**Tennessee Student Industry Credential (TSIC)**
**REC Foundation Pre-Engineering Certification**

## Section 1: Introduction

This pathway details the steps to be taken in order to obtain a Tennessee Student Industry Credential for the Pre-Engineering Certification from the REC Foundation. Learners of all age and experience levels have the opportunity to receive this certification through the STEM School. To qualify for the exam, students must pass the Fundamentals of Engineering test and then two of the three of subject specific tests listed below. The tests will be administered during Tech Time or ER week at STEM School.

## Test 1: Fundamentals of Engineering (approximately 100 multiple choice questions)

The first exam is called "Fundamentals of Engineering" and covers a wide range of engineering topics. Content for the Fundamentals of Engineering Test will be covered throughout 9th grade and the fall semester of 10th grade in different classes (PWC, Tech Time, PBL). At the end of the 10th grade fall semester, students will complete the Fundamentals of Engineering test study guide.

The Tech-Time instructors will review the study guide for accuracy. Upon correctly completing the study guide, students will be given a voucher code for the REC "Fundamentals of Engineering" exam. The exam will be given at the end of the fall semester of 10th grade during ER week. This exam is a prerequisite for all other REC Engineering and Robotics Certification Exams and must be passed with a score of 70% or greater.

Topics include:

- History of Engineering
- Engineering Design Process
- Materials and Processes
- Safety
- Engineering Drawings
- CAD Systems
- Electrical Engineering
- Mechanical Engineering
- Robotics
- Aerospace Engineering
- Civil Engineering
- Computer Science / Programming
- Chemical Engineering
- Manufacturing

## For the Pre-Engineering, students must pass 2 out of 3 of the following subject specific tests:

**Test 2: Mechanical Engineering (approximately 30 multiple choice questions)**

If students successfully pass the Fundamentals of Engineering Test, they will be permitted to take the Mechanical Engineering Test. Content for the Mechanical Engineering Test will be covered during a Tech Time rotation in the spring semester of 10th grade. Students will need to correctly complete the study guide and practice problems in order to be registered for the Mechanical Engineering Test. The EDP tech time instructor will approve and give feedback on the work if necessary. The EDP instructor will administer and proctor the Mechanical Engineering test. The exam must be passed with a score of 70% or greater.

Topics include:

Mechanical Systems:

- Rack and pinion
- Miter gears
- Worm gears
- Compound gears
- Chains
- Sprockets
- Pulleys
- Spur Gears
- Pneumatics
- Hydraulics
- Simple machines: inclined planes, wedges, levers and pulleys

Applications problems-ability to calculate:

- Newton's Laws
- Thermodynamics o Acceleration
- Gear ratios
- Velocity
- Engine displacement
- Speed and torque
- Compound gear ratios
- Mechanical advantage

**Test 3: Electrical Engineering (approximately 30 multiple choice questions)**

If students successfully pass the Fundamentals of Engineering Test, they will be permitted to take the Electrical Engineering Test. Content for the Electrical Engineering Test will be covered during a Tech Time rotation in the GCDI during the spring semester of 10th grade. Students will need to correctly complete the study guide and practice problems (coming soon) in order to be registered for the Electrical Engineering Test. The GCDI tech time instructor will approve and give feedback on the work if necessary. The test will be administered through the proctors at the GCDI and must be passed with a score of 70% or greater.

Topics Include:

- AM and FM radio frequencies
- Mechanical energy
- Motor windings
- Ohms law calculations – ability to calculate:
    - Amperage
    - Resistance Voltage
    - Ohms
- Knowledge of basic computer hardware, i.e. storage devices, memory, RAM, ROM, FIFO
- Knowledge of and applications for sensors:
    - Potentiometers o Ultrasonic
    - Shaft encoders o Gyroscopic
    - Accelerometers
    - Optical shaft encoders o Line following
    - Light sensing
    - Limit switches

**Test 4: Computer Science / Programming (approximately 25 multiple choice questions)**

If students successfully pass the Fundamentals of Engineering Test, they will be permitted to take the Computer Science / Programming Test. Content for the Computer Science / Programming Test will be covered during a Tech Time rotation in the spring semester of 10th grade. Students will need to complete the Computer Engineering practice problems and study guide (coming soon) in order to be registered for the Computer Science / Programming Test. The test will be administered through the GCDI and must be passed with a score of 70% or greater.

Topics include:

- Common programming languages, databases and web design o
    - C++, JAVA, Python, Scratch
    - HTML
    - SQL, Oracle, DB2
- Common terminology
    - IP - Internet Protocol
    - I/O (input/output)
    - Infinite loop
    - Memory access violation

    - HTTP, HTTPS
- General networking and inter-computer communication o Internet, intranet
    - Computer, Server, Cloud
    - Services - ISP, DHCP, DNS
    - Hardware - Switch, Router, Wi-fi
- General understanding of the parts and workings of a computer, including various levels of software from BIOS through applications
    - Input and output devices
    - Central Processing Unit (CPU), Floating Point Units, Graphical Processing Unit
    - RAM, ROM
    - Storage devices
- Malware
    - Virus, Worm, Denial of Service, Spam
    - Firewall
- Binary and hexadecimal representation of numbers
    - Binary representation of 1, 2, 3, 15, etc.
    - Hexadecimal representation of 10, 15, 16, 30, etc.
- Ability to understand simple programs written in pseudo-code
    - Loops, Queue, Stack
    - Functions
    - Errors - Compile Time, Run Time, Logical, divide by zero, memory allocation error
    - Variable types - integer, character, string, floating point, array
    - Follow program code to determine output or value of given variables
    - Comments in code
- Debugging logic errors in a program
- Application problems
    - Find solutions in basic Pseudo-code programming lines
    - Solve binary and hexadecimal representations
- Robotics
    - Evaluate simple code to determine robot movement and shapes

**Section 5: Certification Exam Enrollment Procedures**

Students must register through REC and make an account through the student portal at: https://answerkey.net/recfp/gVx0Uu. Students should REMEMBER the password to ease login issues in the future as they will be taking 4 tests.

Fundamentals of Engineering will be proctored during ER week at the end of 1st semester during 10th grade. All other tests will be proctored during tech time by the tech time instructor or some other licensed proctor.

Once a student has an account, the testing coordinator at the GCDI can assign a voucher to a student to grant permission to take a test.  Tests must be proctored by a licensed proctor (currently DiLorenzo or Burrus) in order to be legitimate.

If questions, email Mr. DiLorenzo at dilorenzo_james@hcde.org.