18EE752

Seventh Semester B.E. Degree Examination, Jan./Feb. 2023
Electric Vehicles

Time: 3 hrs.

Max. Marks: 100

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. Explain the laws of motion of vehicle. **(06 Marks)**
   b. Explain the concept of constant FTR, Level road of vehicle. **(06 Marks)**
   c. An electric vehicle has the following parameter values :
      m = 800 kg, CD = 0.2, AF = 2.2 m^2, C_0 = 0.008, C_1 = 1.6×10^{-6} s^2/m^2
      Also, take density of air $\rho = 1.18$ kg/m^3 and acceleration due to gravity g = 9.81 m/s^2. The vehicle is on level road. It accelerates from 0 to 65 mph in 10S. Such that its velocity profile is given by,
      $v(t) = 0.29055t^2$ for $0 \le t \le 10S$
      i) Calculate $F_{TR}(t)$ for $0 \le t \le 10S$
      ii) Calculate $P_{TR}(t)$ for $0 \le t \le 10S$
      iii) Calculate the energy loss due to non conservative forces E_{loss}.
      iv) Calculate Δe_{TR} **(08 Marks)**

OR

2 a. Explain the dynamics of vehicle motion. **(07 Marks)**
   b. Explain the concept of maximum gradeability of a vehicle. **(06 Marks)**
   c. Explain the concept of propulsion system design used for EV. **(07 Marks)**

Module-2

3 a. Discuss the variety of possible EV configurations due to variations in electric propulsion system and energy source with relevant block diagram. **(08 Marks)**
   b. Explain the characteristics of traction motor. **(05 Marks)**
   c. Explain the concept of energy consumption of EV. **(07 Marks)**

OR

4 a. List the different architecture of HEV's and explain the series hybrid drive trains with neat diagram. **(10 Marks)**
   b. Explain the torque coupling parallel hybrid drive trains with two shaft design configuration. **(10 Marks)**

Module-3

5 a. Explain the following battery parameters:
      (i) Discharge rate   (ii) State of discharge   (iii) Depth of discharge **(06 Marks)**
   b. Explain with a neat sketch the working principle of LI-ION battery used for EV and EHV. **(08 Marks)**
   c. Find the curve-fitting constants n and λ for Peukert's equation for the two measurements available from a constant current discharge experiment of a battery:
      Find the curve-fitting constants n and λ for Peukert's equation for the two measurements available from a constant current discharge experiment of a battery:
      (i) $(t_1, I_1) = (10, 18)$
      (ii) $(t_2, I_2) = (1, 110)$ **(06 Marks)**

OR

6 a. Explain with neat sketch the basic principle and operation of fuel cell. (08 Marks)
   b. List the different types of fuel cells and explain Proton Exchange Membrane Fuel Cell (PEMFC). (06 Marks)
   c. Explain in detail super capacitors used for EV and HEV. (06 Marks)

Module-4

7 a. Explain the functional block diagram of electric propulsion system. (07 Marks)
   b. Explain the torque-speed characteristics of induction motor used for traction application using constant volt/hertz control. (08 Marks)
   c. Explain the phase flux linkage based sensorless control to estimate the rotor position of SRM drive used for EV and HEV. (05 Marks)

OR

8 a. Explain the dc motor speed control using armature voltage and field control of electric propulsion system. (06 Marks)
   b. Explain with a neat block diagram the torque control of BLDC motor. (07 Marks)
   c. Explain the operation of SRM drive converter for EV. (07 Marks)

Module-5

9 a. Explain in detail-thermostat control strategy (engine on-off) used in vehicle controller. (08 Marks)
   b. Explain the concept of power rating design of traction motor. (06 Marks)
   c. Explain the concept of power rating design of the engine/generator. (06 Marks)

OR

10 a. Explain in detail the maximum state of change of peaking power source control strategy of parallel hybrid drive train. (12 Marks)
    b. Explain in detail energy storage design of parallel hybrid electric drive train design. (08 Marks)

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