Massachusetts CTE Teacher Testing Program
Robotics and Automation Technology Content Outline

Written and Performance Exam General Overview

- The intent of this exam is to assess the candidate's ability to teach the skills found in the Massachusetts Technical Education Framework.
- The written exam is a state-developed exam aligned to the frameworks which can be accessed here. The performance exam is a NOCTI-developed teacher test and has been determined by DESE to align to the state frameworks.
- Many questions and tasks require a synthesis of knowledge based on experience in the field and may not be found in any book.
- Use this exam outline and the Massachusetts Technical Education Framework to focus your preparation for the exams.
- Candidates are encouraged to prepare for their written exam by reviewing textbooks and reference material which have been listed as part of this exam outline. These resources can be found using online search tools, online vendors, and websites.

Written Exam

- Number of Questions: 100
- Administration Time: 3 hours
- Passing Score: 70.0%
- Administration Method: Remote Proctored Online Testing Session

Written Exam Content Coverage

3%   ***Fundamentals of Health and Safety***
- Health and Safety Practices

5%   ***Tools and Instruments***
- Use of Tools, Fasteners, and Equipment
- Use of Electronics Hand Tools and Equipment
- Use of Electrical Test Equipment

8%   ***Engineering Design Process***
- Components of Design Process

10%   ***Technical Communications***
- Various Types of Written Technical Communications
- Visual Communications Within the Electrical and Electronics Fields
- Flowcharts
- Hand Sketch Drawings
- CAD System

12%   ***Mechanical Concepts***
- Mechanical Transfer System
- IMA, AMA, and Efficiency
- Simple Versus Compound Machines
- Hydraulic System
- Mechanical System
- Pneumatic System

15%   ***Electrical Concepts***
- Basic Electronic Components
- Test Basic Electric Circuits
- Magnetic Devices
- AC Circuits
- Diodes and Transistors
- Digital Logic Circuits
- Electric Power Transmission and Distributor
- Convert Integers with Binary, HEX, and Decimal Number Systems

12%   ***Fundamentals of Sensor Technology***
- Position Sensors
- Velocity Sensors
- Proximity Sensors
- Load and Force Sensors
- Pressure Sensors
- Temperature Sensors

17%   ***Programmable Logic Controllers (PLCs)***
- Basic Building Blocks of a PLC
- PLC Hardware Components
- PLC Logic
- PLC Programs and PLC Wiring Diagrams

14%   ***Robotics Technology***
- Basic Building Blocks and Critical Specifications
- Industrial Robot Characteristics and Classifications
- Robot Work-Cell Sensors
- End-of-Arm Tooling with Industrial Robots
- Programming Techniques

4%   ***Automated Systems***
- Motor Control and Punch Press Applications

Written Exam Reference Materials (Reference Current Edition)

- **Programmable Logic Controllers** by Frank Petruzella (McGraw-Hill)
- **Introduction to Robotics, Module Robotics 701** (Schoolcraft Publishing) (http://www.schoolcraftpublishing.com/Introduction-to-Robotics.html)
- **Electronic Devices – Conventional** by Thomas Floyd (Prentice Hall)
- **Digital Fundamentals** by Thomas Floyd (Pearson/Prentice Hall)
- **Robotics Demystified: A Self-Teaching Guide** by Edwin Wise (McGraw-Hill)
- **Introduction to Engineering Design and Problem Solving** by Arvid Eide, Roland Jenison, Larry Northup, and Lane Mashaw (McGraw-Hill)
- **Design Concepts for Engineers** by Mark Horenstein (Prentice Hall)
- **Industrial Robotics and Automation** by A.K. Gupta (Mercury Learning & Information)

- **Internet Resources**
  - **Robot Sensors:** www.robotplatform.com
  - **Robotic Arms:** http://en.wikipedia.org/wiki/Robotic_arm
  - **Industrial Robot Info:** http://en.wikipedia.org/wiki/Industrial_robot
  - **Basic Logic Gates:** http://en.wikipedia.org/wiki/Logic_gate
  - **Ohm's Law:** http://www.allaboutcircuits.com/vol_1/chpt_5/6.html
  - **Boolean Algebra Rules:** http://www.uotechnology.edu.iq/dep-eee/lectures/1st/Digital%20techniques/part2.pdf

Materials Needed for the Written Exam

- A four-function calculator is included in the online testing system. No other calculators are permitted.
- Scrap paper and pencil/pen are permitted.

Written Exam Sample Items

Each question on the exam consists of one incomplete sentence or question followed by four choices. Some items reference an image or diagram. A few sample items are included below; the correct answer is designated with an asterisk (*).

Which of the following can be used to simulate the movement or track the flow of parts and information?
- a.   Sequencer
- b.   Shift register (*)
- c.   Math instruction
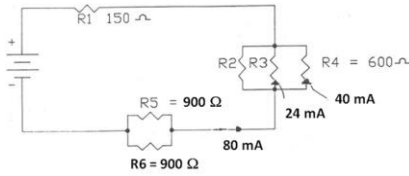- d.   Both A and B

The primary difference between closed-loop and open-loop control in robots is the addition of the:
- a.   control path.
- b.   feedback path. (*)
- c.   point-to-point path.
- d.   continuous path.

Which is a method of proportioning a sketch?
- a.   Cut out a cardboard template.
- b.   Use graph paper. (*)
- c.   Project the image on a wall.
- d.   Use a compass.

In the circuit shown below, compute the value of R2:

    a.   150 ohms
    b.   300 ohms
    c.   1.5K ohms (*)
    d.   3K ohms

Performance Exam

- Administration Time: 4 hours
- NOCTI Criterion-Referenced Cut Score/Passing Score: 70%
- Administration Method: Onsite at a DESE approved Massachusetts Area Testing Center (MATC) location. Candidates must register and schedule their exam session through NOCTI.

Performance Exam Content Coverage

32%   **Speed and Direction Control of a Permanent Magnet DC Motor**
The candidate will accurately wire and test LM555 PWM circuit according to industry and OSHA standards and demonstrate duty cycle output using the schematic.

38%   **PLC Application**
The candidate will develop the non-simplified Boolean Expression using the Truth Table.

25%   **Robotic Work Cell**
The candidate will, using previously generated Boolean Expression, produce a simplified version of the same expression by use of Boolean Algebra or K-Mapping.

5%   **Safety**
The candidate will demonstrate safety knowledge and follow safety procedures according to current industry and OSHA standards.

> **Notes:** If a component is blown (destroyed) due to faulty set up/wiring, the candidate will be given a second chance to correct the problem and continue the task with a grade point reduction. If the problem occurs again, the task will be terminated.

Candidate Supplied

Candidates must bring all appropriate Personal Protective Equipment (PPE), attire/uniform, and any other safety items as is routinely expected to be used by an employee in the related industry. If the candidate does not bring what is needed to safely complete all jobs on the exam as required in the workplace, the testing session will need to be rescheduled at the candidate's expense.

Candidates have the option of bringing their own PLC system and appropriate hardware/software to be able to run the system and perform the required tasks. However, prior to bringing personal equipment, candidates are required to:

a)   Refer to the specs of the systems and equipment supplied by the performance exam test site and verify that the system performs similarly.

b)   Notify NOCTI at nocti@nocti.org no later than two weeks prior to the exam date to indicate what system/equipment, if any, you wish to bring to the exam.

Site Supplied

Additional equipment and supplies needed to complete the jobs on the performance test will be provided by the testing site.

Performance Exam Site Requirements

Testing sites may have individual requirements based on location and any relevant and current guidance from the Center for Disease Control and Prevention (CDC).