

# **SRM VALLIAMMAI ENGINEERING COLLEGE**

**(An Autonomous institution)**

SRM Nagar, Kattankulathur– 603203

## **DEPARTMENT OF MECHANICAL ENGINEERING**

### **QUESTION BANK**



**VI SEMESTER**

**PME304 - ENERGY STORAGE DEVICES**

**Regulation–2023**

**Academic Year 2025-2026 (EVEN Semester)**

*Prepared by*

**Mr. P. VIJAYAN, Assistant Professor (O.G)/MECH**



**DEPARTMENT OF MECHANICAL ENGINEERING**

**QUESTION BANK**

**SUBJECT NAME: ENERGY STORAGE DEVICES**

**Sem / Year: VI/III**

**UNIT 1: INTRODUCTION TO ENERGY STORAGE**

Need for Energy Storage – Types of Energy Storage – Various forms of Energy Storage – Mechanical–Thermal - Chemical– Electrochemical – Electrical - Other alternative energy storage technologies – Efficiency and Comparison.

**PART-A**

Q.No.	Questions	BT Level	Competence
1.	State two applications of energy storage systems.	BTL1	Remembering
2.	Mention any two types of energy storage systems.	BTL2	Understanding
3.	Define energy density.	BTL1	Remembering
4.	Define power density.	BTL2	Understanding
5.	Why is energy storage necessary in renewable energy systems?	BTL1	Remembering
6.	List two challenges of energy storage systems.	BTL2	Understanding
7.	What is the main function of an energy storage device?	BTL1	Remembering
8.	Name two mechanical energy storage systems.	BTL2	Understanding
9.	Mention two examples of thermal energy storage.	BTL1	Remembering
10.	List two electrical energy storage devices.	BTL2	Understanding
11.	Define round-trip efficiency.	BTL1	Remembering
12.	Mention one advantage and one limitation of chemical storage.	BTL2	Understanding
13.	What is meant by grid balancing?	BTL1	Remembering
14.	Name two energy storage technologies used in electric vehicles.	BTL2	Understanding

15.	Define "backup power" in the context of energy storage.	BTL1	Remembering
16.	What are hybrid energy storage systems?	BTL2	Understanding
17.	State two advantages of energy storage for smart grids.	BTL1	Remembering
18.	Mention any two factors affecting the selection of an ESS.	BTL2	Understanding
19.	Define intermittent energy sources.	BTL1	Remembering
20.	State one application of ESS in the residential sector.	BTL2	Understanding
21.	What is peak shaving?	BTL1	Remembering
22.	List two components of a typical energy storage system.	BTL2	Understanding
23.	Mention any two emerging trends in energy storage.	BTL1	Remembering
24.	Give one reason why energy storage reduces carbon footprint.	BTL2	Understanding
25.	State two applications of energy storage systems.	BTL1	Remembering

**PART-B**

Q.No	Questions	Marks	BT Level	Competence
1.	Discuss the necessity of energy storage in modern energy systems.	(16)	BTL3	Applying
2.	Explain in detail the different types of energy storage systems.	(16)	BTL4	Analyzing
3.	Compare mechanical, chemical, electrical, and thermal energy storage systems.	(16)	BTL3	Applying
4.	Analyze the criteria for selecting a suitable energy storage technology for grid applications.	(16)	BTL4	Analyzing
5.	Evaluate the advantages and limitations of energy storage technologies.	(16)	BTL3	Applying
6.	Write a detailed note on the role of energy storage in renewable energy integration.	(16)	BTL4	Analyzing
7.	Describe the applications of energy storage systems in electric vehicles and power backup systems.	(16)	BTL3	Applying
8.	Discuss how energy storage systems contribute to grid stability.	(16)	BTL4	Analyzing
9.	Explain the role of energy storage in peak load	(16)	BTL3	Applying

	management.			
10.	Compare short-term and long-term energy storage systems with examples.	(16)	BTL4	Analyzing
11.	Discuss economic and environmental aspects of deploying energy storage systems.	(16)	BTL3	Applying
12.	A wind turbine generates 200 kW of power during the day for 6 hours and operates at 80 kW during the night. Calculate the energy required to store for the night. Assume that the storage system has 90% efficiency.	(16)	BTL4	Analyzing
13.	Describe the performance characteristics and design considerations for energy storage systems.	(16)	BTL3	Applying
14.	Compare energy storage systems based on energy density and power density.	(16)	BTL4	Analyzing
15.	Explain the impact of ESS on carbon emission reduction.	(16)	BTL3	Applying
16.	How do energy storage systems help in reducing transmission congestion?	(16)	BTL4	Analyzing
17.	Describe the classification of energy storage technologies with suitable examples.	(16)	BTL3	Applying
18.	Explain the relevance of energy storage in the context of smart grids.	(16)	BTL4	Analyzing

