



# **SNS COLLEGE OF TECHNOLOGY**

**(An Autonomous Institution)**

**COIMBATORE-35.**



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Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai.

## **DEPARTMENT OF AUTOMOBILE ENGINEERING**

**COURSE NAME : 19AUB204 – AUTOMOTIVE ELECTRICAL AND ELECTRONICS ENGINEERING**

**II YEAR / IV SEMESTER**

**Unit 1 – Electrical Systems**

**Topic : Principle and Construction of Lithium Ion Battery**



# LITHIUM ION BATTERY



- ❖ A lithium-ion battery is a rechargeable type of battery that utilizes lithium ions as the primary component of its electrochemistry.
- ❖ These batteries have become immensely popular due to their high energy density, which means they can store a large amount of energy relative to their size and weight.
- ❖ They are widely used in various applications ranging from consumer electronics like smartphones and laptops to electric vehicles and renewable energy storage systems.





# COMPONENTS



- ❖ **Cathode:** The cathode is the positive electrode of the battery. It is typically made of a lithium metal oxide compound, such as lithium cobalt oxide ( $\text{LiCoO}_2$ ), lithium iron phosphate ( $\text{LiFePO}_4$ ), or lithium manganese oxide ( $\text{LiMn}_2\text{O}_4$ ). The cathode material determines the battery's specific energy capacity and voltage.
  
- ❖ **Anode:** The anode is the negative electrode of the battery. It is commonly made of carbon-based materials, such as graphite. During charging, lithium ions are extracted from the cathode and inserted into the anode, and during discharge, they move back to the cathode.



# COMPONENTS



- ❖ **Separator:** The separator is a thin, porous membrane that physically separates the cathode and anode while allowing lithium ions to pass through. It prevents short circuits by preventing direct contact between the cathode and anode while facilitating the movement of lithium ions.
- ❖ **Electrolyte:** The electrolyte is a conductive solution that facilitates the movement of lithium ions between the cathode and anode during charge and discharge cycles. It is typically a lithium salt dissolved in an organic solvent. Common electrolyte salts include lithium hexafluorophosphate ( $\text{LiPF}_6$ ) or lithium perchlorate ( $\text{LiClO}_4$ ).



# COMPONENTS



- ❖ **Current Collectors:** Current collectors are conductive materials that collect the electrical current generated by the movement of lithium ions between the cathode and anode. They are usually thin metal foils, such as aluminum for the cathode and copper for the anode.
- ❖ **Enclosure:** The enclosure or casing holds all the components of the battery together and provides protection from physical damage and environmental factors. It is typically made of metal or plastic.



# CONSTRUCTION



- ❖ The basic construction of a lithium-ion battery includes a positive electrode (cathode), a negative electrode (anode), and an electrolyte solution.
- ❖ During charging, lithium ions move from the positive electrode to the negative electrode through the electrolyte, where they are stored in the anode material (typically graphite).
- ❖ During discharge (when the battery is providing power), the lithium ions move back to the positive electrode through the electrolyte, releasing energy that can be used to power devices.



# WORKING OF LITHIUM ION BATTERY – CHARGING



- ❖ When a lithium-ion battery is connected to a charger, an external electrical current is applied to the battery.
- ❖ Lithium ions ( $\text{Li}^+$ ) in the electrolyte migrate from the positive electrode (cathode) through the electrolyte and into the negative electrode (anode).
- ❖ At the anode, lithium ions are absorbed into the host material (typically graphite) in a process called intercalation. This is where lithium ions are inserted between the layers of the graphite structure.
- ❖ Simultaneously, electrons are released from the lithium ions at the anode and flow through the external circuit, providing electrical energy.



# WORKING OF LITHIUM ION BATTERY – DISCHARGING



- ❖ When the battery is connected to a device, such as a smartphone or electric vehicle, the stored energy is used to power the device.
- ❖ Lithium ions move from the anode back to the cathode through the electrolyte.
- ❖ At the cathode, lithium ions are absorbed into the host material (such as lithium metal oxide) through a similar process of intercalation.
- ❖ As lithium ions are absorbed into the cathode material, electrons are released into the external circuit, generating electrical current to power the device.





