

Emerging Battery Technologies (NY)

Exam Information	Description																								
Exam number 905 Items 53 Points 62 Performance standards Yes Certificate available Yes	The course covers the topics covered for Emerging Battery Technologies, including safety practices, proper use of test equipment, electronic components, basic electronic theory, soldering and desoldering, battery types and functions, technical battery characteristics, battery systems, power converters, energy storage applications (stationary, mobile, and consumer electronics), and recycling. The course emphasizes both theoretical understanding and practical application, including hands-on activities like building circuits, testing components, and designing a functional product. Students will learn about various battery types (lithium-ion, lead-acid), battery management systems, power conversion, and the importance of recycling. The course also includes performance standards and project requirements.																								
	Exam Blueprint																								
	<table> <tr> <th>Standard</th><th>Exam %</th></tr> <tr> <td>1. Safety Practices</td><td>14%</td></tr> <tr> <td>2. Proper Use of Test Equipment</td><td>10%</td></tr> <tr> <td>3. Electronic Components</td><td>12%</td></tr> <tr> <td>4. Basic Electronic Theory</td><td>19%</td></tr> <tr> <td>5. Solder and Desolder Components</td><td>0%</td></tr> <tr> <td>6. Battery Types, Functions, and Characteristics</td><td>19%</td></tr> <tr> <td>7. Battery Systems</td><td>3%</td></tr> <tr> <td>8. Power Converters</td><td>8%</td></tr> <tr> <td>9. Energy Storage Stationary Applications</td><td>8%</td></tr> <tr> <td>10. Mobile and Consumer Electronics Applications</td><td>3%</td></tr> <tr> <td>11. Recycling</td><td>4%</td></tr> </table>	Standard	Exam %	1. Safety Practices	14%	2. Proper Use of Test Equipment	10%	3. Electronic Components	12%	4. Basic Electronic Theory	19%	5. Solder and Desolder Components	0%	6. Battery Types, Functions, and Characteristics	19%	7. Battery Systems	3%	8. Power Converters	8%	9. Energy Storage Stationary Applications	8%	10. Mobile and Consumer Electronics Applications	3%	11. Recycling	4%
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Standard 1 - Safety Practices

Students will follow safety practices.

Objective 1 Identify potential safety hazards and follow general laboratory safety practices.

1. Assess workplace conditions with regard to safety and health.
2. Identify potential safety issues and align with relevant safety standards to ensure a safe workplace/jobsite.
3. Describe typical electric shock hazards in industry.
4. Describe the effects of electricity on the human body.
5. Locate and understand the use of shop safety equipment.
6. Select appropriate personal protective equipment.

Objective 2 Use safe work practices.

1. Use personal protective equipment according to manufacturer rules and regulations.
2. Follow correct procedures when using any hand or power tools.

Objective 3 Complete a basic safety test without errors (100%) before using any tools or shop equipment.

Standard 2 - Proper Use of Test Equipment

Students will understand the proper use of test equipment.

Objective 1 Understand the proper configuration, handling, and storage of a(n):

1. Voltmeter
2. Ammeter
3. Ohm meter
4. Bench power supply

Standard 3 - Electronic Components

Students will be able to understand and demonstrate how to use, test, and select electronic components.

Objective 1 Identify the following components and draw their schematic symbols

1. Resistor
2. Potentiometer
3. Capacitor
6. Transformer
7. Diode
9. Transistor
10. Microphone

11. Speaker
12. Battery
13. AC power supply
14. Terminal Post
15. Normally-open switch
16. Normally-closed switch
18. Induction coil
19. Light emitting diode
20. Earth ground
21. Chassis ground
22. Single-pole single-throw switch
23. Single-pole double-throw switch
24. Ammeter
25. Volt meter
26. Ohm meter

Objective 2 Determine the values for electronic components from their markings and physical characteristics.

Objective 3 Describe the operation of and procedures for testing resistors and capacitors in both a series and in a parallel circuit.

Standard 4 - Basic Electronic Theory

Students will be able to understand and demonstrate basic electronic theory.

Objective 1 Describe basic principles of electrical theory.

2. Describe the units of electrical charge, voltage, current, resistance, capacitance, and power.
3. Describe the factors that affect the movement of electrical charges.
4. Clearly distinguish between direct (DC) and alternating (AC) current.

Objective 2 Verify Ohms Law.

1. State Ohms Law and graph the relationships between current, resistance, and voltage in circuits.
2. Describe the effect on current when changing voltage or resistance.
3. Use formulas and basic mathematics to solve Ohms Law problems.
4. Calculate the power through a given resistor in a circuit.

Objective 3 Construct, measure and analyze simple series and parallel resistive circuits.

1. Describe the principles of a series circuit.
2. Describe the principles of a parallel circuit.

3. Calculate the theoretical values of voltage, current, resistance and power in all parts of a series circuit.

Standard 5 - Solder and Desolder Components

Students will demonstrate the ability to successfully solder components and desolder components from a printed circuit board.

Objective 1 Show appropriate use of heat sinks on solid state components.

Objective 2 Solder and desolder wires and discrete components on a printed circuit board.

Standard 6 - Battery Types ,Functions and Characteristics

Students will be able to identify and understand the different types of batteries and their functions.