## UNIT-II: ENERGY STORAGE SYSTEMS

Pumped Air Energy Storage – Compressed Air Energy Storage – Flywheel – Sensible and Latent Heat Storage – Storage Materials – Performance Evaluation - Thermochemical systems – Batteries – Types- Charging and Discharging – Battery testing and performance.

### PART-A

Q.No.	Questions	BT Level	Competence
1.	Define Pumped Air Energy Storage (PAES).	BT-1	Remembering
2.	What is Compressed Air Energy Storage (CAES)?	BT-1	Remembering
3.	List any two advantages of CAES systems.	BT-2	Understanding
4.	What is the working principle of a flywheel energy storage system?	BT-2	Understanding
5.	Define sensible heat storage.	BT-1	Remembering
6.	Define latent heat storage.	BT-1	Remembering
7.	Mention any two materials used for sensible heat storage.	BT-1	Remembering
8.	What are phase change materials (PCM)?	BT-2	Understanding
9.	State any two advantages of latent heat storage over sensible heat storage.	BT-2	Understanding
10.	What is meant by storage efficiency?	BT-1	Remembering
11.	Define thermochemical energy storage.	BT-1	Remembering
12.	Mention two examples of thermochemical storage materials.	BT-1	Remembering
13.	What is a battery?	BT-1	Remembering
14.	List any two applications of batteries in energy systems.	BT-2	Understanding
15.	What is meant by battery charging?	BT-1	Remembering
16.	What is battery discharging?	BT-1	Remembering
17.	Define state of charge (SOC).	BT-1	Remembering
18.	What is depth of discharge (DOD)?	BT-2	Understanding
19.	Mention any two types of rechargeable batteries.	BT-1	Remembering
20.	What is battery capacity?	BT-1	Remembering
21.	Define energy density of a battery.	BT-1	Remembering
22.	What is cycle life of a battery?	BT-2	Understanding
23.	What is meant by battery efficiency?	BT-1	Remembering
24.	Name any two battery testing methods.	BT-1	Remembering
25.	What is meant by C-rate in batteries?	BT-2	Understanding

**PART-B**

<b>Q.No</b>	<b>Questions</b>	<b>Marks</b>	<b>BT Level</b>	<b>Competence</b>
1.	Explain the working principle of Pumped Air Energy Storage with a neat schematic diagram. Discuss its advantages and limitations.	16	BT-3	Applying
2.	Describe the construction and operation of a Compressed Air Energy Storage (CAES) system. Analyze its performance characteristics.	16	BT-4	Analyzing
3.	With a neat diagram, explain the working of a flywheel energy storage system and discuss its applications.	16	BT-3	Applying
4.	Compare sensible heat storage and latent heat storage systems with respect to working principle, materials, advantages and limitations.	16	BT-4	Analyzing
5.	Explain sensible heat storage systems in detail. Discuss suitable storage materials and performance parameters.	16	BT-3	Applying
6.	Describe latent heat storage systems using phase change materials. Explain selection criteria for PCM.	16	BT-4	Analyzing
7.	Discuss various thermal energy storage materials used for high and low temperature applications.	16	BT-3	Applying
8.	Explain the performance evaluation of thermal energy storage systems. Include efficiency, capacity and heat loss aspects.	16	BT-4	Analyzing
9.	Describe the principle of thermochemical energy storage systems with suitable examples.	16	BT-3	Applying
10.	Analyze the advantages of thermochemical storage systems over sensible and latent heat storage systems.	16	BT-4	Analyzing
11.	Explain the construction, working and characteristics of different types of batteries used in energy storage.	16	BT-3	Applying
12.	Compare lead-acid, nickel-based and lithium-ion batteries with respect to performance parameters.	16	BT-4	Analyzing
13.	Explain the charging and discharging characteristics of a battery with neat curves.	16	BT-3	Applying
14.	Discuss different battery charging methods and their	16	BT-4	Analyzing

