

# Massachusetts CTE Teacher Testing Program Engineering 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



### Required Resource for Testing Session!

*Please print and bring this guide for the administration of the written exam for your reference.*

## Written Exam Content Coverage

### 8% **Automated System Engineering**

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|---|--|
| <ul style="list-style-type: none"> <li>• Concepts</li> <li>• Design Implementation</li> <li>• The major and minor axes of a robotic arm</li> <li>• Robotic grippers and work envelopes</li> </ul> | <ul style="list-style-type: none"> <li>• Sensors</li> <li>• Basic Elements of a Computer Integrated Manufacturing (CIM) Station</li> </ul> |
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### 10% **Electrical Engineering**

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|---|--|
| <ul style="list-style-type: none"> <li>• Concepts</li> <li>• Analyze series and parallel resistive circuits</li> <li>• Basic digital logic (INV, AND &amp; OR gates)</li> </ul> | <ul style="list-style-type: none"> <li>• Analyze and extract information from a truth table</li> <li>• Convert binary and Hexadecimal Notation</li> <li>• Ohm’s Law and Related Calculation</li> </ul> |
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**14% Engineering Mathematics**

- Physics Problems
- Calculate problems related to Civil and General Engineering
- Apply basic algebra, trigonometry and geometry principles
- Basic properties of materials
- Apply the Reynolds number and Pascal's Law
- Degrees and Rads

**36% Engineering Fundamentals**

- Design Process
- Problem Solving, Diagnostics
- Documentation and Communication Concepts
- Product Objectives and Criteria
- Production, Planning and Methods
- Manufacturing Process
- Mode, Mean and Median
- Basic instruments in Temperature, Fluid and Pressure regulation
- Open and closed loop principles
- Engineering journals, notebooks and written reports
- Application of drawing views (i.e. front, side views)
- Tools, Terminology and Applications of Total Quality Management (TQM)
- Basic Statistics
- General CAD Concepts

**4% Engineering Health and Safety**

- Basic Application of the SDS

**12% Mechanical Engineering**

- Physics of Mechanical Systems
- Materials
- Simple Machine Concepts and Applications
- Fluid System Concepts and Pascal's Law
- Heat Flow Systems and Control Devices
- Solve Related Calculations
- Apply various machining techniques
- Apply basic manufacturing techniques
- Process Control (Six Sigma Defects per Unit)
- Elements of
  - Gear Trains
  - Turbofan Engines
  - Turbojet Engines
  - Rocker Arms
- Linear and Rotational Mechanical Systems
- Basic Rapid Prototyping Concept
- General Gas Laws

**5% Engineering Related Science**

- Newton's 3 Laws of Motion
- Energy, Work and Power
- Thermal Systems and Properties
- Electrical Systems and Properties, Ohm's Law Applications
- Fluid Systems
- Materials and Ceramics
- Calculate basic one-dimensional kinematics
- Fundamentals of Physics

**11% Civil and Architectural Engineering Concepts**

- Importance of Civil and Architectural Engineering
- Components of and Coordination Required for an Entire Construction Document
- Structural Systems
- Surveying Equipment and Strategies
- Free-body Diagrams
- Site Surveys
- Conduct Soil Testing and Analyze Results
- Analyze Site and Determine the Drainage Requirements
- Dead, Live and Environmental Loads on a Structure
- Tributary Area of Structural Elements
- Architectural Styles
- As-build Drawings

**Written Exam Reference Materials (Reference Current Edition)**

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- **Digital Fundamentals** by Thomas Floyd (Prentice Hall)
- **Electricity & Electronics** by H.H. Gerrish, W.E. Dugger, Jr. and R.M. Roberts (Goodheart-Willcox)
- **The Science and Engineering of Materials** by Donald Askeland PWS Publishing Company
- **Industrial Robotics and Automation** by A.K. Gupta (Mercury Learning & Information)
- **Instrumentation and Process Control** by Terry L. M. Bartelt (Cengage Learning)
- **Basic Physics: A Self Teaching Guide** by Karl Kuhn (Wiley)
- **Introduction to Statistical Quality Control** by Douglas C. Montgomery (John Wiley & Sons, Inc.)
- **Introduction to Engineering** by Paul H. Wright (John Wiley & Sons Inc.)
- **Instrumentation** by Franklyn W. Kirk and Nicholas R. Rimboi (American Technical Publishing)
- **Internet Resources:**
  - Math (Algebra): [www.khanacademy.org](http://www.khanacademy.org)
  - Physics Equations: <http://physics.info/equations/>
  - Basic Physics Tutorial: <http://gbhsweb.glenbrook225.org/gbs/science/phys/class/bboard.html>
  - Robotic Arm info and links: [http://en.wikipedia.org/wiki/Robotic\\_arm](http://en.wikipedia.org/wiki/Robotic_arm)
  - Industrial Robot info and links: [http://en.wikipedia.org/wiki/Industrial\\_robot](http://en.wikipedia.org/wiki/Industrial_robot)
  - Statistical Quality Control (Chp. 6): <http://www.wiley.com/college/sc/reid/chap6.pdf>
  - Science and Engineering of Materials: <http://ocw.mit.edu/courses/materials-science-and-engineering/>
  - Basic Logic Gates: [http://en.wikipedia.org/wiki/Logic\\_gate](http://en.wikipedia.org/wiki/Logic_gate)
  - Ohm's Law: [http://www.allaboutcircuits.com/vol\\_1/chpt\\_5/6.html](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>
  - Civil and Architectural Engineering:
    - <https://www.indiabix.com/civil-engineering/questions-and-answers/>
    - <https://engineeringmcqs.blogspot.in/2014/07/civil-engineering-questions-and-answers.html>

