

EEPE3012 STORAGE TECHNOLOGY (3-0-0)

Course Learning Objectives: This course will enable students to:

- Understand the various types of energy storage Technologies.
- Analyze thermal storage system.
- Analyze different battery storage technologies
- Analyze the thermodynamics of Fuel Cell
- Study the various applications of energy storage systems.

Module I (5 Hours)

Introduction: Necessity of energy storage – types of energy storage – comparison of energy storage technologies – Applications

Module II (6 Hours)

Thermal Storage System: Thermal storage – Types – Modeling of thermal storage units – Simple water and rock bed storage system – pressurized water storage system – Modelling of phase change storage system – Simple units, packed bed storage units - Modelling using porous medium approach,

Module III (6 Hours)

Electrical Energy Storage: Fundamental concept of batteries – measuring of battery performance, charging and discharging, power density, energy density, and safety issues. Types of batteries – Lead Acid, Nickel –Cadmium, Zinc Manganese dioxide, Li-ion batteries - Mathematical Modelling for Lead Acid Batteries – Flow Batteries.

Module IV (6 Hours)

Fuel Cell : Fuel Cell – History of Fuel cell, Principles of Electrochemical storage – Types – Hydrogen oxygen cells, Hydrogen air cell, Hydrocarbon air cell, alkaline fuel cell, detailed analysis – advantages and disadvantages

Module V (7 Hours)

Alternate Energy Storage Technology: Flywheel, Super capacitors, Principles & Methods – Applications, Compressed air Energy storage, Concept of Hybrid Storage – Applications, Pumped Hydro Storage – Applications, hydrogen as green fuel, synthetic approach of green hydrogen production

Course Outcomes (CO): On completion of this course, students are able to:

- CO1 Understand different types storage technologies
- CO2 Design a thermal storage system
- CO3 Model battery storage system
- CO4 Analyze the thermodynamics of fuel cell
- CO5 Analyze the appropriate storage technologies for different applications
- CO6 Explore the alternate energy storage technologies.

Text Book(s):

1. Ibrahim Dincer and Mark A. Rosen, 'Thermal Energy Storage Systems and Applications', John Wiley & Sons, 3rd Edition, 2021.
2. Ru-shi Liu, Lei Zhang and Xueliang sun, 'Electrochemical technologies for energy storage and conversion', Wiley publications, 2nd Volume set, 2012.
3. James Larminie and Andrew Dicks, 'Fuel cell systems Explained', Wiley publications, 3rd Edition, 2018.

Reference Book(s):

1. Schmidt.F.W. and Willmott.A.J., 'Thermal Energy Storage and Regeneration', Hemisphere Publishing Corporation, 1981, 1st Edition.

2. Prof. Subhasish Basu Majumder, "Electrochemical Energy Storage", NPTEL Course, <https://nptel.ac.in/courses/113105102>.
3. Prof. PK Das, "Energy conservation and waste heat recovery", NPTEL Course, <https://nptel.ac.in/courses/112105221>.