	impact on battery life.			
15.	Explain battery testing methods such as capacity test, efficiency test and life cycle test.	16	BT-3	Applying
16.	Analyze battery performance parameters such as energy density, power density, efficiency and cycle life.	16	BT-4	Analyzing
17.	Evaluate the suitability of different energy storage systems for renewable energy applications.	16	BT-5	Evaluating
18.	Critically assess the role of advanced battery technologies in modern energy storage systems.	16	BT-5	Evaluating



### UNIT III: MOBILE AND HYBRID ENERGY STORAGE SYSTEMS

Batteries for electric vehicles - Battery specifications for cars, heart pacemakers, computer standby supplies – V2G and G2V technologies – HESS

#### PART A

Q.No.	Questions	BT Level	Competence
1.	Define batteries used for electric vehicles (EVs).	BTL 1	Remembering
2.	List any two types of batteries commonly used in electric cars.	BTL 1	Remembering
3.	What is meant by battery energy density?	BTL 1	Remembering
4.	State the importance of battery voltage rating in EVs.	BTL 2	Understanding
5.	What is a heart pacemaker battery?	BTL 1	Remembering
6.	Mention any two requirements of batteries used in heart pacemakers.	BTL 2	Understanding
7.	Define computer standby power supply.	BTL 1	Remembering
8.	What type of battery is commonly used in computer standby systems?	BTL 1	Remembering
9.	What is meant by battery capacity (Ah)?	BTL 1	Remembering
10.	Define battery cycle life.	BTL 1	Remembering
11.	What is V2G (Vehicle-to-Grid) technology?	BTL 1	Remembering
12.	Define G2V (Grid-to-Vehicle) technology.	BTL 1	Remembering
13.	State one advantage of V2G technology.	BTL 2	Understanding
14.	What is bidirectional charging?	BTL 2	Understanding
15.	Define hybrid energy storage system (HESS).	BTL 1	Remembering
16.	Mention two components used in HESS.	BTL 1	Remembering
17.	What is the function of supercapacitors in HESS?	BTL 2	Understanding
18.	Define power density of a battery.	BTL 1	Remembering
19.	What is state of charge (SOC)?	BTL 1	Remembering
20.	What is depth of discharge (DOD)?	BTL 2	Understanding
21.	State any two safety requirements for EV batteries.	BTL 2	Understanding

22.	What is thermal management in EV batteries?	BTL 2	Understanding
23.	Define backup time of a standby battery system.	BTL 1	Remembering
24.	What is meant by fast charging?	BTL 2	Understanding
25.	Mention any one advantage of HESS in electric vehicles.	BTL 2	Understanding

**PART-B**

Q.No	Questions	Marks	BT Level	Competence
1.	Explain the construction, working and specifications of batteries used in electric vehicles with neat diagrams.	16	BT-3	Applying
2.	Discuss battery specifications required for electric cars such as energy density, power density, cycle life and safety.	16	BT-4	Analyzing
3.	Explain the battery requirements and specifications for heart pacemakers.	16	BT-3	Applying
4.	Analyze the importance of reliability and safety in pacemaker battery systems.	16	BT-4	Analyzing
5.	Describe the battery system used for computer standby power supplies with advantages and limitations.	16	BT-3	Applying
6.	Compare batteries used in electric cars, pacemakers and computer standby supplies.	16	BT-4	Analyzing
7.	Explain the working principle of V2G technology with suitable block diagrams.	16	BT-3	Applying
8.	Analyze the benefits and challenges of V2G implementation in smart grids.	16	BT-4	Analyzing
9.	Explain G2V technology and its role in EV charging infrastructure.	16	BT-3	Applying
10.	Compare V2G and G2V technologies with respect to operation and applications.	16	BT-3	Applying
11.	Describe the concept of Hybrid Energy Storage Systems (HESS).	16	BT-4	Analyzing
12.	Explain the configuration and working of battery–	16	BT-4	Analyzing

	supercapacitor based HESS.			
13.	Analyze the performance advantages of HESS over single energy storage systems.	16	BT-5	Evaluating
14.	Discuss the role of HESS in improving EV efficiency and battery life.	16	BT-5	Evaluating
15.	Evaluate the suitability of different batteries for EV applications.	16	BT-5	Evaluating
16.	Evaluate the impact of V2G technology on grid stability and renewable integration.	16	BT-5	Evaluating
17.	Critically assess the future prospects of advanced battery technologies for EVs.	16	BT-3	Applying
18.	Justify the need for HESS in next-generation electric vehicles.	16	BT-4	Analyzing



