Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2022

Programme Name: B Tech (ADE) **Semester : VII**
Course Name : Electric Vehicle Technology **Time : 03 hrs**
Course Code : MEAD 4010 **Max. Marks: 100**
Nos. of page(s) : 4
Instructions: All the questions are compulsory.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
1	Discuss the importance of the degree of hybridization and how it is calculated.	**4**	**CO1**
2	How regenerative systems in an EV works?	**4**	**CO1**
3	Discuss the advantages of mild/micro hybrid technology?	**4**	**CO1**
4	Enlist the research gaps in the evolvement of EVs/HEVs.	**4**	**CO1**
5	define “charge capacity” and “energy stored”.	**4**	**CO1**

SECTION B
(4Qx10M= 40 Marks)

6	Discuss the essential elements and working principle of hydrogen fuel cell-powered vehicles. **OR** Tabulate the comparison between pure EVs and HEVs in terms of performance, limitations and future scope.	**10**	**CO2**
7	Discuss the working principle and advantages of BMS.	**10**	**CO2**
8	Differentiate between electrically coupled and mechanically coupled hybrid vehicles.	**10**	**CO2**
9	Compare the performance of an EV with a gasoline-powered vehicle for a run of 100 KMs, if: - Energy rates are 8 Rs per kWh, gasoline costs 95 Rs per liter, and a new fuel-efficient gasoline vehicle gets 26 KMPL. - The electric vehicle KMPLe (Kilometer per Litre equivalent) represents the number of KMs the vehicle can travel using the same energy content as gasoline. if KMPLe is 99 (maximum distance this vehicle can travel on a full charge).	**10**	**CO3**

	- EV manual says it uses 34 kWh per 160 KMs driven, whereas 10 kWh of electricity is equivalent to one liter of gasoline.		
SECTION-C (2Qx20M=40 Marks)			
10	Tabulate the performance and applicability of various traction motors used in EVs/HEVs. **OR** "Existing buildings have a fixed capacity in accordance with design requirements at the time of construction, which do not include support for EV charging. The majority of existing buildings have insufficient capacity to accommodate the electrical load of uncontrolled EV charging. Electric vehicle energy management systems (EVEMS) represent an opportunity to maximize usage efficiency of existing electrical infrastructure and avoid prohibitive costs inherent with capacity upgrades". Counter the above statement with various Energy management schemes.	**20**	**CO4**
11	**Case Study: Nexon EV Running Cost Breakdown by Owner** 84,995 km to be precise. That's how much Manu M has covered in a span of two years of ownership. This averages to 114 km per day. When stabilizer losses are excluded, Manu M has consumed 11262.8 kWh of energy. Which gives us 132.51 Wh/km of energy consumption per km. Hence range covered with 1 kWh of charge is 7.55 km. Still not bad, we should say. Excluding stabilizer losses, total cost incurred to charge his vehicle to cover 85K km is Rs. 95,681. Which yields a charging cost per km of just Rs. 1.13. Including stabilizer losses, we get more realistic numbers. He claims that he has consumed 10983.22 kWh of electricity to charge his EV to cover said 85K km. This figure includes slow chargers, also fast chargers and stabilizer losses as well. The owner has taken Rs. 9.28 as the cost per kWh in Kerala. When calculated, he has spent Rs. 1,01,686 for charging the batteries to cover 85K km. Charging cost per km is Rs. 1.2 and energy consumption per kWh is 129.22 Wh/km. This gives us a range of 7.74 km per kWh of battery capacity. **Service Costs for EVs**: Since there are significantly less moving parts, EVs require significantly less maintenance. Owner Manu M has provided valuable info regarding EV maintenance. He reports a total of Rs. 32,375 spent on maintaining the car. We say car, because like ICE vehicles there are few parts required to keep it running despite being an EV. Manu M reports transaxle oil change after the first 7,000 km, which never recurs. He seems to have changed transmission oil every 30,000 km interval. Rest of the costs involve regular shenanigans like wheel alignment,	**20**	**CO4**

wheel balancing, washing, brake fluid and so on. None of these are really expensive. Excluding optional services like foam washing, AC disinfectant and others, he reports a total cost of Rs. 28,976. When servicing costs are taken into account along with charging costs, we land on a figure of Rs. 1.58 per km traveled. Which is really economical when compared to petrol or diesel-powered alternatives.

