



8438

ENGINEERING DESIGN
DRAFTING (11C)

30S/30E/30M

A Design Drafting Course

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Course Description

Engineering Design Drafting is intended for students continuing in the specialization phase of engineering design drafting.

Curriculum content focuses on engineering product design. Students will present their design solutions to others.

Topics include the following:

- freehand sketching
- principles of design
- drafting and engineering standards
- manufacturing materials, fasteners, standard components, and processes
- computer model parts, assemblies, and sub-assemblies
- part and assembly drawings

The course includes an emphasis on safety, employability skills, career development, sustainability, and new and emerging technologies related to engineering design.

Cross-curricular learning outcomes, which include those in design drafting math, science, and the interpretation of technical documents, are to be integrated into the course.

The learning outcomes are organized by Technology Fundamentals (F), Technology Skills (S), and Professional Practice (P) strands. For instructional purposes, the sequence of learning outcomes and the learning outcomes included in each unit of study can vary based on the projects within the course.

Goal 1: Solve problems using the **design process.**

GLO 1.1: Define design problems.

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| SLO 11C.F.1.1.1 | Describe the feedback process in a structured problem-solving model. |
| SLO 11C.F.1.1.2 | Define design problems (e.g., original or re-engineered design). |
| SLO 11C.S.1.1.1 | Use a structured model to solve, refine, and revise engineering problems. |
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GLO 1.2: Research and analyze information for design solutions.

- SLO 11C.F.1.2.1 Identify engineering design principles, including aerodynamics, friction, motion, mechanical advantage, displacement, and ergonomics.
 - SLO 11C.F.1.2.2 Examine the factors (e.g., manufacturing processes, material properties, availability, cost, standard components) that influence design.
 - SLO 11C.F.1.2.3 Examine sustainable engineering principles (e.g., energy, service life, recycling, resource consumption) to solve engineering problems.
 - SLO 11C.F.1.2.4 Examine universal design principles to include in engineering design solutions.
 - SLO 11C.F.1.2.5 Consider aesthetic principles (e.g., colour, balance, texture, form, proportion) in relation to engineering design.
 - SLO 11C.S.1.2.1 Incorporate engineering design principles (e.g., aerodynamics, friction, motion, mechanical advantage, displacement, and ergonomics) into design solutions (e.g., sketch, notes).
 - SLO 11C.S.1.2.2 Create and revise sketches and notes based on engineering research.
 - SLO 11C.S.1.2.3 Incorporate materials and manufacturing processes into design solutions.
 - SLO 11C.S.1.2.4 Incorporate engineering aesthetic, sustainability, and universal design principles into design solutions.
 - SLO 11C.S.1.2.5 Research and reference information from various engineering sources (e.g., websites, manufacturer specifications, engineering tables, *Machinery's Handbook*).
 - SLO 11C.S.1.2.6 Predict consequences of design modifications.
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GLO 1.3: Synthesize information and ideas to create design solutions.

- SLO 11C.F.1.3.1 Identify the decision-making process required to arrive at the best (compromised) design solutions (e.g., cost, materials).
- SLO 11C.F.1.3.2 Identify sketching techniques related to specialized media (e.g., charcoal, paint, felt pen, pen and ink).
- SLO 11C.S.1.3.1 Select design solutions based on engineering research (e.g., manufacturing processes, material properties, availability, cost, standard components).
- SLO 11C.S.1.3.2 Create freehand sketches to illustrate refined engineering design solutions.

Goal 2: Communicate design solutions.**GLO 2.1:** Prepare **computer models** of design solutions.