**UNIT IV: RENEWABLE ENERGY STORAGE AND ENERGY MANAGEMENT**

Storage of Renewable Energy Systems –Solar Energy – Wind Energy – Energy Storage in Micro grid– Smart Grid – Energy Conversion Efficiency - Battery Management Systems – EVBMS – Energy Audit and Management

**PART A**

<b>Q.No.</b>	<b>Questions</b>	<b>BT Level</b>	<b>Competence</b>
1.	Define energy storage in renewable energy systems.	BTL 1	Remembering
2.	State the need for energy storage in solar energy systems.	BTL 2	Understanding
3.	What is meant by wind energy storage?	BTL 1	Remembering
4.	List any two energy storage methods used in wind energy systems.	BTL 1	Remembering
5.	Define microgrid.	BTL 1	Remembering
6.	Mention any two components of a microgrid.	BTL 1	Remembering
7.	What is the role of energy storage in a microgrid?	BTL 2	Understanding
8.	Define smart grid.	BTL 1	Remembering
9.	State any two features of a smart grid.	BTL 2	Understanding
10.	What is energy conversion efficiency?	BTL 1	Remembering
11.	Define battery management system (BMS).	BTL 1	Remembering
12.	State the main functions of a BMS.	BTL 2	Understanding
13.	What is EVBMS?	BTL 1	Remembering
14.	Mention any two advantages of EVBMS.	BTL 2	Understanding
15.	Define state of charge (SOC).	BTL 1	Remembering
16.	What is state of health (SOH)?	BTL 2	Understanding
17.	Define energy audit.	BTL 1	Remembering
18.	State the objectives of energy audit.	BTL 2	Understanding
19.	What is energy management?	BTL 1	Remembering
20.	Mention any two benefits of energy management.	BTL 2	Understanding
21.	What is load leveling?	BTL 2	Understanding
22.	Define peak shaving.	BTL 2	Understanding
23.	What is meant by renewable energy integration?	BTL 1	Remembering

24.	State one challenge in renewable energy storage.	BTL 2	Understanding
25.	What is meant by grid stability?	BTL 1	Remembering

**PART - B**

Q.No	Questions	Marks	BT Level	Competence
1.	Explain various energy storage technologies used in renewable energy systems with suitable diagrams.	16	BT-3	Applying
2.	Describe the role of energy storage in solar energy systems and analyze its impact on reliability.	16	BT-4	Analyzing
3.	Explain wind energy storage systems and their operational challenges.	16	BT-3	Applying
4.	Analyze the importance of energy storage in microgrids.	16	BT-4	Analyzing
5.	Explain the architecture and operation of a microgrid with energy storage.	16	BT-3	Applying
6.	Describe the concept of smart grid and explain the role of energy storage in smart grids.	16	BT-3	Applying
7.	Analyze the advantages of smart grids over conventional grids.	16	BT-4	Analyzing
8.	Explain energy conversion efficiency and factors affecting it in renewable energy systems.	16	BT-3	Applying
9.	Analyze methods to improve energy conversion efficiency in renewable systems.	16	BT-4	Analyzing
10.	Explain the working and functions of a Battery Management System (BMS).	16	BT-3	Applying
11.	Describe EV Battery Management System (EVBMS) architecture and safety features.	16	BT-3	Applying
12.	Analyze the importance of BMS and EVBMS in extending battery life.	16	BT-4	Analyzing
13.	Explain the procedure for conducting an energy audit in an industrial facility.	16	BT-3	Applying
14.	Analyze the role of energy audit in energy	16	BT-4	Analyzing

	conservation and cost reduction.			
15.	Evaluate different energy storage options for renewable energy integration.	16	BT-5	Evaluating
16.	Evaluate the impact of microgrids and smart grids on renewable energy utilization.	16	BT-5	Evaluating
17.	Critically assess challenges in large-scale renewable energy storage systems.	16	BT-5	Evaluating
18.	Justify the need for effective energy management strategies in renewable energy systems.	16	BT-5	Evaluating



## UNIT V: OTHER ENERGY DEVICES

Superconducting Magnetic Energy Storage (SMES), Supercapacitors – MHD Power generation – Hydrogen Storage - Fuel Cells – Basic principle and classifications – PEMFC, AMFC, DMFC, SOFC, MCFC and Biofuel Cells – Biogas Storage.

