



8854

MILLING OPERATIONS I (11C)

30S/30E/30M

A Machining Technology Course

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Course Description

Students develop skills and knowledge necessary to select, operate, and maintain tools, as well as perform calculations, interpret engineering drawings, work set-up, and machine material in a safe, efficient, and responsible manner through the application of practical projects related to the milling machine. Presented as a precision machining tool, emphasis is placed upon the set-up and machining of flat features and angles to precise measurements using appropriate tools, speeds, and feed rates. Use of various work-holding devices and accessories are put into practice to complete common milling operations. Development of machining technique and consistency is reinforced through the close observation of the milling process. Opportunity may also be taken to introduce CNC milling machines.

Goal 1: Describe and apply appropriate **health and safety** practices as they relate to the **maintenance of a safe workplace.**

GLO 1.1: Create and maintain a **safe working environment** in machining technology.

- SLO 11C.1.1.1 Identify safety and health requirements. (A1.1)
- SLO 11C.1.1.2 Identify personal protective equipment (PPE) and PPE procedures. (A1.2)
- SLO 11C.1.1.3 Identify appropriate safety procedures for working with electricity. (A1.3)
- SLO 11C.1.1.4 Identify appropriate safety procedures to reduce fire hazards. (A1.4)
- SLO 11C.1.1.5 Identify ergonomically correct procedures to avoid injury (e.g., stress, strain). (A1.5)
- SLO 11C.1.1.6 Identify hazard recognition and control. (A1.6)
- SLO 11C.1.1.7 Describe the hazards of confined-space entry. (A1.7)
- SLO 11C.1.1.8 Identify first aid/cardiopulmonary resuscitation (CPR). (A1.8)
- SLO 11C.1.1.9 Identify safety requirements as they apply to the WHMIS. (A1.9)
- SLO 11C.1.1.10 Describe the identification and control of specified hazards. (A1.10)
- SLO 11C.1.1.11 Identify types of personal protective equipment (PPE), and describe their applications. (A2.1)

SLO 11C.1.1.12	Describe the procedures used to care for and maintain PPE. (A2.2)
SLO 11C.1.1.13	Identify types of fire extinguishing equipment, and describe their applications and procedures for use. (A2.3)
SLO 11C.1.1.14	Identify workplace hazards, and describe safe work practices and equipment. (A2.4)
SLO 11C.1.1.15	Identify and interpret workplace safety and health regulations. (A2.4)
SLO 11C.1.1.16	Identify hazards, and describe safe work practices pertaining to fluids and coolants. (A8.2)
SLO 11C.1.1.17	Identify hazards, and describe safe work practices pertaining to hand and power tools. (B1.1)
SLO 11C.1.1.18	Demonstrate understanding and adherence to safe work procedures/job hazards analysis documents for each piece of equipment, tool, and consumable that they use.
SLO 11C.1.1.19	Demonstrate understanding and adherence to safe practices and procedures for facilities, processes, tools, and equipment found in machining technology.
SLO 11C.1.1.20	Discuss worker's responsibility to refuse unsafe work.
SLO 11C.1.1.21	Demonstrate use of personal protective equipment (PPE) and adherence to PPE procedures used in machining technology.
SLO 11C.1.1.22	Demonstrate the safe use of compressed air.
SLO 11C.1.1.23	Practise appropriate cleaning and maintenance of the machining technology area and equipment for the promotion of a safe work/learning environment.
SLO 11C.1.1.24	Practise appropriate safe behaviour to ensure personal safety, as well as the safety of others.
SLO 11C.1.1.25	Demonstrate an understanding of the machinist's responsibility to maintain and clean equipment and tools.
SLO 11C.1.1.26	Develop appropriate safety habits.
SLO 11C.1.1.27	Demonstrate a safe, clean, organized, and uncluttered work area.
SLO 11C.1.1.28	Explain the purpose/importance and use of accident report forms.
SLO 11C.1.1.29	Identify hazards, and describe safe work practices pertaining to being present in a machine shop.
SLO 11C.1.1.30	Identify machine-shop-related safety concerns.
SLO 11C.1.1.31	Practise safe set-up/operation of tools used.

GLO 1.2: Demonstrate knowledge of the **Trade Safety Awareness Manual**.
(www.gov.mb.ca/tce/apprent/apprentice/trade_safety/)

No applicable SLOs.

