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**PRESIDENCY UNIVERSITY**

**Bengaluru**

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| **Ph.D. Course Work End Term Examinations – JAN-FEB 2025** |
| **Date:** 30- 01- 2025 **Time:** 09:30 am – 12:30 pm |

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| **School:** SOE | **Program:** EEE | |
| **Course Code:** EEE 811 | **Course Name:** EV Battery Charging Technology | |
| **Semester**: | **Max Marks:**100 | **Weightage:**50% |

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| **CO - Levels** | **CO1** | **CO2** | **CO3** | **CO4** | **CO5** |
| **Marks** | **30** | **20** | **10** | **30** | **10** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Do not write anything on the question paper other than roll number.*

**Part A**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Answer ALL the Questions. Each question carries 10 marks. 6Q x 10M=60Marks** | | | | |
| **1** | Explain the detailed block diagram for a universal EV charger capable of supporting multiple charging standards (e.g., CCS, CHAdeMO, GB/T). Describe the function of each block and the associated design challenges. | **10 Marks** | **L2** | **CO1** |
| **2** | Analyze the efficiency trade-offs in a PSFB converter when operating under varying load conditions. How does the zero-voltage switching (ZVS) condition affect the overall performance of the converter? | **10 Marks** | **L3** | **CO2** |
| **3** | Compare and contrast the PSFB, DAB, LLC, and DAB in CLLLC mode in terms of efficiency, power density, and suitability for bidirectional energy transfer. Provide a scenario where each topology is most suitable. | **10 Marks** | **L3** | **CO2** |
| **4** | Discuss the role of ultra-capacitors in hybrid energy storage systems for peak power management. How can hybridizing ultra-capacitors with batteries improve system performance? | **10 Marks** | **L3** | **CO3** |
| **5** | Analyze the coulombic efficiency, energy efficiency, and round-trip efficiency of a rechargeable battery under various operating scenarios. How do these efficiencies vary between lead-acid, lithium-ion, and sodium-based batteries? | **10 Marks** | **L3** | **CO4** |
| **6** | An EV uses a battery with a nominal voltage of 360 V and a capacity of 80 kWh. During operation, the battery provides 25 kW of power to the load for 2 hours.   1. Calculate the remaining state of charge (SoC) of the battery after 2 hours if it starts at 100%. 2. If the battery’s discharge efficiency is 90%, what is the actual energy delivered to the load? 3. Estimate the energy lost due to inefficiencies during discharge. | **10 Marks** | **L3** | **CO5** |

**Part B**

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| --- | --- | --- | --- | --- | --- |
| **Answer the Questions. Each question carries 20 marks 2Q x 20 = 40 Marks** | | | | | |
| **7.** |  | A universal charger supports output voltages between 200V and 1000V and can deliver a maximum output power of 150 kW.   1. Calculate the range of output currents the charger must support. 2. If the output current ripple must be limited to 2% of the rated current, determine the allowable current ripple at 200V and 1000V outputs. | **20 Marks** | **L3** | **CO1** |
|  | | | | | |
| **8.** |  | Describe the procedure/ expermental setup to measure the state of charge (SoC) and state of health (SoH) of batteries in real time. How can these metrics be integrated into a battery management system (BMS) to enhance reliability? | **20 Marks** | **L3** | **CO4** |

**\*\*\*\*\* BEST WISHES \*\*\*\*\***