Chapter I: Introduction

1.1 Battery Vocabularies and Basic Physics
1.2 Applications
1.3 History and Discovery of Batteries

Chapter II: Battery Performance Parameters

2.1 Battery Voltage
2.2 Battery Cut off Voltage
2.3 Battery Open Voltage Circuit (OVC)
2.4 Battery Self-Discharge Rate
2.5 Battery Capacity and C-rate
2.6 Battery Internal Resistance
2.7 Battery Energy Density, Battery Power Density
2.8 Battery State-Of-Charge (SOC), Battery State-Of-Charge (SOH)
2.9 Cycle life, Calendar life

Chapter III: Different Types Of Batteries, Uses and Applications

3.1 Lead–Acid Batteries (LAB)
3.2 Nickel-Cadmium Batteries (N-Cd)
3.3 Nickelmetal hydride batteries (NiMH)
3.4 Lithium batteries

Chapter IV: Electrochemistry

4.1 Definition of electrochemical reactions
4.2 Overview of oxidation and reduction processes
4.3 Detailed analysis of redox reactions
4.4 Introduction to kinetics in electrochemistry
4.5 The Butler-Volmer equation: derivation and applications
4.6 Lithium-ion battery thermodynamics and kinetics

Midterm Exam I (Chapter I-IV)

Chapter V: Battery Modeling

5.1 Equivalent Circuit Models for Different Battery Chemistries
5.2 Governing Equations of Batteries
5.3 Battery Modeling : A CFD Approach
5.4 Lead-Acid Batteries Electrochemical CFD models
5.5 Lithium-Ion Batteries Electrochemical CFD models

Chapter VI: Battery Management Systems (BMS)

6.1 Introduction to BMS terminology and functions
6.2 Importance of BMS in safety and performance management (SOC, SOP, Balancing)
6.3 BMS Architecture and Design
6.4 State Estimation Techniques
6.5 Safety and Protection Mechanisms
6.6 Protection schemes against over-voltage, over-current, and thermal runaway

Midterm Exam II (Chapter IV-VI)

Chapter VII: Thermal Battery Management Systems (TBMS)

7.1 Importance of thermal management in batteries
7.2 Fundamentals of heat transfer: conduction, convection, radiation
7.3 Heat generation in batteries during operation
7.4 Active vs. passive thermal management systems
7.5 Cooling methods: air cooling, liquid cooling, phase change materials
7.6 Design considerations for BTMS

Final Exam(Comprehensive)

TEXT: Class Notes

List of References:

Battery Technology Crash Course: A Concise Introduction, Slobodan Petrovic, Springer, 2021.

Simulation of Battery Systems , Fundamental and Applications, Farschad Torabi, Pouria Ahmadi, APP, 2020.

Electrochemical Engineering, Thomas F. Fuller and John N. Harb, Wiley, 2018.

Battery Management Systems: Volume I, Battery Modeling, Gregory L. Plett ,Artech House, 2015.

Battery Management Systems, Volume II: Equivalent-Circuit Methods, Gregory L. Plett, Artech House, 2015.

Handbook of Batteries, David Linden and Thomas B. Reddy, 3rd edition, McGraw-Hill, 1995.

Electrochemical Systems, J. Newman and K. E. Thomas-Alyea, 3rd edition ,Wiley-Interscience , 1972.

Grading: The following weights will be used for grading:

Homeworks	10%
Computer Projects	10%
Quizzes	20%
First Midterm	15%
Second Midterm	15%
Final Exam	30%
Total	100%