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Question Paper Code	13902
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**B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025**

Seventh Semester

**Electrical and Electronics Engineering**

**20EEEL712 - ENERGY STORAGE TECHNOLOGIES**

Regulations - 2020

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. How do interruptions in energy supply influence storage needs? (a) They reduce the need for storage systems (b) They increase fossil fuel dependency (c) They eliminate the use of renewable energy (d) They require storage to maintain power availability	1	K1	CO1
2. A remote area experiences frequent power outages. What is the most sustainable energy strategy for that region? (a) Rely on grid power with backup from fossil fuels (b) Use energy storage systems integrated with renewable (c) Increase grid dependency (d) Use only portable diesel generators	1	K1	CO1
3. What is the primary medium for thermal energy storage with phase change? a) Flywheel      b) Steam      c) Lithium-ion battery      d) Coal	1	K1	CO2
4. Compare thermal energy storage with and without phase change. What is the key difference? (a) One is mechanical; the other is electrical (b) One uses air, the other uses water (c) Both are identical in operation (d) Phase change storage absorbs/release latent heat, while non-phase change stores sensible heat	1	K1	CO2
5. Environmental consideration in ESS includes: (a) Time of charging      (b) Efficiency rate (c) Recyclability of materials      (d) Cycle frequency	1	K1	CO3
6. Durability in ESS refers to: (a) Resistance to software hacking      (b) Voltage spike absorption (c) Physical robustness and longevity under usage      (d) High dispatch rate	1	K1	CO3
7. Why super capacitors are considered in hybrid energy storage systems? (a) They provide high energy density for long-term storage (b) They offer high power density for peak power needs (c) They are cheaper than fuel cells (d) They are renewable by nature	1	K1	CO4
8. If a super-capacitor provides 200 W for 10 seconds, how much energy is delivered? (a) 1000 J      (b) 2000 J      (c) 4000 J      (d) 500 J	1	K2	CO4
9. What is the primary chemical component in a lead-acid battery? (a) Aluminium      (b) Lead dioxide      (c) Copper      (d) Magnesium	1	K1	CO5
10. A super-capacitor is an energy storage device that stores electrical energy through (a) capacitor      (b) Magnetic fields (c) electrostatic fields      (d) electromagnetic fields	1	K1	CO5

**PART - B (12 × 2 = 24 Marks)**

Answer ALL Questions

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|---|---|----|-----|
| 11. What are the main reasons behind the need for energy storage systems?                                       | 2 | K1 | CO1 |
| 12. State any two environmental concerns associated with energy storage systems.                                | 2 | K1 | CO1 |
| 13. What is the working principle of electrochemical energy storage systems?                                    | 2 | K1 | CO2 |
| 14. Identify any two factors to consider when selecting an energy storage system for grid applications.         | 2 | K2 | CO2 |
| 15. Explain dispatchability in the context of energy storage systems.   | 2 | K2 | CO3 |
| 16. Explain how scale flexibility benefits energy storage system deployment.                                    | 2 | K2 | CO3 |
| 17. A super-capacitor has capacitance 50 F and is charged to 20 V. Calculate its stored energy.                 | 2 | K2 | CO4 |
| 18. Identify the most suitable hybrid storage option for regenerative braking in electric vehicles and justify. | 2 | K2 | CO4 |
| 19. Compare the characteristics of lead–acid and lithium-ion batteries.   | 2 | K2 | CO5 |
| 20. What are the challenges and solutions in greenhouse heating energy storage?                                 | 2 | K1 | CO5 |
| 21. How can energy storage be used to manage transmission congestion effectively?                               | 2 | K1 | CO1 |
| 22. What is thermal energy storage with phase change? Give two suitable materials.                              | 2 | K1 | CO2 |

**PART - C (6 × 11 = 66 Marks)**

Answer ALL Questions

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|--|----|----|-----|
| 23. a) Explain the different types of energy storage needs based on their technical requirements and effectiveness.  | 11 | K2 | CO1 |
| <b>OR</b>  |    |    |     |
| b) Describe the environmental and sustainability issues linked with energy storage technologies.   | 11 | K2 | CO1 |
| 24. a) Explain various types of potential energy storage systems with suitable examples.   | 11 | K2 | CO2 |
| <b>OR</b>  |    |    |     |
| b) What are electromagnetic energy storage using superconducting magnets (SMES)? Explain its working and mention two advantages in grid applications.  | 11 | K2 | CO2 |
| 25. a) Explain the safety risks associated with energy storage systems, especially batteries. Discuss the causes and consequences of fire, explosion, and toxic emissions.   | 11 | K2 | CO3 |
| <b>OR</b>  |    |    |     |
| b) Explain the merits and demerits of different energy storage systems, focusing on their environmental impact and recycling aspects.  | 11 | K2 | CO3 |
| 26. a) Describe the role of hydrogen and oxygen in a hydrogen fuel cell. What are the chemical reactions involved at the anode and cathode?  | 11 | K2 | CO4 |
| <b>OR</b>  |    |    |     |
| b) Explain why the super capacitors are widely used in hybrid energy systems and their properties, energy and power calculation methods, and highlight their role in managing peak power demands in hybrid vehicles. | 11 | K2 | CO4 |
| 27. a) Describe the working and functions of a Battery Management System (BMS) with neat sketch.   | 11 | K2 | CO5 |
| <b>OR</b>  |    |    |     |
| b) Explain the energy storage system for a power plant integrating renewable energy. Suggest suitable battery types, charging patterns, and management strategies.   | 11 | K2 | CO5 |

28. a) i) Summarize the key components of a Bacitor system. 5 K2 CO4  
ii) Explain any two areas where energy storage systems are applied in industrial processes. 6 K2 CO5

**OR**

- b) i) Explain the merits and demerits of peak and continuous power needs. 5 K2 CO4  
ii) Summarize the properties of super-capacitors. 6 K2 CO5