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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

June / July 2025 Semester End Main Examinations

Programme: B.E. **Semester: V**

Branch: Mechanical Engineering **Duration: 3 hrs.**

Course Code: 23ME5PEEHV/22ME5PEEHV/21ME5DEEV1 **Max Marks: 100**

Course: Electric Hybrid Vehicles / Electric and Hybrid Vehicles - 1

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	Explain the advantages and limitations for EHV over ICE.	CO1	PO1	**06**
	b)	Explain with the block diagram the working of Fuel cell EV	CO1	PO1	**06**
	c)	A decent size of petrol 4-W consumes 15km per litre and an equivalent EV consumes 150Wh/km with cells being 250Wh/kg and 500Wh/lt. Petrol energy is 45MJ/kg and its density is 0.75 kg/lt. Compute i) Ratio of energy efficiency of EV Vs ICE ii) Ratio of battery weight and petrol weight per km of travel by two vehicles iii) Ratio of battery volume and petrol volume per km of travel by two vehicles	CO1	PO1	**08**
		OR			
2	a)	Explain with the block diagram the working of pure BEV	CO1	PO1	**06**
	b)	What is well to wheel efficiency for ICE and pure BEV?	CO1	PO1	**06**
	c)	Explain volumetric and gravimetric energy density. Also quantify the significance of power density	CO1	PO1	**08**
		UNIT - II			
3	a)	A vehicle needs to reach maximum speed V_f in T seconds. Derive expressions for average power and peak power i) if it accelerates linearly. ii)if it accelerates at a rate "a1" for first T/2 time and at a rate "a1/2" from T/2 to T. Hence prove that peak power reduces to 2/3rdof the peak power required for linear acceleration.	CO1	PO1	**10**

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	b)	What is driving cycle? Explain its uses. Assume the sedan is stuck on a climb 12° slope. It needs to start and have a acceleration of 0.5 m/sec^2. what is the starting Torque. R_{wheel}= 0.31m. Use density as 1.20kg/m^3; C_D=0.35; Area=2.5 m^2; μ=0.013; and kerb weight=1200 kgs	*CO1*	*PO1*	**10**
		OR			
4	a)	Enlist and explain with neat diagram the different resistance a vehicle need to overcome for net tractive force.	*CO2*	*PO2*	**10**
	b)	For the three vehicles given in the table, compute total traction force assuming pick-up from 0 to 50 kmph in 20 sec, with linear acceleration and zero slope. assume ρ = 1.2 (kg/m3). Also compute the power and torque at v = 30 km/h, 50 km/h and 80 km/h.	*CO2*	*PO2*	**10**

Vehicle	GVW (kg)	C_D	Area(sqm)	μ	v1(kmph)	v2(kmph)	Tyre radius (m)
2-wheeler	200	0.9	0.6	0.015	30	80	0.28
3-wheeler	600	0.45	1.6	0.015	30	80	0.2
4-wheeler	1500	0.3	2.5	0.015	30	80	0.3

		UNIT - III			
5	a)	What are advantages and limitations of Li-Ion battery.	*CO2*	*PO2*	**06**
	b)	Explain the Factors affecting Battery cell life cycles with graphs.	*CO2*	*PO2*	**06**
	c)	Describe the Eight Asks of a Battery.	*CO2*	*PO2*	**08**
		OR			
6	a)	With a sketch explain the Six parameters of NCA and NMC.	*CO2*	*PO2*	**06**
	b)	Why Na-Ion batteries can replace Li-Ion batteries in future.	*CO2*	*PO2*	**06**
	c)	Explain the construction of the following battery packs-Prismatic, Cylindrical Cells, and Pouch cells.	*CO2*	*PO2*	**08**
		UNIT - IV			
7	a)	What are the factors to be considered in the design of the Battery Pack? Explain	*CO3*	*PO2*	**06**
	b)	The 10kWh Battery with Capital Cost of Rs.100000 with life of 3000 cycles, use of 1 cycle per day. DoD of operation is 0.9 and have 80% EoL. Rate of interest as 12%. Determine the effective battery cost per kWh of the usage.	*CO3*	*PO2*	**06**
	c)	Discuss Battery Management System (BMS)	*CO3*	*PO2*	**08**
		OR			

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	8	a)	Explain methods to prevent thermal runaway in batteries.	*CO3*	*PO2*	**06**
		b)	A battery pack of 375V, 200Ah is to be made to power a luxury car. One battery pack is made with 3.65V, 4Ah, Cylindrical cells and another pack uses 3.65V, 50Ah prismatic cells. a. Suggest nPmS configuration for each case to achieve the pack requirements. b. Find the total number of cells in both cases.	*CO3*	*PO2*	**06**
		c)	Explain Building mSnP battery pack and nPmS battery pack with example.	*CO3*	*PO2*	**08**
			UNIT - V			
	9	a)	With a block diagram explain the level 3 DC chargers for EV	*CO4*	*PO2*	**06**
		b)	Explain On-board and off-board Chargers	*CO4*	*PO2*	**06**
		c)	Why Standardize battery charging? What are the Parameters that need Standardization.	*CO4*	*PO2*	**08**
			OR			
	10	a)	Explain the working of universal battery charger with simplified diagram	*CO4*	*PO2*	**06**
		b)	With a block diagram explain the level 1 and level 2 chargers	*CO4*	*PO2*	**06**
		c)	Write the block diagram of Authorization Flow Using Mobile Application in battery charging application.	*CO4*	*PO2*	**08**

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