Reg. No.															

Question Paper Code	13766

M.E. - DEGREE EXAMINATIONS, APRIL / MAY 2025

Second Semester

M.E. - Power Electronics and Drives

24PPEEL210 - ELECTRIC VEHICLES AND POWER MANAGEMENT

Regulations - 2024

Duration: 3 Hours | Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	List the classification of EVs based on propulsion system.	2	K1	CO1
2.	Define aero dynamic drag.	2	K1	CO1
3.	Define Gear Tooth Ratio.	2	K1	CO2
4.	Name the three primary types of transmission.	2	K1	CO2
5.	Why rotor position information is important in SRM drives?	2	K1	CO3
6.	Discuss about the two modes of operation converter.	2	K2	CO3
7.	State the traction battery.	2	K1	CO4
8.	Compare the energy density of Lithium-Ion (Li-Ion) and Lead-Acid batteries. Given the following data: • Energy density of Li-Ion battery = 150 Wh/kg • Energy density of Lead-Acid battery = 40 Wh/kg How much more energy can be stored in 1 kg of Li-Ion battery compared to a Lead-Acid battery?	2	K2	CO4
9.	Mention the role of the hydrogen tank in an FCEV.	2	K1	CO5
10.	Mention any four characteristics of a fuel cell.	2	K1	CO5

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

			Marks	K – Level	CO
11.	a)	Explain the role of drivetrain layout (FWD, RWD, AWD) in vehicle performance, and how is it implemented in EVs?	13	K2	CO1
		OR			
	b)	How does regenerative braking contribute to energy efficiency in EVs and HEVs? Explain.	13	K2	CO1
12.	a)	How do series, parallel, and series-parallel hybrid architectures differ, and what are the advantages of each?	13	K2	CO2
		OR			
	b)	How does the charging strategy affect the performance and efficiency of a PHEV? Explain.	13	K2	CO2

13.	a)	Explain how braking is achieved in a V/f controlled inverter-fed induction motor drive model. Distinguish between dynamic braking, regenerative braking, and plugging.	*13*	*K2*	*CO3*
		OR			
	b)	An induction motor drive operates under a constant V/f control. The base frequency is 50 Hz and base voltage is 400 V. At a certain operating point, the inverter supplies 30 Hz and 240 V. The motor is rated at 5 HP, 4-pole, and has a full-load slip of 0.04. (a) Find the synchronous and actual speed of the motor. (b) Determine the torque developed by the motor if the load torque is proportional to the square of the speed. (c) Discuss braking operation and calculate the regenerative power if the motor operates in braking at 25 Hz with a slip of -0.02.	*13*	*K2*	*CO3*
14.	a)	Infer the significance of thermal management in battery systems. How does temperature affect battery performance and lifespan?	*13*	*K2*	*CO4*
		OR			
	b)	Describe the different battery charging technologies used in electric vehicles. Discuss the advantages and limitations of fast charging, wireless charging, and induction charging.	*13*	*K2*	*CO4*
15.	a)	Explain how can ultra capacitors and batteries/fuel cells be integrated for improved EV performance? Explain its model.	*13*	*K2*	*CO5*
		OR			
	b)	A hydrogen fuel cell produces a voltage of 0.7 V at a current of 100 A. The enthalpy change (ΔH) for the reaction is -285.8 kJ/mol and the Gibbs free energy change (ΔG) is -237.1 kJ/mol. If 1 mole of H_2 produces 2 mol of electrons, calculate: a) The actual power output of the cell b) The theoretical maximum efficiency c) The actual efficiency of the fuel cell (Faraday's constant F = 96485 C/mol).	*13*	*K2*	*CO5*

PART - C (1 × 15 = 15 Marks)

16.	a) (i)	Explain battery management in electric vehicles.	*8*	*K2*	*CO4*
	(ii)	Explain in detail about the automotive hydrogen storage and its usage.	*7*	*K2*	*CO5*
		OR			
	b) (i)	Explain the recent advancements in battery technology for traction applications.	*8*	*K2*	*CO4*
	(ii)	An ultracapacitor bank is rated at 500 F and charged to 48 V. a) Find the total energy stored in the ultra capacitor bank. b) If the ultracapacitor is discharged to 24 V, how much energy was delivered? c) Compare this energy to a Li-ion battery of 0.5 kWh.	*7*	*K2*	*CO5*