Roll No											

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING
END TERM EXAMINATION - AUGUST 2024

Semester : II	**Date :09-08-2024**
Course Code : EEE3036	**Time :9.30AM -12.30PM**
Course Name : Battery Management Systems	**Max Marks :100**
Program : B.TECH	**Weightage :50%**

Instructions:
(i) Read all questions carefully and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and non-programmable calculator are permitted.
(iv) Do not write any information on the question paper other than Roll Number.

PART A			
	ANSWER ANY 5 QUESTIONS		**5Q X 4M=20M**
1	There is some confusion in the terms used to describe the various components of a battery pack, probably due to the fact that we say “batteries” when referring to alkaline cells, and that we tend to forget that a car starter battery is really made up of six cells. Define Cell, block, battery and pack.	(CO 1)	[Knowledge]
2	Battery management systems have different topologies based on their functionality. List the difference between Distributed and Non-distributed Topologies based on Battery Electrical Noise Immunity.	(CO 3)	[Knowledge]
3	Li-Ion rechargeable cells have the highest energy density, and among the highest power densities, of any cell commercially available today. Draw circuit diagrams for cell voltage measurement methods: (a) discrete, (b) single-end multiplexed, and (c) differential multiplexed.	(CO 4)	[Knowledge]
4	There are different equivalent circuits of a battery management system. Identify 1 difference and 1 similarity between relaxed RC and AC impedance RC.	(CO 2)	[Comprehension]
5	Battery systems can be of balanced or unbalanced types based on their voltage distribution among different cells. Design a balanced and unbalanced battery system with 27 V as total supply voltage.	(CO 3)	[Application]
6	Battery Management systems can be categorized based on functionality. Identify 2 differences between monitor and balancer.	(CO 2)	[Comprehension]
7	Battery management system is an important component of any battery system. Mention the safety features of BMS.	(CO 5)	[Comprehension]

PART B			
	ANSWER ANY 4 QUESTIONS	**4Q X 10M=40M**	
8	Li-ion batteries should have higher efficiency in order to provide the expected service. The M1 26,650 cells from A123 (used in power tools and PHEV conversion), have a typical resistance of 10 mΩ; when loaded at 1C (2.3A), calculate the efficiency of the cell.	(CO 1)	[Comprehension]
9	Most Li-ion batteries have an expected lifespan of around 500 cycles. LiFePO4 batteries have higher expected lifespans and can undergo thousands of cycles before the capacity is heavily affected. Discuss the similarities and dissimilarities between cycle life and calendar life of Li-ion cells with proper plots.	(CO 1)	[Comprehension]
10	The equivalent circuit models are based on an electrical representation using volage and current source, capacitors, and resistors. Discuss Electrical equivalent models of a Li-Ion cell and plots of voltage and current	(CO 2)	[Comprehension]
11	A battery pack's performance, use, and safety are monitored and managed by a battery management system (BMS), an intelligent electronic device. Explain how BMS is used in Electric and hybrid vehicles.	(CO 5)	[Comprehension]
12	Battery management refers to the critical task of monitoring, protecting, and controlling batteries, particularly with rechargeable battery packs, where many batteries are connected in series or parallel. Compare Distributed and Non-distributed Topologies based on Expansion Versatility, Battery Electrical Noise Immunity, Loss of Isolation, High Voltage Shorts.	(CO 4)	[Comprehension]
13	Ensuring the optimum performance of a battery management system (BMS) requires measuring the performance of cell, module, and pack voltage, current, and temperature, plus verification of the operational performance of the battery. Compare BMS Topologies based on Measurement Quality, Noise Immunity, Versatility, Safety, Electronics Cost.	(CO 3)	[Comprehension]

PART C			
	ANSWER ANY 2 QUESTIONS	**2Q X 20M=40M**	
14	In our technology-driven world, batteries power essential devices and systems. BMS play a crucial role in optimizing battery performance and safety. It continuously monitors and safeguards batteries, enhancing efficiency and prolonging lifespan. BMS topologies, and different configurations of BMS components, offer unique advantages and are vital for efficient battery management. Discuss the balancing algorithms of BMS.	(CO 2)	[Application]
15	BMS is technology dedicated to the oversight of a battery pack, which is an assembly of battery cells, electrically organized in a row x column matrix configuration to enable delivery of targeted range of voltage and current for a duration of time against expected load scenarios. Discuss the measurement function of BMS with proper diagram.	(CO 4)	[Comprehension]
16	BMS is any electronic system that manages a rechargeable battery, such as by protecting the battery from operating outside its safe operating area. Demonstrate a comparison between Distributed and Non-distributed Topologies based on Connection to Cells, Connection Reliability, Installation Ease, Replacement Assembly, Cost and Measurement Precision	(CO 3)	[Application]