

Miniproject

Electric Energy Storage and
New Energy Sources for
Electric Vehicles (EE546)

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- **Teaching and learning are mutually motivating**
- Please feel free to give your suggestions on our teaching and learning

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1. **State-of-the-Art Batteries for EVs** – Battery performance, battery materials, battery safety, cost-effectiveness, why they are widely applied in industry, etc
2. **Supercapacitor Technology in EVs** – Power density, energy density, working principle, category and performance in supercapacitor, etc
3. **Flywheels & Fuel Cells** – Kinetic energy storage, electrochemical reaction principle, efficiency, durability, advantages and disadvantages as power supplies in EV, etc
4. **Hybridisation of Energy Sources** – Energy management system, powertrain style, driving range, eco-friendliness, dynamic performance analysis of the application process, etc
5. **Battery Faults** – Types of faults, causes, consequences, examples and solutions
6. **Remaining Useful Life of Batteries** – Concept, causes, prediction methods and their comparison
7. **Reuse of Retired EV Batteries** – Reasons, importance, methods and examples
8. **Battery Charging Strategies** – Concept, design methods, examples, pros and cons
9. **Machine Learning in Battery Management** – Working principles, examples, pros and cons

Battery performance, battery materials, battery safety, cost-effectiveness, etc

- What are the mainstream battery technologies available in the market today?
- What are the key performance metrics for evaluating battery performance in EVs? How do different battery types compare in terms of these metrics?
- How do different battery materials compare in EV applications?
- What are the general safety risks associated with different kinds of batteries used in EVs?
- What are the current costs of different kinds of batteries for EVs? Is a significant cost reduction expected in the future?
- What future trends in battery technology should we anticipate in the next decade? In your opinion, which battery technology is likely to prevail in the future?

Power density, energy density, hybrid supercapacitor, voltage balancing, etc

- How do they differ from batteries? How do the power density and energy density of supercapacitors compare with that of batteries?
- What materials are commonly used in the construction of supercapacitors, and how do they affect performance?
- How are supercapacitors used in EVs?
- Explain the concept of voltage balancing in supercapacitor systems. Why is it important?
- How can they be integrated with batteries? What benefits does this offer?
- Compare the lifecycle and environmental impact of supercapacitors versus traditional batteries.
- What are future trends in supercapacitor technology? How might they affect EVs?

Kinetic energy storage, electrochemical reaction, efficiency, durability, etc

- How do flywheels store energy? Discuss the mechanisms of energy storage and release.
- What are the advantages of using flywheels in energy systems? Consider efficiency, lifespan, and response time.
- Are there challenges associated with the use of flywheels in EVs, and how can they be resolved?
- How do fuel cells generate electricity? Describe the chemical processes involved.
- What are the benefits of fuel cells for electric vehicles? Discuss factors like emissions and energy density.
- Do fuel cells pose safety issues when used in EVs, and how can their safety be assessed?
- How can flywheels and fuel cells be integrated? Explore potential applications in electric vehicles.

Energy management system, powertrain, driving range, eco-friendliness, etc

- What is hybrid energy sourcing? Define the concept and its significance in energy systems.
- What are the common combinations of energy sources?
- How do we optimize the use of different energy sources in a hybrid vehicle?
- What are the advantages of hybrid systems? Consider factors such as efficiency, reliability, and reduced emissions.
- How do hybrid systems improve energy storage? Explore the role of different technologies in enhancing storage capabilities.
- What challenges do hybrid energy systems face? Discuss issues like integration, cost, and technology compatibility.
- What are future trends in hybrid energy systems? Consider innovations and their potential impact on electric vehicles.

Types of faults, causes, consequences, examples and solutions

- What are common battery faults?
- What causes them?
- What are the consequences?
- Examples of battery faults.
- How can battery faults be detected and diagnosed?
- How can battery faults be prevented?
- Your suggestions for improving battery safety.

Concept, causes, prediction methods and their comparison

- The lifespan of lithium-ion batteries in EVs.
- Why do batteries age?
- What is the remaining useful life (RUL) of batteries?
- What are the consequences?
- How is battery RUL measured?
- Why do we need to know battery RUL?
- Methods for predicting battery RUL?
- Advantages and disadvantages of different prediction methods.
- How can we extend battery life?

Reasons, importance, methods and examples

- Why do EV batteries retire?
- How many EV batteries will retire in the future?
- The value and quality of retired batteries.
- How can we repropose retired batteries?
- Examples of reuse of retired batteries.
- Your suggestions for battery reuse.

Concept, design methods, examples, pros and cons

- What happens when the battery is charged?
- What is a battery charging strategy?
- Examples of common charging strategies and their differences.
- Why do we develop charging strategies?
- Your suggestions for designing battery charging strategies.



Working principles, examples, pros and cons

- How can machine learning benefit battery management?
- Examples of the use of machine learning in battery management.
- Differences between machine learning and traditional battery management algorithms.
- What are the advantages and disadvantages of machine learning for battery management?
- Your suggestions for applications of machine learning in this area.

- Even distribution among the project members
- The presentation is **12 min** for each group (all members). **Do not over time**
- Try to present the **same duration for each member**
- There is no fixed answer for each miniproject, you need to **persuade** us of your points
- State the **sources of materials**
- Other tips:
 - Present the ppt, not to read the slide
 - Add illustration
 - Not too much text in each slide
 - Animation, diagram and chart are useful