

**M.E. / M.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025**

Third Semester

**Power Electronics and Drives**

**24PPEEL309 – ADVANCED ENERGY STORAGE TECHNOLOGY**

Regulations - 2024

Duration: 3 Hours

Max. Marks: 100

**PART - A (MCQ) (10 × 1 = 10 Marks)**

Answer ALL Questions

	<i>Marks</i>	<i>K- Level</i>	<i>CO</i>
1. Interruption in energy supply can be minimized using storage systems because they: a) Generate additional power continuously      b) Act as a backup source during outages c) Reduce the load on renewable sources      d) Increase fossil fuel usage	1	K1	CO1
2. Small-scale portable energy storage is generally required for: a) Mobile electronics and EVs      b) Bulk industrial energy demand c) Seasonal energy balancing      d) Long-distance transmission support	1	K1	CO1
3. The main limitation of superconducting magnetic energy storage (SMES) is: a) Slow response time      b) High energy density c) Requirement of cryogenic cooling      d) Inability to deliver high power	1	K1	CO2
4. Which of the following is an example of potential energy storage? a) Flywheels      b) Pumped hydro      c) Molten salts      d) Fuel cells	1	K1	CO2
5. Which energy storage method has very low environmental impact but requires large geographical space? a) Flywheel energy storage      b) Pumped hydro storage c) Lithium-ion battery storage      d) Supercapacitors	1	K1	CO3
6. Which of the following is a major demerit of flywheel energy storage systems? a) Low power density      b) Risk of mechanical failure at high speed c) Low cycle life      d) Toxic material usage	1	K1	CO3
7. The combination of a Bacitor with a fuel cell or flow battery primarily aims to: a) Increase charging time b) Improve response speed and efficiency of hybrid power systems c) Decrease system voltage d) Eliminate storage units	1	K1	CO4
8. In hybrid energy storage systems, the role of the supercapacitor is mainly to: a) Store large amounts of energy for long durations b) Provide peak power and handle sudden load changes c) Generate hydrogen d) Convert DC to AC	1	K1	CO4
9. The main chemical reaction in a Lead-Acid battery involves: a) Zinc and copper electrodes b) Lead and lead dioxide with sulfuric acid electrolyte c) Nickel and cadmium d) Lithium and cobalt oxide	1	K1	CO5
10. Power storage capacity of a battery is commonly expressed in: a) Amperes      b) Volts c) Watt-hours (Wh) or Kilowatt-hours (kWh)      d) Coulombs per second	1	K1	CO5

**PART - B (12 × 2 = 24 Marks)**

Answer ALL Questions

11. List the alternative sources of energy.	2	K1	CO1
12. Identify the main form of energy storage used in modern power systems.	2	K1	CO1

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|--|---|----|-----|
| 13. List the applications of potential energy.                           | 2 | K1 | CO2 |
| 14. State energy transformations.  | 2 | K1 | CO2 |
| 15. Define Autonomy.   | 2 | K1 | CO3 |
| 16. List the reasons why batteries are not fully efficient.              | 2 | K1 | CO3 |
| 17. Enumerate the uses for flow batteries.                               | 2 | K2 | CO4 |
| 18. List the advantages and disadvantages of hybrid energy storage.      | 2 | K1 | CO4 |
| 19. Define scale flexibility.  | 2 | K1 | CO4 |
| 20. State the importance of lead acid batteries.                         | 2 | K1 | CO5 |
| 21. List the applications of lithium batteries.                          | 2 | K1 | CO5 |
| 22. Justify why energy storage is important for automotive applications. | 2 | K2 | CO5 |

**PART - C (6 × 11 = 66 Marks)**

Answer ALL Questions

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|---|----|----|-----|
| 23. a) Describe various types of energy storages with suitable examples.                            | 11 | K2 | CO1 |
| <b>OR</b>   |    |    |     |
| b) Describe the impact of energy storage on the environment.  | 11 | K2 | CO1 |
| 24. a) Explain how superconducting magnetic energy storage stores and delivers energy.              | 11 | K2 | CO2 |
| <b>OR</b>   |    |    |     |
| b) Describe in detail the construction, working, and applications of a Pumped Hydro Storage system. | 11 | K2 | CO2 |
| 25. a) Discuss the importance of cycling capacity in energy storage systems.                        | 11 | K2 | CO3 |
| <b>OR</b>   |    |    |     |
| b) Discuss in detail the Characteristics of energy storage techniques.                              | 11 | K2 | CO3 |
| 26. a) Explain how the pressurized PEM water electrolysis process flows with a neat sketch.         | 11 | K2 | CO4 |
| <b>OR</b>   |    |    |     |
| b) Explain about Electrochemical double layer super capacitor and its application.                  | 11 | K2 | CO4 |
| 27. a) Explain in detail about lead-acid batteries and their applications.                          | 11 | K2 | CO5 |
| <b>OR</b>   |    |    |     |
| b) Explain with neat diagram of solar energy storage system.  | 11 | K2 | CO5 |
| 28. a) i) Summarize how regenerative energy storage systems works.                                  | 6  | K2 | CO4 |
| ii) Summarize how waste heat recovery systems improve overall efficiency in industries.             | 5  | K2 | CO5 |
| <b>OR</b>   |    |    |     |
| b) i) Describe the dual-mode hybrid electric vehicle in detail.                                     | 6  | K2 | CO4 |
| ii) Explain the concept of greenhouse heating and its role in energy storage systems.               | 5  | K2 | CO5 |