ELECTIVE COURSE 5

Course Code	Course Name	L-T-P	Credits
CKV733	**Energy storage technology**	2-2-0	4

Module 1:
Necessity of Energy Storage: Types of energy storage – comparison of energy storage technologies - Applications.

Module 2:
Thermal Storage: Types - Modelling 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 - Use of Transys.

Module 3:
Fundamental Concepts of Batteries: Measuring of battery performance - Charging and discharging of a battery - Storage density - Energy density - Safety issues - Types of batteries - Lead Acid, Nickel, Cadmium, Zinc Manganese dioxide and modern batteries for example (i) Zinc-Air (ii) Nickel Hydride (iii) Lithium Battery.

Module 4:
Hybrid Storage Devices: Flywheel - Super capacitors - Principles & Methods – Applications -Compressed air Energy storage - Concept of Hybrid Storage - Applications.
Hydrogen Storage Devices: Hydrogen storage options – Compressed gas – Liquid hydrogen – Hydride – Chemical Storage – Comparisons - Safety and management of hydrogen - Applications of Hydrogen.

References

1. Solar Engineering of Thermal Processes, John A. Duffie, William A. Beckman(auth.), Fourth Edition (2013)
2. Solar Energy, G.D. Rai
3. Engg. Technology, S. Rao & D.B Parulkar
4. Solar Energy, Sukhatme
5. Thermal Energy Storage Systems and Applications, Ibrahim Dincer and Mark A. Rosen, John Wiley & Sons 2002.
6. Fuel cell systems Explained, James Larminie and Andrew Dicks, Wiley publications, 2003.
7. Electrochemical technologies for energy storage and conversion, Ru-shiliu, Leizhang, Xueliang sun, Wiley publications, 2012
8. Fuel Cells – Principles and Applications, Viswanathan. B and M Aulice Scibioh, Universities Press (2006).
9. Hydrogen and Fuel Cells: A Comprehensive Guide, Rebecca L. and Busby, Penn Well Corporation, Oklahoma (2005).
10. Hydrogen and Fuel Cells: Emerging Technologies and Applications, Bent Sorensen (Sorensen), Elsevier, UK (2005).
11. Fuel Cell and Their Applications, Kordesch, K and G.Simader, Wiley-Vch, Germany (1996).
12. Fuel Cells: Theory and Application, Hart, A.B and G.J.Womack, Prentice Hall, NewYork Ltd., London (1989)
13. The Hydrogen Economy, Jeremy Rifkin,Penguin Group, USA (2002).