Objective 1 Classifications of batteries

1. List the basic components of a battery cell.
2. Examine the properties of different battery types, and associate them to applications.

Objective 2 Lithium-ion batteries

1. Define a lithium-ion battery, based on its operating principles.
2. Recognize the main advantages and disadvantages of lithium-ion batteries, identifying their main applications and limitations.
3. Recognize the electrochemical reactions in a lithium-ion cell.

Objective 3 Lead acid batteries

1. Describe the overcharging reaction and recall the differences between types regarding water loss.
2. Identify key differences between how lead acid batteries work versus nickel-based or lithium-ion batteries.

Objective 4 Basic Technical Battery Characteristics

Students will be able to identify and understand the characteristics and vocabulary associated with batteries.

1. Vocabulary of energy storage in batteries
 - a. 1. Define basic vocabulary used for energy storage in batteries.

2. Battery Capacity and Energy
 - a. Define an electric charge in ampere hours (Ah) and electrical energy in Watt hours (Wh).
 - b. Estimate the maximum energy content of a battery pack given the rated capacity.
 - c.
3. Battery definitions, datasheets, and characteristics
 - a. Recognize battery testing properties, and identify the related values in a manufacturer's battery testing datasheet.

Standard 7 - Battery Systems

Students will understand and explain battery management systems.

Objective 1 Series-parallel Connection

1. Recognize series-parallel battery cell arrangements, and how the arrangements change the electrical capabilities of the battery.

Objective 2 Introduction to Battery Management Systems

1. Explain the purpose of a battery management system.

Standard 8 - Power Converters

Students will understand the need and types of power converters, and the applications.

Objective 1 The Need for Power Conversion

1. Identify the basic parameters of electrical power in examples of common present-day electrical applications.
2. Recognize the direction of electric power flow in electrical applications.

Objective 2 Types of Switched Power Converters

1. Classify power converters according to the AC or DC nature of inputs and outputs.
2. Identify different specifications of power converters.

Objective 3 Total System Energy Efficiency in Battery Applications

1. Describe the differences between power dependent efficiency and energy efficiency.
2. Recognize the impact of chaining different component efficiencies.

Standard 9 - Energy Storage Stationary Applications

Students will understand the battery storage principles and applications.

Objective 1 Behind-the-Meter Battery Storage Application

1. Describe the role of battery storage behind-the-meter and the added value for end-users, as well as the technical requirements, barriers, and drivers of these applications.

Objective 2 Benefits of Storage Facilities at Home

1. Examine key differences between AC and DC coupled systems.
2. Identify the best financial benefits and energy efficiency rates with local energy storage.

Objective 3 Benefits and Challenges of Local Grids

1. Examine the benefits and challenges of creating local grids.

Objective 4 Local Energy Storage to Manage Increasing Need of EV Charging

1. Recognize the risks of increased EV charging activity on the grid, and summarize methods to manage this use at grid-scale.

Objective 5 Home Storage

1. Define and summarize the main battery technology uses and storage systems available for residential homes and the benefits they provide.
2. Recognize and describe the main components of home storage installations.
3. Recognize AC and DC coupled system topologies, and the converter requirements and energy losses related to home battery storage systems.
4. Examine how to install a li-ion battery home storage system, and the effects of connecting different components.

Standard 10 - Mobile and Consumer Electronics Applications

Students will understand charging infrastructures and the different types of mobile and consumer applications.

Objective 1 Charging Infrastructure

1. Identify different types of EV charging, and observe the growth trends in the US.

Objective 2 Battery Storage Application in Mobility

1. Describe the application of battery storage in the mobility sector.
2. Recognize the role of battery storage for mobility in the transport industry.
3. Identify the main technical requirement of batteries in small-form mobility applications.

Objective 3 Battery Powered Consumer Electronics

1. Recall the main batteries used in consumer electronics and their characteristics.
2. Identify appropriate battery types for consumer electronics based on technical properties

Objective 4 Application Example—Energy Efficiency of a USB Power Bank

1. Recognize how to verify capacity and energy content.
2. Examine how to measure the capacity and energy efficiency of a USB power bank.

Standard 11 - Recycling

Students will understand and recognize the importance of recycling for the sustainable management of resources.

Objective 1 Battery Recycling: General Overview

1. Recognize the importance of recycling for the sustainable management of resources.
2. Identify the main features of spent batteries.
3. Recall operations, processes, and technologies used for treatment and materials recovery through recycling.
4. Describe the technical challenges of recycling.

Performance Standards

Standard 1 – Safety Practices:

- Follow safety practices for a given task

Standard 2 – Proper Use of Test Equipment:

- Test and troubleshoot a circuit using appropriate equipment
- Test battery performance using appropriate equipment

Standard 4–Basic Electronic Theory

- Construct, measure and analyze simple series and parallel resistive circuits with batteries.

Standard 5 – Solder and Desolder Components:

- Demonstrate the ability to successfully solder components to and desolder components from a printed circuit board.

Standard 7–Battery Systems

- Construct series-parallel battery cell arrangements and demonstrate how the arrangements change the electrical capabilities of the battery

Standard 10 – Mobile and Consumer Electronics Applications:

Project build with the following criteria:

- Design a functional electronic product with system components:
 - Create an electrical schematic
 - Show electrical calculations
 - Create a mock-up construction
 - Build the product
 - Test product