- SLO 11C.F.2.1.1 Describe the function of computer models (e.g., visualization, model to engineering drawing).
 - SLO 11C.F.2.1.2 Define geometric construction principles related to engineering design.
 - SLO 11C.F.2.1.3 Identify basic engineering features of parts and assemblies (e.g., cylinders, fillets, chamfers, holes, standard components).
 - SLO 11C.F.2.1.4 Describe the process of modelling basic parts, sub-assemblies, and assemblies.
 - SLO 11C.S.2.1.1 Incorporate basic engineering features into computer model parts, sub-assemblies, and assemblies.
 - SLO 11C.S.2.1.2 Use a computer model to visualize design solutions and to create manufacturing drawings.
 - SLO 11C.S.2.1.3 Apply geometric construction principles.
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GLO 2.2: Prepare working and presentation drawings and documents.**Layout (F)**

- SLO 11C.F.2.2.1 Identify the components (e.g., title block information, border with zones, view arrangements, parts lists, revision blocks, general tolerance notes, projection symbol) of an engineering drawing.
- SLO 11C.F.2.2.2 Identify engineering symbols (e.g., cylinders, fillets, chamfers, holes, standard components) for orthographic, auxiliary, and section drawings.

Line Work (F)

- SLO 11C.F.2.2.3 Identify engineering line types (e.g., object, hidden, centre, construction, extension, dimension, leader, section, break, cutting plane, phantom lines) and their intended uses (e.g., cylinders, fillets, chamfers, holes, standard components).

Dimensioning and Annotating (F)

- SLO 11C.F.2.2.4 Identify engineering dimensioning, tolerancing, and annotation standards.

Layout (S)

- SLO 11C.S.2.2.1 Use engineering drawing components (e.g., title block information, border with zones, view arrangements, parts lists, revision blocks, general tolerance notes, projection symbols).
- SLO 11C.S.2.2.2 Create orthographic, auxiliary, and section drawings (e.g., full, half, offset, revolved, removed, aligned, section views) of parts, sub-assemblies, and assemblies using engineering symbols.
- SLO 11C.S.2.2.3 Create schedule tables (e.g., tabular dimensions, fastener tables) and parts lists.
- SLO 11C.S.2.2.4 Combine orthographic, section, auxiliary, detail, and isometric drawings into a set of working drawings.
- SLO 11C.2.2.5 Create a flat pattern drawing for a 3-D object (e.g., packaging).

Line Work (S)

- SLO 11C.S.2.2.6 Select and use line types for engineering applications based on standards.

Dimensioning and Annotating (S)

- SLO 11C.S.2.2.7 Use industry standard engineering dimensioning, tolerancing, and annotation.

Goal 3: Use appropriate **materials and processes** of building/manufacturing.

GLO 3.1: Describe **materials** used in design solutions.

- SLO 11C.F.3.1.1 Identify materials (e.g., ferrous and non-ferrous metals, woods, plastics) used in manufacturing parts.
- SLO 11C.F.3.1.2 Identify the use and material properties of standard parts.
- SLO 11C.S.3.1.1 Select materials and standard parts for design solutions.

GLO 3.2: Describe **building/manufacturing processes** used in design solutions.

- SLO 11C.F.3.2.1 Identify basic manufacturing processes (e.g., machining, casting, drilling, threading) for engineering design.
- SLO 11C.F.3.2.2 Define project management.
- SLO 11C.S.3.2.1 Select basic manufacturing processes for design solutions.

Goal 4: Present design solutions.**GLO 4.1: Plan and organize presentations** of design solutions.

- SLO 11C.F.4.1.1 Identify traditional and digital engineering presentation methods.
 - SLO 11C.S.4.1.1 Select written and visual presentation methods for engineering design solutions (e.g., oral, written, 2-D/3-D freehand sketch, graphic, physical, or digital 3-D model).
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GLO 4.2: Use presentation production methods.

- SLO 11C.F.4.2.1 Differentiate among the formats and functions of technical reports, design briefs, and scope-of-work documents.
 - SLO 11C.F.4.2.2 Differentiate among the formats and functions of visual presentation formats (e.g., presentation software, renderings, physical models).
 - SLO 11C.S.4.2.1 Create design briefs to support engineering design solutions.
 - SLO 11C.S.4.2.2 Communicate effectively using presentation software incorporating design elements (e.g., formatting, layout, font size).
 - SLO 11C.S.4.2.3 Create visual presentations to support engineering design solutions.
 - SLO 11C.S.4.2.4 Create animations from 3-D CADD models.
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GLO 4.3: Present/defend design solutions.