Goal 2: Understand **terminology, abbreviations, symbols, and acronyms** related to machining technology.

GLO 2.1: Understand **terminology, abbreviations, symbols, and acronyms** related to machining technology.

- SLO 11C.2.1.1 Describe metallurgical terminology, abbreviations, symbols, and acronyms.
- SLO 11C.2.1.2 Identify terminology, abbreviations, symbols, and acronyms associated with milling machines.
- SLO 11C.2.1.3 Identify terminology, abbreviations, symbols, and acronyms associated with engineering drawings.
- SLO 11C.2.1.4 Define *tolerance* as it pertains to machining.

Goal 3: Understand **technical drawings**.

GLO 3.1: Understand **technical drawings**.

- SLO 11C.3.1.1 Produce basic paper-and-pencil sketch of project.
- SLO 11C.3.1.2 Interpret and extract information from drawings. (A6.3)
- SLO 11C.3.1.3 Identify industry methods of showing dimensions and tolerances.
- SLO 11C.3.1.4 Identify the principles of orthographic projection.

Goal 4: Demonstrate **layout and planning**.

GLO 4.1: Demonstrate **planning and layout procedures**.

- SLO 11C.4.1.1 Calculate layout dimensions and reference points. (C3.4)
- SLO 11C.4.1.2 Identify methods used to mark work pieces for identification, and describe their associated procedures. (C3.7)
- SLO 11C.4.1.3 Use planning worksheets for projects.
- SLO 11C.4.1.4 Identify and use tools required to perform basic layout on milling projects.
- SLO 11C.4.1.5 Perform basic layout. (C3.9)
- SLO 11C.4.1.6 Use bevel protractor.

Goal 5: Use measurement and quality control tools.**GLO 5.1: Use measurement and quality control tools.**

- SLO 11C.5.1.1 Describe the procedures used to inspect, maintain, and store basic precision measuring instruments. (C1.6)
- SLO 11C.5.1.2 Describe digital read-out (DRO).
- SLO 11C.5.1.3 Measure using Vernier caliper to three decimal places.
- SLO 11C.5.1.4 Measure lengths.

Goal 6: Identify basic elements of metallurgy.**GLO 6.1: Identify basic elements of metallurgy.**

- SLO 11C.6.1.1 Describe metallurgical processes.
- SLO 11C.6.1.2 Identify ferrous and nonferrous metals.
- SLO 11C.6.1.3 Identify the process of steel manufacturing.
- SLO 11C.6.1.4 Identify hardness testing of metals.

Goal 7: Understand tools, equipment, and accessories.**GLO 7.1: Identify tools, equipment, accessories, and work-holding devices.**

- SLO 11C.7.1.1 Identify types of milling machines, and describe their applications. (E1.3)
- SLO 11C.7.1.2 Identify the components and controls of milling machines, and describe their purpose and operation. (E1.4)
- SLO 11C.7.1.3 Identify types of milling machine accessories and attachments, and describe their applications and maintenance. (E1.5)
- SLO 11C.7.1.4 No applicable SLO.
- SLO 11C.7.1.5 No applicable SLO.
- SLO 11C.7.1.6 No applicable SLO.

GLO 7.2: Use tools, equipment, accessories, and work-holding devices.

- SLO 11C.7.2.1 Describe climb milling and conventional milling. (E1.10)
- SLO 11C.7.2.2 Perform procedures used to handle, store, and dispose of fluids and coolants. (A8.9)
- SLO 11C.7.2.3 Perform dialing in a vise parallel to table travel with a dial indicator.

SLO 11C.7.2.4	Mill a flat surface.
SLO 11C.7.2.5	Mill surfaces parallel and perpendicular.
SLO 11C.7.2.6	Use parallels in setup.
SLO 11C.7.2.7	Use two flute and four flute end mills.
SLO 11C.7.2.8	Use an edge finder.
SLO 11C.7.2.9	Use the paper shim method for finding edge.
SLO 11C.7.2.10	Use milling machine vise as work-holding device.
SLO 11C.7.2.11	Use a form milling cutter.
SLO 11C.7.2.12	Use a slitting saw cutter.
SLO 11C.7.2.13	No applicable SLO.
SLO 11C.7.2.14	Identify potential set-up problems, and describe their causes and remedies as they pertain to milling machines.
SLO 11C.7.2.15	Identify techniques used to troubleshoot milling machine operations, and describe their associated procedures.

