Reg.No.:												

VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN
[AUTONOMOUS INSTITUTION AFFILIATED TO ANNA UNIVERSITY, CHENNAI]
Elayampalayam – 637 205, Tiruchengode, Namakkal Dt., Tamil Nadu.

Question Paper Code: 8003

B.E. / B.Tech. DEGREE END-SEMESTER EXAMINATIONS – MAY / JUNE 2024
Eighth Semester
Electrical and Electronics Engineering
U19EEE20 – ELECTRICAL AND HYBRID VEHICLES
(Regulation 2019)

Time: Three Hours | Maximum: 100 Marks

Answer ALL the questions

Knowledge Levels (KL)	K1 – Remembering	K3 – Applying	K5 - Evaluating
	K2 – Understanding	K4 – Analyzing	K6 - Creating

PART – A

(10 x 2 = 20 Marks)

Q.No.	Questions	Marks	KL	CO
1.	What is the significance of Electric Vehicles (EVs)?	2	K1	CO1
2.	What are the technical requirements of an EV drive?	2	K1	CO1
3.	Infer the principle of IC engine.	2	K2	CO2
4.	What are the various types of electric motors commonly utilized in electric vehicles?	2	K1	CO2
5.	What is the function of a bidirectional converter in HEV?	2	K1	CO3
6.	Interpret the parameters to be controlled for a battery in HEV.	2	K2	CO3
7.	Illustrate the components comprising HEV drive train.	2	K2	CO4
8.	Distinguish HEV from plug in HEV.	2	K4	CO4
9.	Define regenerative braking.	2	K1	CO5
10.	Select any two motors to apply regenerative braking system and justify the reason for the same.	2	K1	CO5

PART – B

(5 x 13 = 65 Marks)

Q.No.		Questions	Marks	KL	CO
11.	a)	Explain the types of electric vehicles with neat diagrams.	13	K2	CO1

(OR)

	b)	Infer the key components of an HEV vehicle and analyze the benefits and drawbacks of HEVs in detail.		13	K2	CO1
12.	a)	Analyze the role of AC and DC drives in HEVs and list the specific converters commonly utilized in these types of drives.		13	K4	CO2
			(OR)			
	b)	i.	Explain the BLDC motor drives used in HEVs and its characteristic with necessary diagram.	10	K2	CO2
		ii.	Identify the performance parameters of IC engines.	3	K3	
13.	a)	i.	Explain the power flow control in a series hybrid vehicle.	8	K2	CO3
		ii.	Explain the design principles of series hybrid drive drain.	5	K2	
			(OR)			
	b)	i.	Explain the operation patterns of an electrically coupled HEV .	8	K2	CO3
		ii.	A 1250 CC capacity IC engine car with a 14-inch wheel diameter can reach a maximum speed of 240 kmph with 170 Nm of torque. If it is converted into a battery-operated vehicle, calculate the required motor sizing in BHP. Additionally, estimate the number of battery packs needed to run continuously for 8 hours at a consistent speed of 60 kmph. Each pack consists of 70 cells connected in series, rated at 3.6 V and 100 Ah.	5	K4	
14.	a)	i.	An electric vehicle has the following attributes: drag coefficient Cd = 0.25, vehicle cross-section A = 2 m^2, and available propulsion energy of Eb = 20 kWh (1kWh = 3 6×106 J). Let the density of air ρ_{air} = 1.2 kg m−3. Instantaneously at a vehicle speed of 120 km/h, calculate the aerodynamic drag force, power, and range, while driving in a. calm conditions with no wind and b. windy conditions with a 12 km/h headwind and c. windy conditions with a 12 km/h tailwind.	8	K6	CO4
		ii.	What is tractive effort? Explain aerodynamic drag in detail.	5	K5	
			(OR)			
	b)	i.	Explain the design steps and control principles of plug-in hybrid electric vehicles.	8	K6	CO4
		ii.	A vehicle with a weight of 1200 kg reaches a speed of 0.1 km within 5 seconds. In calm conditions, calculate the acceleration force required and the power consumption from the source during acceleration.	5	K4	

15.	a)	i.	List the factors influencing energy recovery during regenerative braking and explain it.	5	K5 CO5
		ii.	A 20 kW rated Vehicle is traveling down a 6 in both positive and negative slopes at 120 km/h and 40 km/h respectively. Assuming calm conditions, how much regenerative power is available to brake the vehicle while maintaining a constant speed? Also, calculate the power required to drive in a positive slope.	8	K4
			(OR)		
	b)		Identify the relation between the parameters given below and illustrate the graphs: i. Braking energy versus vehicle speed ii. Braking energy versus braking power iii. Braking power versus vehicle speed iv. Braking energy versus vehicle deceleration rate	13	K3 CO5

PART – C

(1 x 15 = 15 Marks)

Q.No.			Questions	Marks	KL	CO
16.	a)	i.	Why is it essential to have an energy management control system in an HEV? Do you believe that a sophisticated energy management system, similar to that of a hybrid vehicle, is indispensable in an electric vehicle? elaborate on your perspective.	10	K4	CO3
		ii.	Design a medium-duty electric vehicle to run 60 kmph with 50 Nm. It should run at least 3 hours continuously with the wheel diameter of 10 inches. Find out the following: Ah rating, Motor sizing, suitable motor, power converter circuit for regeneration, and power devices rating. Consider a 48V motor and BLDC hub motor drive	5	K6	
			(OR)			
	b)		Analyze the brake systems utilized in EVs and HEVs, providing a detailed list of the equipment involved in this process. Further mention the companies in India that specialize in manufacturing EV cars and two-wheelers, as well as the global companies that produce HEV cars.	15	K4	CO5