- SLO 11C.F.4.3.1 Describe elements (e.g., clear and concise communication, appearance and dress, enunciation and volume, body language) of effective presentations.
 - SLO 11C.F.4.3.2 Discuss out-of-school student competitions related to engineering design drafting.
 - SLO 11C.S.4.3.1 Present engineering design solutions to an audience (e.g., group) and reflect on feedback.
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Goal 5: Describe and apply the common tools and equipment used in design drafting.**GLO 5.1: Describe and use drawing and modelling tools and equipment.**

- SLO 11C.F.5.1.1 Identify sketching tools and media.
- SLO 11C.F.5.1.2 Identify physical modelling tools (e.g., drills, scroll saws, band saws, sanders, CNC router, 3-D printer).

- SLO 11C.F.5.1.3 Identify measuring devices (e.g., protractors, engineering and metric scales, calipers, micrometers).
 - SLO 11C.S.5.1.1 Use sketching tools and media.
 - SLO 11C.S.5.1.2 Use physical modelling tools (e.g., drills, scroll saws, band saws, sanders, CNC router, 3-D printer).
 - SLO 11C.S.5.1.3 Use measuring devices (e.g., protractors, engineering and metric scales, calipers, micrometers).
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GLO 5.2: Describe and use **computer hardware and equipment.**

- SLO 11C.F.5.2.1 Identify basic hardware problems (e.g., power, cords, and device connections) and maintenance procedures.
 - SLO 11C.F.5.2.2 Identify the uses of input devices (e.g., specialized mice, digitizing tablets) related to design.
 - SLO 11C.F.5.2.3 Identify the uses of output devices (e.g., 3-D printers) related to design.
 - SLO 11C.S.5.2.1 Operate input devices (e.g., digital camera, scanner).
 - SLO 11C.S.5.2.2 Operate output devices (e.g., printers, plotters).
 - SLO 11C.S.5.2.3 Troubleshoot computer and printer/plotter problems.
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GLO 5.3: Describe and use **software.**

- SLO 11C.F.5.3.1 Identify drafting and presentation components of industry standard engineering software (e.g., CADD, wind tunnel-simulation, CNC).
- SLO 11C.F.5.3.2 Discuss features of office software in the design and presentation process.
- SLO 11C.F.5.3.3 Identify information communication technologies (e.g., RSS feeds, blogs, technical websites, discussion boards) related to design drafting.
- SLO 11C.S.5.3.1 Use drafting and presentation components of industry standard engineering software (e.g., CADD, wind tunnel-simulation, CNC).
- SLO 11C.S.5.3.2 Use features of office software in the design and presentation process.
- SLO 11C.S.5.3.3 Manage project data using CADD software.
- SLO 11C.S.5.3.4 Manage, organize, and share project files.
- SLO 11C.S.5.3.5 Use and manipulate digital images to obtain and record information (e.g., portfolio collection, research).
- SLO 11C.S.5.3.6 Use information communication technologies (e.g., RSS feeds, blogs, technical websites, discussion boards) related to engineering design drafting.

Goal 6: Describe and apply transferable **cross-curricular knowledge and skills** that relate to design drafting.

GLO 6.1: Describe and apply **mathematical concepts** as they relate to design drafting.

- SLO 11C.F.6.1.1 Demonstrate an understanding of metric and imperial conversions.
 - SLO 11C.F.6.1.2 Identify the buildable levels of precision used in engineering drawings.
 - SLO 11C.F.6.1.3 Identify mathematical concepts (e.g., volume, density, mass, slope, ratio, proportion, angles) related to engineering drafting.
 - SLO 11C.F.6.1.4 Identify material estimation techniques, including cost and quantity.
 - SLO 11C.F.6.1.5 Demonstrate an understanding of basic trigonometry.
 - SLO 11C.S.6.1.1 Perform metric and imperial conversions.
 - SLO 11C.S.6.1.2 Produce engineering models and drawings to a buildable precision.
 - SLO 11C.S.6.1.3 Perform mathematical calculations (e.g., volume, density, mass, slope, ratio, proportion, angles) related to engineering drafting.
 - SLO 11C.S.6.1.4 Estimate the cost and quantity of materials.
 - SLO 11C.S.6.1.5 Use algebra and trigonometry processes as required for engineering design drafting.
 - SLO 11C.S.6.1.6 Extract engineering data using measuring devices.
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GLO 6.2: Read, interpret, and communicate information.