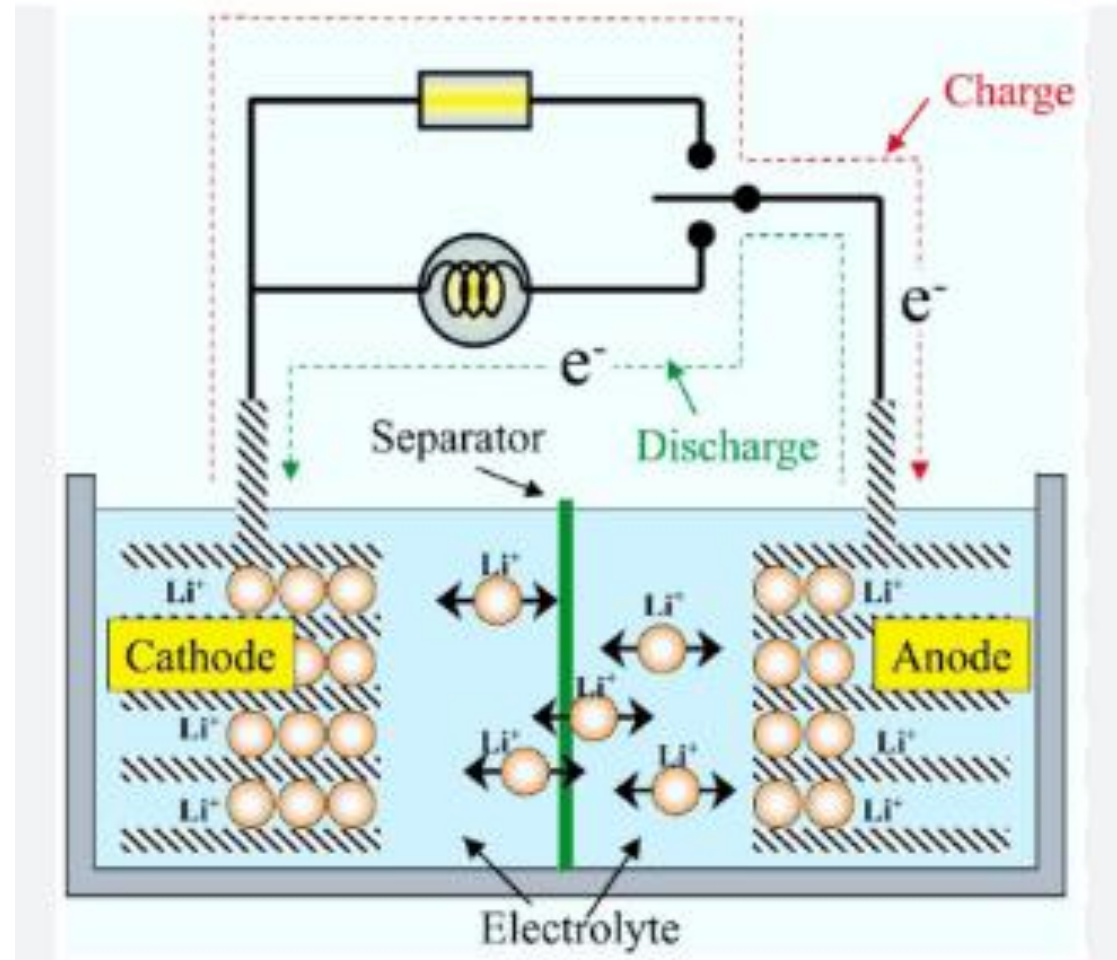
# OVERALL REACTION



- ❖ During both charging and discharging, the flow of lithium ions and electrons through the electrolyte and electrodes generates an electrical potential difference (voltage) between the cathode and anode.
- ❖ This voltage is what allows the battery to deliver electrical energy to a device.
- ❖ It's important to note that the reversible movement of lithium ions between the cathode and anode is what allows lithium-ion batteries to be rechargeable.
- ❖ This movement occurs as ions shuttle back and forth between the electrodes, maintaining the balance of charge within the battery.



# OVERALL REACTION





# APPLICATIONS



- ❖ Electrical vehicle
- ❖ Consumer electronics
- ❖ Portable power bank
- ❖ Aerospace and military application
- ❖ Medical device



THANK YOU !!!