### PART A

Q.No.	Questions	BT Level	Competence
1.	Define Superconducting Magnetic Energy Storage (SMES).	BTL 1	Remembering
2.	State the principle of energy storage in SMES.	BTL 2	Understanding
3.	List any two advantages of SMES systems.	BTL 2	Understanding
4.	What is a supercapacitor?	BTL 1	Remembering
5.	Mention any two characteristics of supercapacitors.	BTL 2	Understanding
6.	Define MHD power generation.	BTL 1	Remembering
7.	State the basic principle of MHD power generation.	BTL 2	Understanding
8.	What is hydrogen storage?	BTL 1	Remembering
9.	List any two methods of hydrogen storage.	BTL 1	Remembering
10.	What is a fuel cell?	BTL 1	Remembering
11.	State the basic working principle of a fuel cell.	BTL 2	Understanding
12.	Classify fuel cells based on electrolyte used.	BTL 1	Remembering
13.	What is PEM fuel cell (PEMFC)?	BTL 1	Remembering
14.	What is alkaline membrane fuel cell (AMFC)?	BTL 1	Remembering
15.	Define direct methanol fuel cell (DMFC).	BTL 1	Remembering
16.	What is solid oxide fuel cell (SOFC)?	BTL 1	Remembering
17.	What is molten carbonate fuel cell (MCFC)?	BTL 1	Remembering
18.	Define biofuel cell.	BTL 1	Remembering
19.	State one advantage of biofuel cells.	BTL 2	Understanding
20.	What is biogas?	BTL 1	Remembering
21.	Define biogas storage.	BTL 1	Remembering
22.	Mention any two biogas storage methods.	BTL 1	Remembering

23.	What is energy density?	BTL 1	Remembering
24.	State one limitation of hydrogen storage.	BTL 2	Understanding
25.	What is meant by round-trip efficiency?	BTL 2	Understanding

**PART-B**

Q.No	Questions	Marks	BT Level	Competence
1.	Explain the construction, working principle and applications of Superconducting Magnetic Energy Storage (SMES) systems.	16	BT-3	Applying
2.	Analyze the advantages and limitations of SMES compared with other electrical energy storage systems.	16	BT-3	Applying
3.	Explain the working principle, construction and applications of supercapacitors.	16	BT-3	Applying
4.	Compare batteries and supercapacitors with respect to energy density, power density and applications.	16	BT-3	Applying
5.	Explain the principle and working of MHD power generation with neat diagrams.	16	BT-4	Analyzing
6.	Analyze the merits and demerits of MHD power generation systems.	16	BT-3	Applying
7.	Describe various hydrogen storage techniques and their applications.	16	BT-3	Applying
8.	Analyze challenges associated with hydrogen storage and transportation.	16	BT-3	Applying
9.	Explain the basic principle and classification of fuel cells.	16	BT-4	Analyzing
10.	Explain the construction, working and applications of PEM fuel cells (PEMFC).	16	BT-4	Analyzing
11.	Describe the working of AMFC and DMFC with suitable diagrams.	16	BT-3	Applying
12.	Explain the construction and operation of SOFC and	16	BT-4	Analyzing

	MCFC.			
13.	Compare PEMFC, SOFC and MCFC based on operating temperature, efficiency and applications.	16	BT-4	Analyzing
14.	Explain the working principle and applications of biofuel cells.	16	BT-3	Applying
15.	Analyze the role of fuel cells in sustainable energy systems.	16	BT-3	Applying
16.	Explain biogas production and storage methods with advantages.	16	BT-4	Analyzing
17.	Evaluate the suitability of hydrogen and biogas as future energy carriers.	16	BT-4	Analyzing
18.	Critically assess the role of advanced energy storage and conversion systems in renewable energy integration.	16	BT-3	Applying

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