

ChE 455/555: Introduction

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<p>Definitions</p> <ul style="list-style-type: none"> - Electrochemistry - Electrochemical Engng. <p>Challenges</p> <ul style="list-style-type: none"> - Course intention <p>Course Content</p> <p>Major Applications</p> <p>History</p>	<h2 style="text-align: center;">Outline</h2> <hr style="width: 50%; margin-left: 0;"/> <ul style="list-style-type: none"> • Definitions: <ul style="list-style-type: none"> - Electrochemistry - Electrochemical Engineering • Challenges • Course Content • Major Applications • History <p style="text-align: right; font-size: small;">ChE 455/555 2</p>
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	<ul style="list-style-type: none"> ▶ The use of chemical engineering fundamental principles for the study and analysis of electrochemical systems <ul style="list-style-type: none"> - Thermodynamics - Transport phenomena - kinetics
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Definitions - Electrochemistry - Electrochemical Engng. Challenges - Course intention Course Content Major Applications History	<h2>What is an electrochemical system?</h2> <hr/>
	<ul style="list-style-type: none"> ▶ System characterized by: <ul style="list-style-type: none"> - Strong interactions among solute and with the solvent (ionic species) - Passage of a current - Potential - Electrical energy transformed into chemical energy or vice versa - e.g., batteries, fuel cells, etc
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Definitions - Electrochemistry - Electrochemical Engng. Challenges - Course intention Course Content Major Applications History	<h2>Challenges</h2> <hr/>
	<ul style="list-style-type: none"> ▶ No much cover on other courses <ul style="list-style-type: none"> - Chemistry - Thermodynamics - Physical chemistry ▶ Electrochemical systems are different ▶ Break any myths about electrochemical systems
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- Definitions
 - Electrochemistry
 - Electrochemical Engng.
- Challenges
 - Course intention
- **Course Content**
- Major Applications
- History

Course Content

Basic concepts

Thermodynamics

Electrode kinetics

Transport mechanisms

Modeling

Applications

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Definitions

- Electrochemistry
- Electrochemical Engng.

Challenges

- Course intention

Course Content

Major Applications

History

Applications

- Production of Al and Cl
- Corrosion
- Batteries and Fuel Cells
- Electroplating
- Cathodic protection
- Super capacitors

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Course Content

Major Applications

History

Major Products based on electrochemical technology

Process or Product (data from National Research Council)	Annual Market (\$ billion)
Aluminium	4
Sodium Hydroxide	3
Chlorine	2
Copper	2
Other metals and chemicals	2
Electroplating	10
Batteries	4
Semiconductor Processing	1
Total	28

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	<p>Discoveries started around 1800</p> <p>Allesandro Volta (first battery)</p> <p>Michael Faraday (Faraday's law)</p> <p>David Grove (1839) discovered the fuel cell</p> <p>Georges Leclanche (1868) constructed the carbon zinc battery</p> <p style="text-align: right;">ChE 455/555 10</p>

Definitions - Electrochemistry - Electrochemical Engng. Challenges - Course intention Course Content Major Applications History	<h2>History</h2> <hr/>
	<ul style="list-style-type: none"> • Hall-Heroult aluminum process (1886) reduced the price from \$100/lb to \$2/lb • Walter Nernst • Julius Tafel • Great advances in electroplating (1920-1940s) <p style="text-align: right;">ChE 455/555 11</p>

Definitions - Electrochemistry - Electrochemical Engng. Challenges - Course intention Course Content Major Applications History	<h2>History</h2> <hr/>
	<ul style="list-style-type: none"> • The formal synthesis of electrochemistry and engineering began in 1950s <ul style="list-style-type: none"> - Norbert Ibl in Switzerland - Charles Tobias in US <p style="text-align: right;">ChE 455/555 12</p>

Summary

- Electrochemistry
- Electrochemical Engineering
- What is an electrochemical system?
- Major applications of electrochemistry

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