UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
Online End Sem Examination, May 2021

Course: Energy Storage & Fuel Cells   **Semester: VI**

Programme: B.Tech Electrical Engineering   **Max Marks:100**

Course Code: EPEG 3015   **Duration : 3 Hrs.**

S. No.		Marks	CO
	Section A Short Answer Question. Each Question carries 5 marks		

Q.1	Fill in the Blanks:
	    a) In batteries _____ energy is converted in to Electrical Energy
	    b) In batteries electrodes are used to collect _____
	    c) In batteries Electrolyte is used to allow _____ of charges
		1+2+2	**CO1**

Q.2	In lithium ion batteries
	    1) During charging Li^+ flows from _____ to _____
	    2) During Discharging electrons flows from _____ to _____
	    3) Electrolyte allows flow of _____
		2+2+1	**CO1**

Q.3	Match the pair for Lithium Ion Batteries:
	    A) Binder P) The last stage of manufacturing (A) = (?)
	    B) Aluminum Q) Holds Electrode & Current collector (B) = (?)
	    C) Copper R) Porous to allow flow of LI^+ (C) = (?)
	    D) Calendaring S) Positive Current Collector (D) = (?)
	    E) Separator T) Positive Current Collector (E) = (?)
		1*5	**CO1**

Q.4	Complete sentence using correct word
	 (P=Water, Q=Heat, R=Oxygen, S=Fuel Cells, T=Hydrogen)
	    A) Electrons add to _____ at the cathode.
	    B) --------------- is acting as fuel in fuel cells.
	    C) _____ is a kind of generator not battery
	    D) In fuel cells _____ is by product which can again act as fuel.
	    E) In fuel cells _____ produced is partially/fully used for reaction.
	 (A=?, B=?, C=?, D=?,E=?)
		1*5	**CO2**

Q.5	In a PHEV, if the size of IC engine based generator is 5 kW, at what rate (in kWH) it can charge the battery/supply energy to motor.	**5**	**CO3**

Q.6	In battery management system
	    A) SoC affects the (Specific Power/ Specific Energy) of battery.
	    B) As SoC decreases, the (weight of battery / available Energy) decreases
	    C) Lithium Ion Batteries works better at (sub zero / room) temperature.
	    D) To monitor health of Li-Ion battery, (SoC / terminal Voltage) is important.
	    E) Batteries are connected in series to increase (Current / Voltage)
		1*5	**CO4**

	Section B		
	Each Question carries 10 marks		
Q.1	With neat diagram describe the architectural block diagram of Battery Management System	**10**	**CO4**
Q.2	With a neat diagram, explain the constant current method of battery charging and brief about the challenges associated with it.	**10**	**CO1**
Q.3	Estimate the size of IC engine based generator required for a PHEV with following configuration: Battery Bank Size: 40 kWh, Mileage 240 km @ 60 km/Hr; Proposed travelling distance 520 kM and IC engine based generator is allowed to use for max. of 3 hours.	**10**	**CO3**
Q.4	'In debate of Cost of eVs and popularity, PHEVs can be an Out of box solution', justify the statement with neat example.	**10**	**CO3**
Q.5	Explain the effect of following on Battery performance: 1) SoC 2) Terminal voltage of Cells 3) Temperature of batteries 4) Specific Energy	**10**	**CO4**
	Section 'C'		
	Long Answer Question (20 Marks)		
Q 1	In Venezuela, it was proposed to set up a micro grid to supply energy to 200 Houses. Along with other Energy Sources like Solar, Wind etc, it was proposed to use Fuel cell based Energy Source as standby/ Back up Energy Source. The specification of the fuel cells are as following: Max power generation : 100 kW Cell Voltage = 0.65 V Hydrogen Utilization Factor = 75% Air Utilization factor = 25% Daily working hours are not exceeding = 8 Hours per day. Estimate the weekly storage of liquid Hydrogen required. Take Liquid hydrogen density as 71 gm/liter. **OR** Estimate the amount of Hydrogen required per hour for a fuel cell based power plant with following specifications. Also estimate, inlet air flow rate/sec, water flow rate per sec and exhaust air flow rate per sec. Power Plant : 1 MW Cell Voltage = 0.63 V, 100 cells are connected in series. Hydrogen Utilization Factor = 80% Air Utilization factor = 23% Take Liquid hydrogen density as 71 gm/liter.	**20 M** **20 M**	**CO2** **CO2**