- SLO 11C.F.6.2.1 Identify sources of design information (e.g., material specifications, aesthetic and design principles, ISO, SAE, *Machinery's Handbook*).
 - SLO 11C.F.6.2.2 Read and interpret information from engineering tables (e.g., fits, screw thread, drill sizes).
 - SLO 11C.S.6.2.1 Organize and record design information from oral, visual, material, print, or electronic sources.
 - SLO 11C.S.6.2.2 Read and interpret design information from text, tables, charts, and graphs.
 - SLO 11C.S.6.2.3 Communicate using the language and terminology of engineering design drafting.
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GLO 6.3: Understand **scientific concepts** as they apply to design drafting.

SLO 11C.S.6.3.1 Apply the scientific applications used in engineering design solutions (e.g., density, mass, malleability, combustibility, fluid dynamics, displacement, electricity).

Goal 7: Demonstrate an awareness of **sustainability** as it pertains to design drafting.

GLO 7.1: Understand the impact of architectural/engineering design on the **environment**.

SLO 11C.F.7.1.1 Identify environmental sustainability factors that influence engineering design solutions (e.g., reusability and recyclability of materials, energy efficiency of manufacturing processes).

SLO 11C.F.7.1.2 Appreciate the environmental factors that have an impact on product design and manufacturing.

SLO 11C.S.7.1.1 Incorporate environmental sustainability factors in engineering design solutions.

GLO 7.2: Describe the impact of architectural/engineering design on **human health and well-being**.

SLO 11C.F.7.2.1 Identify human health and well-being sustainability factors that influence engineering design solutions (e.g., ergonomics, coatings, sharp edges, pinch points).

SLO 11C.F.7.2.2 Appreciate the human health and well-being sustainability factors that have an impact on manufacturing processes.

SLO 11C.S.7.2.1 Incorporate human health and well-being sustainability factors in engineering design solutions.

GLO 7.3: Recognize the **economic impact** of sustainable practices in architectural/engineering design.

SLO 11C.F.7.3.1 Identify the economic sustainability factors that influence engineering design solutions (e.g., local versus imported products, cradle to cradle, serviceable and recycled materials).

SLO 11C.F.7.3.2 Appreciate the economic impact of sustainability factors on engineering design solutions.

SLO 11C.S.7.3.1 Incorporate economic sustainability factors in engineering design solutions.

Goal 8: Understand the **evolution** of design drafting, including its **technological progression and emerging trends**.

GLO 8.1: Describe the **evolution of design drafting, including its technological progression and emerging trends**.

- SLO 11C.F.8.1.1 Discuss emerging trends related to the tools and equipment of engineering design.
- SLO 11C.F.8.1.2 Describe emerging styles and trends (e.g., cradle to cradle, virtual design and testing, development of new materials, questioning existing design, creative thinking) and their impact on engineering design.
- SLO 11C.F.8.1.3 Research past/historical/contemporary examples of engineering design.

Goal 9: Follow the **ethical and legal standards** in design drafting.

GLO 9.1: Incorporate the local and national **building codes and standards as well as manufacturing and engineering standards** into designs.

- SLO 11C.P.9.1.1 Identify the commonly used standards for engineering drafting.
- SLO 11C.P.9.1.2 Produce technical drawings to CAN/CSA, ISO, and ANSI standards.
- SLO 11C.P.9.1.3 Follow recognized engineering standards.
- SLO 11C.P.9.1.4 Demonstrate an awareness of variations in CADD standards (e.g., discipline specific, trade specific, organization).
- SLO 11C.P.9.1.5 Describe the legal (e.g., as enunciated by government regulatory guidelines, professional associations) and contractual (e.g., manufacturers, material suppliers) obligations of engineering drawings.

