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

Autonomous Institute Affiliated to VTU

February / March 2023 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 21ME5DEEV1 **Max Marks: 100**
Course: Electric and Hybrid Vehicles - 1 **Date: 07.03.2023**

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

UNIT - I

1	a)	Enlist and explain the advantages and disadvantages of EV over conventional ICE.	**08**
	b)	With the help of neat sketch, enlist the different components of Battery Electric Vehicle (BEV). Also explain the working principle of BEV.	**08**
	c)	Enlist the advantages and limitations of flywheel in vehicles.	**04**

OR

2	a)	Explain the term Volumetric energy density and Gravimetric energy density.	**03**
	b)	A Petrol four-wheeler car manufacturer declare Automotive Research Association of India (ARAI) mileage of 22 kms per litre, while on-road condition mileage was 20% less than ARAI condition. The equivalent EV consume 150 Wh / km with battery cells being 250 Wh/kg and 500 Wh/ltr. Petrol energy is 45 megajoules per kilogram (MJ/kg) and its specific gravity is 0.775. Compute i) the ratio of Energy Efficiency of EV Vs ICE (Internal Combustion Engine) vehicle 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	**07**
	c)	Explain the well to wheel basis efficiency for IC engines and electric vehicles.	**06**
	d)	Explain the working principle of solar car with advantages.	**04**

UNIT - II

3	a)	Discuss the different resistances need to overcome by the tractive force in order to propel the vehicle in forward direction.	**10**
	b)	An electric vehicle has the following attributes: drag coefficient C_D = 0.25, vehicle cross section A = 2 m^2, and available propulsion energy of 20 kWh (1kWh = 3.6×10^6 J). Let the density of air is 1.2 kg m^{-3}. Instantaneously at a vehicle speed of 75 miles/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.	**06**

	c)	Draw the pressure distribution curve on tyre surface when vehicle is at rest. Also explain the hysteresis in tyre with force deformation curve.	**04**

UNIT - III

4	a)	Describe in detail the eight asks of a battery.	**08**
	b)	Explain any three factors affecting battery cell life.	**06**
	c)	Explain the advantages and disadvantages of Lithium Ion batteries.	**06**

OR

5	a)	Explain six parameters along with detail sketch of six chemistries used in Lithium Ion battery.	**08**
	b)	Explain the factors responsible for battery failure in electric vehicles	**06**
	c)	Explain the term SoC, DoD, and SoH for a battery with suitable example.	**06**

UNIT - IV

6	a)	Explain the term Battery Management System (BMS) in Electric vehicle	**06**
	b)	15 kWh Battery with Capital Cost ₹1,20,000 with life of 5000 cycles, use of 1 cycle per day. Depth of Discharge of operation is 0.92 and have 75% End of Life. Rate of interest as 12.50%. Determine capital cost per kWhr, battery life in years, battery cost per year, and Effective Battery cost per kWh.	**08**
	c)	Enlist the various charging methods for Li-Ion batteries and explain Constant-current-constant-voltage (CC-CV) method in detail.	**06**

UNIT - V

7	a)	Explain On-board and off-board Chargers in EV.	**08**
	b)	What is battery swapping? Enlist the different types of swapping. Explain the working Structure of battery swapping system (BSS)	**06**
	c)	Explain with simplified diagram working of universal battery charger.	**06**

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