



Industry Certifications Sample Course Sequence

Overview

The objective of the **Sample Course Sequence** is to assist with a framework with the topics in a suggested sequence to build a curriculum around, or incorporate elements of existing curricula. This is done by utilizing the schools’ and teachers’ expertise for curricula, facility and materials. For additional detail of specific topics to develop or select curricula around, see the REC Foundation’s Pre-Engineering and Robotics Certifications document “[Knowledge and Occupational Skills List](#)”. These documents are designed to work with existing curriculum materials. They may also be utilized in building a curriculum, but they are not a curriculum in and of themselves.

The Sample Course Sequence is broken into two parts:

- **Part One:** The Fundamentals of Engineering Exam: Covers the topics and skills in the Fundamentals of Engineering Module.
- **Part Two:** Pre-Engineering Area Modules: Covers each of the individual eight “Pre-Engineering Area Module” topics and skills for the Pre-Engineering and/or the Robotics Certifications.

Both the **Pre-engineering Certification** and the **Robotics Certification** require passing of the **Fundamentals of Engineering** as a pre-requisite before taking any of the eight modules. Two of the eight modules are required to earn the **Pre-Engineering Certification**. These are selected by the instructor based on community need, available facilities, curricula, equipment and supplies as well as instructor expertise.

Three modules of the eight are required to earn the Robotics Certification: specifically Mechanical, Computer Science/Programming and Electrical. The individual then earns both the Pre-Engineering and the Robotics certification when they pass the third engineering module because at this point they exceed the two areas required for Pre-Engineering.

| Pre-Engineering Modules | |
|--|--------------------------|
| Mechanical Engineering | Aerospace Engineering |
| Electrical Engineering | Chemical Engineering |
| Computer Science & Engineering (Programming) | Civil Engineering |
| Engineering Technology | Manufacturing Technology |

Part One: The Fundamentals of Engineering

I. Introduction to Engineering

- What is engineering and technology? What is science?
- Types of engineering areas: Electrical, Mechanical, Aerospace, Robotics, Civil, Computer Science, CAD, Manufacturing. Education required for vocational certification to BS, salaries, typical work weeks.
- History of engineering, including timelines from early history until today. Space history, specifically early space programs and the technologies we enjoy today as a result of them. Also includes miniaturization of components and an overview of the history of American and Soviet rockets and astronauts. The Industrial Revolution as the time period of Engineering Societies and development of standards. The development of assembly lines and mass production of products

XI. Fundamentals of Robotics

- Education required, salaries, work weeks, job duties
- Applications (in industry, in space, at home)
- Cartesian Coordinates for robotic arm automation (x, y, z)

Part 2: Pre-Engineering Area Modules

The **Pre-Engineering Modules** are required after passing the **Fundamentals of Engineering Module**. Select any two [Pre-Engineering Modules](#) required for the Pre-Engineering industry certification with specifically Mechanical, Computer Science, and Electrical for the Robotics industry certification.

I. Mechanical Pre-Engineering Module

- Mechanical advantage
- Rack and pinion
- Simple machines
- Gear ratio calculations
- Newton's laws
- Chain and Sprocket
- Laws of thermodynamics
- Speed and Torque
- Application problems to solve in: Velocity, Acceleration

II. Computer Science (Programming) Pre-Engineering Module

- Common programming languages and related terminologies
- Parts and workings of a computer
- Common programming languages: C++, Python, JAVA, Scratch and Common Databases: SQL, Oracle, DB2
- Evaluating pseudo code, loops and common programming structures
- Networking and inter-computer communications
- Binary and Hexadecimal representations of numbers
- Malware and Prevention: Virus, Worm, Denial of Service, Spam, Firewall
- Applications include finding solutions in basic C programming lines and recognizing binary and hexadecimal representations

III. Electrical Pre-Engineering Module

- AM and FM radio frequencies
- Mechanical energy and efficiency
- Motor windings function
- Ohms law calculations
- Basic computer hardware components
- Digital and Analog Sensors and their applications
- Applications include potential and kinetic energy, frequencies, and kilowatt hours calculations

IV. Chemical Pre-Engineering Module

- Chemical reactions and related terminology
- Chemical handling safety
- Familiarize the Periodic Table
- Applications include solutions calculations and gas law calculations

V. Aerospace Pre-Engineering Module

- Basic aerodynamic principles
- Basic rocket design
- Types of clouds
- Applications include Newton's drag calculations, winds aspect ratio, horsepower to wattage calculations, airspeed and velocity calculations

VI. Civil Engineering Pre-Engineering Module

- Common types of bridges
- Common bridge materials
- Various methods of transportation
- Surveying
- Rivers, dams and canals
- Applications include boat hull design calculations, surveying techniques, and bridge efficiency calculations

VII. Engineering Technology Pre-Engineering Module

- Engineering design process/loop
- Practice and know soft skills
- Common manufacturing processes
- Aerospace basics
- Civil engineering basics
- Mechanical systems
- Programming basics
- Common manufacturing materials and their processing
- Engineering drawings
- Applications include engineering design process in multiple configurations, select proper tools for tasks, select proper lab and tool safety situations, and identify missing views of engineering drawings

çIII. Manufacturing Technology Pre-Engineering Module

IE. Various manufacturing methods

Ë. Engineering drawings with 2D and 3D computer aided drafting systems

ËI. Quality assurance methods

ËII. Applications include tensile strength applications, hardness testing techniques, and stress and strain curves