

Minnesota Articulated College Credit (ACC) Agreement

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Agreement Name: **Principles of Engineering**

Agreement Last Reviewed: **Fall 2023**

Next Review Date: **Fall 2025**

College Courses

Class	Title	School	Credits	
DRFT 1001	Principles of Engineering	Ridgewater College	1.0	of 1.0
CTLS 2110	Statics & Strength of Material	South Central College	2.0	of 3.0
MECA 2110	Sensors & Controls	South Central College	1.0	of 3.0

Curriculum Content Objectives

To receive credit, students will meet 80% of the following content objectives:

1. Mechanisms

- Differentiate between engineering and engineering technology.
- Conduct a professional interview and reflect on it in writing.
- Identify and differentiate among different engineering disciplines.
- Measure forces and distances related to mechanisms.
- Distinguish between the six simple machines, their attributes, and components.
- Calculate mechanical advantage and drive ratios of mechanisms.
- Design, create, and test gear, pulley, and sprocket systems.
- Calculate work and power in mechanical systems.
- Determine efficiency in a mechanical system.
- Design, create, test, and evaluate a compound machine design.

2. Energy Sources

- Identify and categorize energy sources as nonrenewable, renewable, or inexhaustible.
- Create and deliver a presentation to explain a specific energy source.
- Summarize and reflect upon information collected during a visit to a local utility company.
- Define the possible types of power conversion.
- Calculate work and power.
- Demonstrate the correct use of a digital multimeter.
- Calculate power in a system that converts energy from electrical to mechanical.
- Determine efficiency of a system that converts an electrical input to a mechanical output.
- Calculate circuit resistance, current, and voltage using Ohm's law.
- Understand the advantages and disadvantages of parallel and series circuit design in an application.

3. Energy Applications

- Test and apply the relationship between voltage, current, and resistance relating to a photovoltaic cell and a hydrogen fuel cell.
- Experiment with a solar hydrogen system to produce mechanical power.
- Design, construct, and test recyclable insulation materials.
- Test and apply the relationship between R-values and recyclable insulation.
- Complete calculations for conduction, R-values, and radiation.

4. Energy & Power Design Problem

- a. Brainstorm and sketch possible solutions to an existing design problem.
- b. Create a decision-making matrix for a design problem.
- c. Select an approach that meets or satisfies the constraints provided in a design brief.
- d. Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix.
- e. Present a workable solution to the design problem.

5. Materials and Structures: Statics

- a. Create free body diagrams of objects, identifying all forces acting on the object.
- b. Mathematically locate the centroid of structural members.
- c. Calculate moment of inertia of structural members.
- d. Differentiate between scalar and vector quantities.
- e. Identify magnitude, direction, and sense of a vector.
- f. Calculate the X and Y components given a vector.
- g. Calculate moment forces given a specified axis.
- h. Use equations of equilibrium to calculate unknown forces.
- i. Use the method of joints strategy to determine forces in the members of a statically determinate truss.

6. Materials and Structures: Material Properties

- a. Investigate specific material properties related to a common household product.
- b. Conduct investigative non-destructive material property tests on selected common household products. Property testing conducted to identify continuity, ferrous metal, hardness, and flexure.
- c. Calculate weight, volume, mass, density, and surface area of selected common household product.
- d. Identify the manufacturing processes used to create the selected common household product.
- e. Identify the recycling codes.
- f. Promote recycling using current media trends.

7. Materials and Structures: Material Testing

- a. Utilize a five-step technique to solve word problems.
- b. Obtain measurements of material samples.
- c. Tensile test a material test sample.
- d. Identify and calculate test sample material properties using a stress strain curve.

8. Materials & Structures Design Problem

- a. Brainstorm and sketch possible solutions to an existing design problem.
- b. Create a decision making matrix for the design problem.
- c. Select an approach that meets or satisfies the constraints given in a design brief.
- d. Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon your team's decision matrix.
- e. Present a workable design solution.

9. Control Systems: Machine Control

- a. Create detailed flow charts utilizing a computer software application.
- b. Create control system operating programs utilizing computer software.
- c. Create system control programs that utilize flowchart logic.
- d. Choose appropriate inputs and output devices based on the need of a technological system.
- e. Differentiate between the characteristics of digital and analog devices.
- f. Judge between open and closed loop systems in order to choose the most appropriate system for a given technological problem.
- g. Design and create a control system based on given needs and constraints.

10. Control Systems: Fluid Power

- a. Identify devices that utilize fluid power.
- b. Identify and explain basic components and functions of fluid power devices.
- c. Differentiate between the characteristics of pneumatic and hydraulic systems.
- d. Distinguish between hydrodynamic and hydrostatic systems. **(Optional)**
- e. Design, create, and test a hydraulic or pneumatic device.

- f. Calculate values in a fluid power system utilizing Pascal's Law.
- g. Distinguish between pressure and absolute pressure.
- h. Distinguish between temperature and absolute temperature.
- i. Calculate values in a pneumatic system, utilizing the perfect gas laws.
- j. Calculate flow rate, flow velocity, and mechanical advantage in a hydraulic system.

11. Control Systems Design Problem

- a. Brainstorm and sketch possible solutions to an existing design problem.
- b. Create a decision-making matrix for a design problem.
- c. Select an approach that meets or satisfies the constraints provided in a design brief.
- d. Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix.
- e. Present a workable solution to the design problem.

12. Statistics

- a. Calculate the theoretical probability that an event will occur.
- b. Calculate the experimental frequency distribution of an event occurring.
- c. Apply the Bernoulli process to events that only have two distinct possible outcomes.
- d. Apply AND, OR, and NOT logic to probability.
- e. Create a histogram to illustrate frequency distribution.
- f. Calculate the central tendency of a data array, including mean, median, and mode.
- g. Calculate data variation, including range, standard deviation, and variance.

13. Kinematics

- a. Calculate distance, displacement, speed, velocity, and acceleration from data.
- b. Design, build, and test a vehicle that stores and releases potential energy for propulsion.
- c. Calculate acceleration due to gravity given data from a free fall device.
- d. Calculate the X and Y components of a projectile motion.
- e. Determine the angle needed to launch a projectile a specific range given the projectile's initial velocity.

Assessments

Students must achieve no less than 80% or B for a final grade in the high school course to receive ACC.

ACC Concept

Skills for selected courses, required for graduation in programs at the colleges participating in this regional agreement are taught in our schools using the assessments developed collaboratively by secondary and post-secondary staff. High School credit is earned and college credits are earned if the student meets the college achievement.