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Question Paper Code : 40782

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2024.

Fifth/Sixth/Seventh Semester

Mechanical Engineering

CME 364 — ENERGY STORAGE DEVICES

(Common to : Materials Science and Engineering/Mechanical Engineering (Sandwich))

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. List four types of energy storage technologies.
2. What is meant by energy storage efficiency?
3. Name two common materials used for thermal energy storage.
4. What factors influence battery performance?
5. What is a Hybrid Energy Storage System (HESS)?
6. Why is energy density important in battery specification for vehicles?
7. How does energy conversion efficiency impact renewable energy system?
8. What is an energy audit?
9. How do supercapacitors differ from conventional batteries?
10. What is the basic principle of hydrogen storage?

PART B — (5 × 13 = 65 marks)

11. (a) Discuss the need for energy storage in modern energy systems. Compare and contrast different types of energy storage systems focusing on their principles, applications, and limitations.

Or

- (b) Explore new alternative energy storage technologies. Summarize the latest innovations and discuss their possible effects on energy systems.
12. (a) Examine the concepts of sensible and latent heat storage systems. Explain their operating principles and practical applications in energy management.

Or

- (b) Discuss the importance of battery testing and performance evaluation. Explain the testing methods, key performance indicators.
13. (a) Evaluate V2G and G2V technologies and their implications for energy management. Discuss how these technologies facilitate the interaction between electric vehicles and the power grid.

Or

- (b) Analyze the potential of HESS in improving the efficiency of energy storage systems. Discuss how integrating different storage technologies can enhance overall system performance.
14. (a) Discuss how smart grid technologies improve energy efficiency, reliability, and integration of renewable sources.

Or

- (b) Evaluate the economic and environmental benefits of renewable energy storage and management systems. Discuss how these systems contribute to sustainability and cost savings.
15. (a) Discuss the role of biogas storage in sustainable energy systems. Explain its production, from various sources.

Or

- (b) Evaluate the integration of supercapacitors and SMES in renewable energy systems. Discuss how these technologies can work together to enhance grid stability and energy management.

PART C — (1 × 15 = 15 marks)

16. (a) Evaluate the potential of integrating Superconducting Magnetic Energy Storage (SMES), hydrogen storage and fuel cell technologies (PEMFC, SOFC etc) into a modern renewable energy grid. Discuss the challenges and advantages of combining these technologies in terms of energy efficiency, scalability and environmental impact.

Or

- (b) Analyze the different types of batteries in terms of their charging and discharging characteristics, efficiency, and overall performance. How do factors like energy density, cycle life, and charge/discharge rates influence their suitability for applications such as electric vehicles.
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