welding processes, conditions, and procedures for commonly welded metals and alloys in accordance with applicable welding codes.
- 10.4 Calculate costs for welding simple structure and welding heat inputs.
- 10.5 Interpret knowledge of joining processes for metals other than arc welding, processes for metals not commonly welded, and processes for welding plastics.
- 10.6 Select and apply correct welding symbols to drawings of welded structures.
- 10.7 Select, specify and compare advantages and disadvantages of non-destructive testing and testing procedures such as dye penetrant, magnetic particle, industrial radiography, eddy current, and ultrasonic testing.
- 10.8 Evaluate, select, and specify common strengthening treatments for metallic engineering materials, and predict post-treatment, microstructure, and mechanical properties.
- 10.9 Select and specify metallographic methods for examination of engineering materials.
- 10.10 Select and specify oxidation and reduction techniques to prevent corrosion of metals.

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