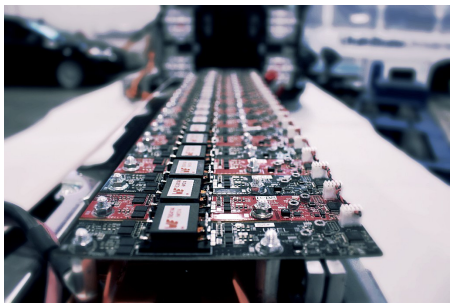
Welcome to the course!

- Welcome to ***Introduction to Battery Management Systems***!
- This course is the first in a specialization that investigates the proper management and control of battery packs, usually comprising many cells
- The methods and algorithms we discuss would typically be implemented by a battery-management system or BMS
- A BMS comprises purpose-built electronics plus custom designed algorithms (computer methods): it is an embedded system



What must a BMS do?

- The primary functions of a BMS are to:
  - Protect human safety of device's operator: Detect unsafe operating conditions and respond
  - Protect cells of battery from damage in abuse/failure cases
  - Prolong life of battery (normal operating cases)
  - Maintain battery in a state in which it can fulfill its functional design requirements
  - Inform the application controller how to make the best use of the pack **right now** (*e.g.*, by providing power limits), control charger, etc.

When do I need a BMS?

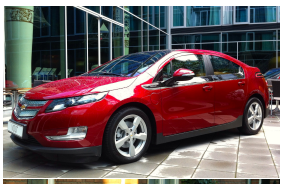
- All lithium-ion battery packs require at least a minimal BMS for safety: unmanaged cells can catch fire and explode!
- However, there is a cost associated with battery management, so not all battery-powered applications implement all features
  - Your battery is "cheap enough" if you can't remember the last time you replaced it
  - Larger battery packs represent greater investment, and motivate better battery management
  - This specialization focuses on large battery packs although the methods you will learn are quite general

Vehicle applications justifying complexity

- Vehicular applications include:
  - Hybrid-electric vehicle (HEV): Motive power provided by battery plus at least one other source (*e.g.*, gasoline engine), essentially zero all-electric vehicle range
  - Plug-in hybrid-electric vehicle (PHEV): Larger battery than HEV allows some all-electric range under certain operating conditions

Vehicle applications justifying complexity

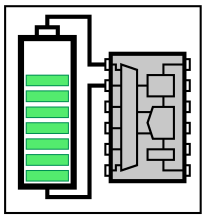
- Vehicular applications include:
  - Extended-Range Electric Vehicle (E-REV): Larger battery than PHEV allows some all-electric range under full-load conditions.
  - Electric Vehicle (EV), a.k.a. Battery-Electric Vehicle (BEV): Battery provides only motive power.



Other applications justifying complexity

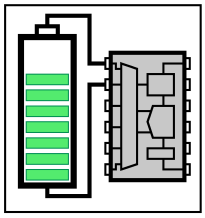
- All of these vehicle types employ battery packs that are "large," "high voltage," and "high current"
  - Some distinctions in design, which we will detail when necessary
  - Commonalities more significant than differences; when distinctions aren't important, we refer to the whole class as xEV
- Another large-scale application that justifies advanced battery management is for grid-storage and backup

What topics will we study in this course?



- In this course, we will study:
  - Battery terminology and composition
  - How lithium-ion cells are made and how they work
  - The primary high-level functions of a BMS
  - BMS electronics and algorithm requirements
- Course prerequisites were introduced in Lesson 1.0
- A prerequisite quiz is provided for you to be able to judge your level of preparedness

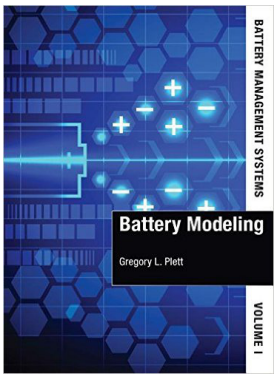
What skills will you gain in this course?

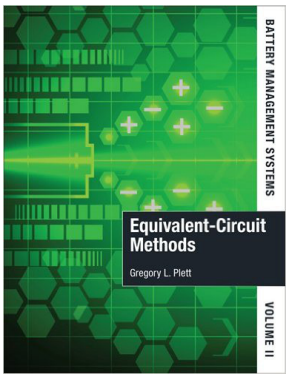


After completing the course, you'll be able to:

- Match terminology to a list of definitions
- Identify major components of lithium-ion cell and their purpose
- List the major functions provided by a battery-management system (BMS) and state their purpose
- Understand how a BMS "measures" current, temperature, and isolation, and how it controls contactors
- Identify electronic components that can provide protection and specify a minimum set of protections needed
- Compute stored energy in a battery pack
- List the manufacturing steps of different types of lithium-ion cells and possible failure modes

For further study





- In this course, we will study topics covered in chapters 1 of both *Battery Management Systems, Vol. 1, Battery Modeling* and *Vol. 2, Equivalent-Circuit Methods*, from Artech House
- For further study, you can confer these optional resources

Credits

Credits for photos in this lesson

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