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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Seventh Semester, B.E. - Automobile Engineering

Semester End Examination; Jan. / Feb. - 2021

Electric and Hybrid Vehicles

Time: 3 hrs

Max. Marks: 100

Note: Answer FIVE full questions, selecting ONE full question from each unit.

UNIT - I

- 1 a. Compare power and torque in IC engines and Electric motors for vehicle propulsion. Discuss their merits and demerits. 6
- b. Name five Indian electric 2 wheeler and 4 wheeler models that are currently running on Indian roads. 3
- c. What is tractive effort? Explain tractive effort as the sum of resistance for vehicle motion with mathematical equations. 7
- d. Explain the procedure to find the range of the electric vehicle. 4
- 2 a. Describe the basic vehicle performance terms;
 - i) Maximum cruising speed 8
 - ii) Gradeability
 - iii) Acceleration. How do we find each of these?
- b. The following data was found when searched for technical specification of Mahindra e Verito. Battery: 21.2 kWh, Curb weight = 1265 kg, Dimensions (l X b X h) are 4265 mm X 1740 mm X 1540 mm. Motor power = 30 kW and torque = 91 Nm. Wheel specifications are 185/70R 14. Take motor to wheel speed reduction as 3 and air density = 1.22 kg/m³. Assume any missing data and with no loss in efficiency with motor or battery pack;
 - i) Find the rolling resistance, if coefficient of rolling resistance is 0.01 12
 - ii) Find the air drag, if coefficient of air drag is 0.28 at 50 KMPH (take frontal area from vehicle dimensions)
 - iii) Gradient resistance if the inclination is 2°
 - iv) Find the acceleration of this vehicle at 50 KMPH on a flat road
 - v) Find the theoretical range on a flat road for 50 KMPH constant speed
 - vi) Find the theoretical maximum speed on a level road taking the torque of 91 Nm

UNIT - II

- 3 a. Show the working of a BLDC motor with diagram. 6
- b. Explain how RMF is produced in a 3 phase induction motor? 6
- c. Explain the principle of switched reluctance Motor with simple sketches. 6
- d. Why brushed DC motors are generally not preferred for Electric vehicle applications? 2

- 4 a. Compare the lead acid battery and lithium battery on atleast six different parameters. 6
- b. Explain the most important four battery parameters required for selecting a battery for Electric vehicle application. 6
- c. How are capacitors different from batteries? How super capacitors can be best used for EV applications? 4
- d. How does Flywheel store energy? Why did Flywheels fail as a potential energy storage method for vehicle propulsion? Discuss. 4

UNIT - III

- 5 a. Explain forward facing and backward facing vehicle model and discuss their benefits and limitations. 10
- b. Describe the concept of well to tank and well to wheel emissions. Why are these important? Compare these for different types of mobility. 6
- c. With a schematic diagram, show the power train structure for any one model of electric vehicle. 4
- 6 a. What are the power train topologies in an electric vehicle? Show them with schematic diagrams. 6
- b. Write a note on Optimization of power train topology and component sizing. 8
- c. With a case study compare tank-to-wheel versus well-to-wheel CO₂ emissions and comment. 6

UNIT - IV

- 7 a. What are the various Hybrid vehicle configurations? Explain with a block diagram. 12
- b. What are the types of mechanical coupling? 3
- c. What are the differences between PHEV and HEV? Give an example for each of these. 4
- d. Are there any Hybrid Electric models running in India? 1
- 8 a. How do load power of a vehicle be decomposed to match the output from IC engine and Electric motor? 6
- b. Explain the different modes of operation in typical power split hybrid. 10
- c. Explain with block diagram the benefits and limitations of series hybrid architecture. 4

UNIT - V

- 9 a. What is a fuel cell? Compare fuel cell to a battery. 4
- b. Explain the principle of operation of a proton exchange membrane fuel cell. 6
- c. Explain the working of a direct methonal fuel cell. What are their applications? 6
- d. Write a note on Hydrogen production and storage. 4
- 10 a. Find the amount of energy lost during braking of a vehicle of 1500 kg from 100 KMPH to full stop. 2
- b. What is regenerative braking system? Why is this more useful in urban driving conditions? 5
- c. Explain series brake for optimal feel and optimal energy recovery for regenerative braking. 8
- d. Explain parallel brake for regenerative braking. 5