# UNIT–III

# Worksheet: Applications of Electrical Energy Storage (EES)

## Part A: Multiple Choice Questions (20 × 1 Mark = 20 Marks)

**1. One major utility application of EES is:**

a) Water purification
b) Time shifting of electricity
c) Road transportation
d) Manufacturing batteries

**Answer:** b) Time shifting of electricity

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**2. Pumped Hydro Storage is mainly used to:**

a) Produce hydrogen
b) Reduce generation costs through time shifting
c) Increase fuel consumption
d) Generate thermal energy

**Answer:** b) Reduce generation costs through time shifting

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**3. A variable-speed PHS can:**

a) Operate only during peak load
b) Function as a frequency controller while pumping
c) Store hydrogen
d) Reduce battery costs

**Answer:** b) Function as a frequency controller while pumping

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**4. The first CAES power plant was built in:**

a) USA
b) Japan
c) Germany
d) France

**Answer:** c) Germany

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**5. The Huntorf CAES plant was commissioned in:**

a) 1958
b) 1978
c) 1988
d) 1998

**Answer:** b) 1978

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**6. The round-trip efficiency of the Huntorf CAES plant is approximately:**

a) 25%
b) 41%
c) 60%
d) 85%

**Answer:** b) 41%

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**7. Which battery technology was installed at the Los Andes substation in Chile?**

a) Lead Acid
b) NaS
c) Li-ion
d) NiMH

**Answer:** c) Li-ion

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**8. The Los Andes battery system provides:**

a) Water pumping
b) Frequency regulation
c) Fuel storage
d) Thermal storage

**Answer:** b) Frequency regulation

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**9. Traditionally, utilities have used _____ batteries for emergency power supply.**

a) Lithium-ion
b) NaS
c) Lead Acid
d) Flow Batteries

**Answer:** c) Lead Acid

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**10. On Hachijo-jima Island, TEPCO uses:**

a) Flywheels only
b) NaS batteries with diesel and wind generation
c) Hydrogen storage only
d) CAES only

**Answer:** b) NaS batteries with diesel and wind generation

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**11. Nearly half of installed NaS battery systems are used for:**

a) Vehicle charging
b) Load levelling
c) Thermal storage
d) Hydrogen production

**Answer:** b) Load levelling

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**12. Which EES technology accounts for about 99% of installed worldwide storage capacity?**

a) Li-ion Batteries
b) NaS Batteries
c) CAES
d) Pumped Hydro Storage

**Answer:** d) Pumped Hydro Storage

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**13. In Smart Grids, EES helps improve:**

a) Frequency control capability
b) Road safety
c) Water management
d) Fuel production

**Answer:** a) Frequency control capability

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**14. Demand-side management encourages consumers to:**

a) Use more electricity at peak times
b) Shift electricity use to surplus-energy periods
c) Stop using renewable energy
d) Install diesel generators

**Answer:** b) Shift electricity use to surplus-energy periods

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**15. A Smart Microgrid should be:**

a) Centralized only
b) Non-scalable
c) Scalable and autonomous
d) Independent of storage systems

**Answer:** c) Scalable and autonomous

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### 16. Smart Houses use EES primarily for:

a) Water storage
b) Load levelling and renewable energy utilization
c) Fuel generation
d) Mining operations

**Answer:** b) Load levelling and renewable energy utilization

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### 17. Which battery technology is most commonly used today in Smart Houses?

a) Lead Acid
b) Flywheel
c) SMES
d) CAES

**Answer:** a) Lead Acid

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### 18. The main obstacle to widespread electric vehicle adoption has been:

a) Motor efficiency
b) Battery energy storage capacity
c) Tire technology
d) Road infrastructure

**Answer:** b) Battery energy storage capacity

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### 19. Which battery technology is widely used in Toyota hybrid vehicles?

a) Lead Acid
b) NaS
c) NiMH
d) SMES

**Answer:** c) NiMH

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**20. ZEBRA batteries are especially suitable for:**

a) Hearing aids
b) Fleet vehicles such as buses
c) Smartphones
d) Aircraft navigation systems

**Answer:** b) Fleet vehicles such as buses

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# Part B: Fill in the Blanks (20 × 1 Mark = 20 Marks)

**1. EES reduces total generation costs through _____ shifting.**

**Answer:** time

**2. Pumped Hydro Storage provides electricity during _____ demand periods.**

**Answer:** peak

**3. The Huntorf CAES plant is located in _____.**

**Answer:** Germany

**4. The McIntosh CAES plant is located in _____.**

**Answer:** Alabama

**5. The Los Andes battery project has a power rating of _____ MW.**

**Answer:** 12

**6. The Los Andes battery has an energy capacity of _____ MWh.**

**Answer:** 3

**7. Utility emergency power systems have traditionally used _____ acid batteries.**

**Answer:** lead

**8. Hachijo-jima Island has approximately _____ inhabitants.**

**Answer:** 8,000

**9. NaS stands for Sodium _____ batteries.**

**Answer:** Sulphur

**10. Pumped Hydro Storage represents approximately _____% of installed global storage capacity.**

**Answer:** 99

**11. Renewable energy sources such as solar and wind are _____ in nature.**

**Answer:** fluctuating

**12. The Renewable Energies Law in Germany is abbreviated as _____.**

**Answer:** EEG

**13. A household example in Madrid used a _____ kWh lithium-ion battery system.**

**Answer:** 6

**14. The Futamata wind power plant uses _____ MW of NaS batteries.**

**Answer:** 34

**15. Smart Grids support _____ power flow between consumers and the grid.**

**Answer:** bi-directional

**16. Demand-side management is a key feature of the _____ Grid.**

**Answer:** Smart

**17. A Smart Microgrid should have a single _____.**

**Answer:** controller

**18. Smart Houses can reduce electricity costs by _____ levelling.**

**Answer:** load

**19. Electric vehicles were first developed in the _____ century.**

**Answer:** 19th

**20. The battery capacity of a full hybrid vehicle is typically less than _____ kWh.**

**Answer:** 5