Charging costs till 04/11/2022 (2 year 15 days/745 days)	
Total distance travelled	**84995 km**
Total cost for charging Car charging cost only Including slow & fast charging. stabilizer losses Considering free charging cost as 0	**Rs. 101686.7**
Total energy usage for charging Including slow & fast charging. stabilizer losses	**10983.22 kWh (unit)**
Charging cost per km	**Rs. 1.2 /km**
Electricity cost per unit - considering above values	**Rs. 9.26**
Energy consumption per km - Including stabilizer losses	**129.22 Wh/km**
Range for 1 kWh - Including stabilizer losses	**7.74 km/kWh**
Service cost	**Rs. 32375.72**
Ownership cost per km - Including service cost	**Rs. 1.58 /km**
Average usage per day	**114.09 km/day**
Values excluding stabilizer losses	
Total energy usage for charging (kWh) Including slow & fast charging Excluding stabilizer losses	**11262.48 kWh (unit)**
Energy consumption per km (Wh/km) - Excluding stabilizer losses	**132.51 Wh/km**
Range for 1 kWh - Excluding stabilizer losses	**7.55 km/kWh**
Processed values with assumptions	
Total cost for charging excluding stabilizer losses Home charging cost considered as Rs. 8.1 per kWh (unit) **The cost is more than value with stabilizer losses** **In some months my KSEB slab was below 8.1 per kWh (unit)**	**Rs. 95681.38**
Charging cost per km (in the above case)	**Rs. 1.13 /km**
If whole charging was done from home **Charging cost per km** (assuming Rs. 8.1 per unit - home energy cost - above average)	**Rs. 1.05 /km**
Free charging cost alone (assuming Rs. 15 per unit) (excluded in above calculation)	**Rs. 8543.46**

Service cost splitup			
Service	**Total cost (Rs.)**	**ODOmeter**	**Remarks**
1	0	1516	Washing & Free service only
2	0	7468	Washing & Free service only. Forgot Transaxle change
3	2106	14017	Transaxle oil - 1206 Wheel alignment and balancing - 900
4	3235	21424	Service cost - 666 Parts cost - 600 Wheel alignment and balancing - 500 Washing - 666 AC disinfecting - 803
5	3072	28460	Service cost - 1332 Transmission oil - 1660 Windshield fluid - 80
6	2140	36400	Service cost - 660 Parts cost - 1480
7	2589	43093	Service cost - 660 Brake fluid - 112 Pollen filter - 568 Wheel alignment and balancing - 496 Washing - 660
8	2602	51258	Service cost - 660 Wheel alignment and balancing - 496 Washing - 660 AC disinfecting - 784
9	7358	58243	Service cost - 1332 Transmission oil - 2187 Coolent - 1059 AC disinfecting - 790 Windshield fluid - 170 Foam washing - 1829
10	660	65905	Service cost - 660
11	3587	72815	Service cost - 1332 AC filter - 407 Wheel alignment and balancing - 892 AC disinfecting - 790 Windshield fluid - 170
12	1627	81015	Service cost - 660 AC disinfecting - 790 Windshield fluid - 170
Grand Total = Rs.28976. Remaining are optional. Windshield fluid, AC disinfection and Foam washing which are listed above are also optional. I usually try to do service 2000km before actual kms			

Answer the following questions:

Compare the over all expenditure (capital + running cost) with Toyota Hyrider hybrid (on road price is 20 Lac, fuel efficiency of 26 KMPL), where on road price of Nexon EV is 15 Lac. The average maintenance cost of Hyrider is Rs. 1.25 per km and gasoline price is 95 Rs per liter.