GLO 9.2: Describe the **ethical expectations** of designers.

- SLO 11C.P.9.2.1 Practise ethical and responsible use of computer hardware and software.
- SLO 11C.P.9.2.2 Consider the ethical implications of compromise in making design decisions (e.g., costs, inadequate design).

Goal 10: Demonstrate a knowledge of and ability to recognize and apply appropriate **health and safety** requirements and practices to maintain a safe workplace.

GLO 10.1: Demonstrate an awareness of **rights, responsibilities, and safety procedures** for specific tools, equipment, and working environments.

- SLO 11C.P.10.1.1 Demonstrate and value safe work practices and procedures.
 - SLO 11C.P.10.1.2 Demonstrate ergonomically correct procedures to avoid injury (e.g., stress, strain).
 - SLO 11C.P.10.1.3 Demonstrate personal responsibility for health and safety.
 - SLO 11C.P.10.1.4 Demonstrate the safety features of tools and equipment.
 - SLO 11C.P.10.1.5 Follow emergency evacuation procedures.
 - SLO 11C.P.10.1.6 Use appropriate aids to minimize risk of injury.
 - SLO 11C.P.10.1.7 Use appropriate personal protective equipment.
 - SLO 11C.P.10.1.8 Locate first aid stations and fire extinguishers.
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GLO 10.2: Describe **health and safety laws and regulations**.

- SLO 11C.P.10.2.1 Describe the reporting process for injuries.
 - SLO 11C.P.10.2.2 Identify WHMIS symbols and terminology, and follow WHMIS guidelines, including the location of MSDS sheets.
 - SLO 11C.P.10.2.3 Comply with health and safety legislation and practices.
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Goal 11: Demonstrate **employability skills** required in design drafting.

GLO 11.1: Demonstrate fundamental **employability skills**.

- SLO 11C.P.11.1.1 Describe the importance of employability skills in school, work, and daily life.
 - SLO 11C.P.11.1.2 Listen and ask questions to clarify problems and instructions.
 - SLO 11C.P.11.1.3 Locate, gather, and organize design drafting information using appropriate technology and information systems.
 - SLO 11C.P.11.1.4 Assess situations and identify problems and possible solutions.
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GLO 11.2: Demonstrate **personal management** skills.

- SLO 11C.P.11.2.1 Demonstrate interest, initiative, and effort.
 - SLO 11C.P.11.2.2 Manage time to complete tasks/projects within stated time frames.
 - SLO 11C.P.11.2.3 Demonstrate accountability for own actions and for the actions of one's team.
 - SLO 11C.P.11.2.4 Respond constructively to changes.
 - SLO 11C.P.11.2.5 Demonstrate a willingness to learn continuously.
 - SLO 11C.P.11.2.6 Appreciate the need for continuous learning in technologically dependent occupations.
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GLO 11.3: Demonstrate **teamwork** skills.

- SLO 11C.P.11.3.1 Be respectful toward, open to, and supportive of the thoughts, opinions, and contributions of others in a group.
 - SLO 11C.P.11.3.2 Contribute information and skills to achieve the goals of a group.
 - SLO 11C.P.11.3.3 Contribute willingly to classroom/shop learning activities.
 - SLO 11C.P.11.3.4 Accept assistance from and offer it to others.
 - SLO 11C.P.11.3.5 Collaborate with peers and industry professionals.
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Goal 12: Describe **career opportunities** in design drafting.

GLO 12.1: Describe **post-secondary opportunities** related to design drafting.

- SLO 11C.P.12.1.1 Identify post-secondary paths and articulation opportunities for engineering design drafting (e.g., requirements, educational institutions, programs).
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GLO 12.2: Describe **career opportunities** available in design drafting across industries.

- SLO 11C.P.12.2.1 Explore engineering careers related to the design drafting industry.
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GLO 12.3: Create, maintain, and present a **portfolio**.

- SLO 11C.P.12.3.1 Collect engineering samples for a design drafting portfolio.
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