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| **Name:**<br>**Enrolment No:** | |

**UNIVERSITY OF PETROLEUM AND ENERGY STUDIES**
**End Semester Examination, May 2025**

**Course: Energy Storage and EV Management.** **Semester: II**
**Program: MBA Power Management** **Time: 03 hrs.**
**Course Code: PIPM8011P_3** **Max. Marks: 100**

**Instructions:**

**SECTION A**
**10Qx2M=20Marks (Answer All Question)**

| S. No. | | Marks | CO |
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| Q 1 | **What is the typical round-trip efficiency of a pumped hydro storage system?**<br>A) 30–40%<br>B) 50–60%<br>C) 70–85%<br>D) 90–95% | **2** | **CO1** |
| Q 2 | **Which challenge in renewable energy generation is most effectively addressed by BESS?**<br>A) Grid inertia<br>B) Seasonal variability<br>C) Intermittency and fluctuation<br>D) Transmission losses | **2** | **CO1** |
| Q 3 | **Which challenge in renewable energy generation is most effectively addressed by BESS?**<br>A) Grid inertia<br>B) Seasonal variability<br>C) Intermittency and fluctuation<br>D) Transmission losses | **2** | **CO1** |
| Q 4 | **What type of BESS application helps in frequency regulation of the grid?**<br>A) Time-shifting<br>B) Peak shaving<br>C) Ancillary services<br>D) Load forecasting | **2** | **CO1** |
| Q 5 | **What is the key metric to evaluate the economic benefit of BESS in a renewable system?**<br>A) Total Harmonic Distortion<br>B) Levelized Cost of Energy Storage (LCOS)<br>C) Radiation Index<br>D) Apparent Power | **2** | **CO1** |

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| Q 6 | **How does BESS contribute to grid decarbonization?**<br>A) By replacing all fossil-fueled generators<br>B) By reducing the need for spinning reserves<br>C) By providing fuel to power plants<br>D) By increasing coal consumption during night | **2** | **CO1** |
| Q 7 | **What is the common impact of not integrating BESS with variable renewable sources like wind and solar?**<br>A) Stable voltage<br>B) High system efficiency<br>C) Grid congestion and curtailment<br>D) Increased grid frequency | **2** | **CO1** |
| Q 8 | **Which Indian policy promotes electric vehicle adoption and infrastructure?**<br>A) FAME<br>B) UDAY<br>C) R-APDRP<br>D) PM-KUSUM | **2** | **CO1** |
| Q 9 | **What is the typical function of a Battery Management System (BMS) in EVs?**<br>A) Charging station locator<br>B) GPS tracking<br>C) Monitoring battery health and safety<br>D) Emissions monitoring | **2** | **CO1** |
| Q 10 | **In a shared EV fleet, which of the following is most important for efficient management?**<br>A) Number of cup holders<br>B) Driver's height<br>C) Scheduling and route optimization<br>D) Engine displacement | **2** | **CO1** |
| **SECTION B**<br>**4Qx5M= 20 Marks** | | | |
| Q 1 | Capital Subsidy vs Soft Loan which option seems to be more fruitful to assure long term sustainability and operation of a renewable energy project and why? | **5** | **CO2** |
| Q 2 | Why do EVs show faster breakeven points in urban driving conditions compared to highways? | **5** | **CO2** |
| Q 3 | What are the challenges may arrive due to increase share of renewable energy in the overall electricity mix of the country. What could be the potential solutions to address these challenges? | **5** | **CO2** |
| Q 4 | Define, Cycle efficiency, Cyle life, Energy Density, and Depth of Discharge (DoD) of BESS system | **5** | **CO2** |

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| **SECTION-C**<br>***(Attempt any three)***<br>**3Qx10M=30 Marks** | | | |
| Q 1 | A 10 MWh BESS system has capital cost of Rs 1 crore per MW. Annual O&M cost is 3% of Capital cost. Estimate the unit cost of electricity generation (Rs/kWh) for the first year of operation.<br>Consider discount rate (d) 10%<br>Life of the project 15 years | **10** | **CO3** |
| Q 2 | A C&I customer planning to procure green energy from BESS through open access during peak demand time, what are the charges consumer has to pay (define each one) | **10** | **CO3** |
| Q 3 | Describe Energy Storage policy and Goals of Govt of India. What are the challenges in present scenario even after such policy provisions | **10** | |
| Q 4 | An electric vehicle (EV) has a 50-kWh battery and is being charged using a 7-kW charger. The battery is at 30% state of charge (SoC) and needs to be charged up to 70%. Calculate the charging time required to bring the battery from 20% to 80% SoC. Consider charging efficiency 95% | **10** | |
| **SECTION-D**<br>**(Attempt any 2)**<br>**2Qx15M= 30 Marks** | | | |
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| Q1 | As per the policy advisory of the Government of India, upcoming solar energy project bids will require the integration of a Battery Energy Storage System (BESS) with a capacity of 10% of the allocated solar capacity, capable of storing energy for 2 hours.<br><br>For a 100 MWp solar plant allocation, determine the following:<br>1. **BESS Specifications:** *Energy Storage Capacity (MWh)*<br>*Power Capacity (MW)*<br>*Consider*<br>**2. BESS Performance Parameters:**<br>Charging & Discharging Efficiency: 95%<br>Depth of Discharge (DoD): 90%<br>Initial BESS Cost: ₹10,000 per kWh<br>Capital Subsidy: 40%<br>BESS Life: 25 years<br>Solar Plant Life: 25 years<br><br>**Estimate Solar PV capacity requires to charge BESS the BESS**<br>Assume Sunshine Hours: 7 hours/day | **15** | **CO4** |
| Q 2 | Capital Cost of Solar PV for Charging BESS**: ₹3 Crore per MW**<br>**Estimate Unit cost of Energy Storage (LCOS) for first year of operation of the BESS Consider discount rate (d) 9%**<br>*(May take other required values from Q1)* | | |

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| Q 3 | **Estimate Net Revenue for first year operation of the (Solar+BESS system) if energy is sold at Rs 10 per kWh (***(May take input values from Q1 or Q2 )*<br>**Consider discount rate (d) 9%**<br>$$LCOE = \frac{\text{Total Annual Cost}}{\text{Annual Energy Delivered}}$$<br>$$ACC = \text{Total Capital Cost} \times CRF$$<br>$$CRF = \frac{d(1+d)^n}{(1+d)^n - 1}$$ | **15** | **CO4** |