GLO 7.3: Identify techniques used to **troubleshoot** and **predict potential problems**.

SLO 11C.7.3.1	Identify potential set-up problems, and describe their causes and remedies as they pertain to milling machines.
SLO 11C.7.3.2	Identify techniques used to troubleshoot milling machine operations, and describe their associated procedures.

Goal 8: Describe and demonstrate the transferable **cross-curricular** knowledge and skills as they pertain to machining technology.

GLO 8.1: Apply **mathematical knowledge and skills** related to machining technology.

SLO 11C.8.1.1	Solve problems involving fractions and decimals.
SLO 11C.8.1.2	Solve problems involving metric and imperial measure.
SLO 11C.8.1.3	Solve problems involving length, perimeter, circumference, volume, area, mass, angles, ratio, and percentage.
SLO 11C.8.1.4	Convert between imperial and metric measurements.
SLO 11C.8.1.5	Use formulas to accurately calculate data for use in machining operations.
SLO 11C.8.1.6	Accurately calculate and measure parts and angles.
SLO 11C.8.1.7	Perform mathematical calculations, conversions, and measurements, as required for the project.

- SLO 11C.8.1.8 Describe the considerations to determine speed, feed, and depth of cut for milling operations.
- SLO 11C.8.1.9 Accurately calculate feed rate for milling operations.
- SLO 11C.8.1.10 Calculate angles for compound rest setting.
- SLO 11C.8.1.11 Calculate angles for milling vise setting.
- SLO 11C.8.1.12 Use charts and reference books to determine tap drill sizes.
- SLO 11C.8.1.13 Use charts and reference books to determine conversions among metric, fractional, and decimal units of measurement.

Goal 9: Demonstrate an awareness of **education and career opportunities** in machining technology and associated occupations.

GLO 9.1: Describe **education and career opportunities** in machining technology

- SLO 11C.9.1.1 Describe the Manitoba Machinist Apprenticeship Program. (A3.2)
- SLO 11C.9.1.2 Research educational opportunities for machining-related fields.

Goal 10: Describe the **history, technological progression, and emerging trends** in machining technology.

GLO 10.1: Describe the **history, technological progression, and emerging trends** in machining technology.

- SLO 11C.10.1.1 Identify lean manufacturing.

Goal 11: Demonstrate **employability skills** related to machining technology.

GLO 11.1: Demonstrate **employability skills** related to machining technology.

- SLO 11C.11.1.1 Demonstrate regular attendance and punctuality.
- SLO 11C.11.1.2 Demonstrate accountability by taking responsibility for their actions.
- SLO 11C.11.1.3 Demonstrate adaptability and effort.
- SLO 11C.11.1.4 Demonstrate the ability to accept and follow directions and listen to feedback.
- SLO 11C.11.1.5 Demonstrate the ability to stay on task and make effective use of time in class and shop environments.
- SLO 11C.11.1.6 Demonstrate the ability to communicate respectfully and effectively.
- SLO 11C.11.1.7 Demonstrate being responsible to oneself and to the facility.
- SLO 11C.11.1.8 Demonstrate behaviour appropriate to the workplace.
- SLO 11C.11.1.9 Demonstrate neat personal appearance and proper hygiene.
- SLO 11C.11.1.10 Prepare/revise a personal resumé specific to an application to an employer of machinists.

Goal 12: Demonstrate awareness of the **ethical and legal standards** as they pertain to machining technology.

GLO 12.1: Demonstrate awareness of the **ethical and legal standards** as they pertain to machining technology.

SLO 11C.12.1.1 Discuss ethical and legal standards.

SLO 11C.12.1.2 No applicable SLO.

Goal 13: Demonstrate awareness of **sustainability** as it pertains to machining technology.

GLO 13.1: Demonstrate awareness of **human sustainability** on machinists.

SLO 11C.13.1.1 Identify sustainable factors that influence health and lifelong well-being for a machinist.

GLO 13.2: Describe machining technology's sustainability practices and impact on the environment.

SLO 11C.13.2.1 Discuss and demonstrate appropriate recycling, reduction of waste, and reusing of materials as they pertain to the machining industry.

SLO 11C.13.2.2 Discuss and demonstrate the appropriate disposal of coolants, oils, and non-recyclable waste.

GLO 13.3: Demonstrate awareness of the **business sustainability** of a machining technology facility.

SLO 11C.13.3.1 Discuss the influence of machining on the local economy.