Reference Materials as stated in the Engineering Technology Frameworks by the DESE

- **Digital Fundamentals** by T.L. Floyd (Pearson: Prentice Hall)
- **Digital Electronics: Principles and Applications** by Roger Tokheim (McGraw Hill)
- **Foundations of Engineering** by Mark T. Holtzapple (McGraw Hill)

- **Civil Engineering Reference Manual for the PE Exam** by M.R. Lindeburg (Professional Publications, Inc.)
- **Civil Engineering and Architecture** by Donna Matteson, Deborah Kennedy, Stuart Baur, Eva Kultermann (Cengage Learning)
- **Revit Architecture** by Paul F. Aubin (Cengage Learning)
- **Engineering Drawing and Design** by David A. Madsen and David P. Madsen (Delmar: Thomson Learning)
- **Engineering Design: An Introduction** by John R. Karsnitz, Stephen O’Brien, and John P. Hutchinson (Delmar: Cengage Learning)
- **Principles of Engineering** by Brent Handley, Craig Coon, and David M. Marshall (Delmar: Cengage Learning)

### Materials Needed for the Written Exam

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

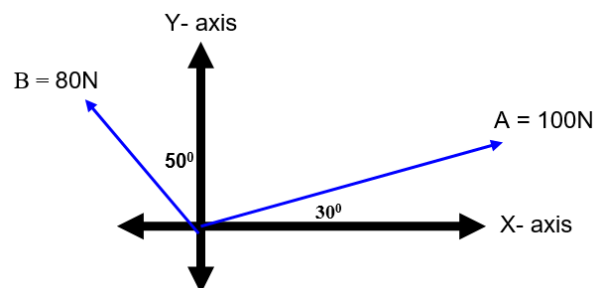
### Written Exam Sample Items

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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 (\*).

When is a fire watch needed?

Given vector A of 100 N and vector B of 80 N as shown in the diagram below, find the magnitude and direction of the resultant vector.



- 105 N at 76° North of the X-axis (\*)
- 105 N at 140° North of the X-axis
- 178 N at 76° North of the X-axis
- 178 N at 140° North of the X-axis

Convert Binary number 001001011011 to HEX

- a. 20C
- b. 25B (\*)
- c. 97D
- d. 125A

A ball is dropped from a height of 5m to the ground. How long is the ball in the air? What is the velocity of the ball just before impact with the ground?

- a. 0.50 sec and 4.37 m/s
- b. 1.01 sec and 9.90 m/s (\*)
- c. 1.54 sec and 12.13 m/s
- d. 2.02 sec and 14.40 m/s

Reduce the Boolean Expression:  $AB'C + AB'C + ABC$

- a.  $AB'$
- b.  $AC$  (\*)
- c.  $AB$
- d.  $B'C$

## NOCTI Performance Exam

- Administration Time: 3 hours and 30 minutes
- NOCTI Criterion-Referenced Cut Score/Passing Score: 85.8%
- 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

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### **60% Technical Writing**

*Identify problem and/or need, evaluate alternatives, design a solution, test the solution, analyze results, draw conclusions, and format.*

### **40% Oral Presentation**

*Presentation time, headings followed the technical report, number or slides, slide with chart, question/answer period, and overall presentation.*

## Performance Exam Requirements

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### 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.

### Site Supplied

Additional equipment and supplies needed to complete the jobs on the performance test will be provided by the testing site. It is also the testing site's responsibility to provide exam assistants to serve as patients, customers, or other roles required for the exam.

### Performance Exam Site Requirements

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