Exam.Code:0937
Sub. Code: 33784

2076
B.E. (Electrical and Electronics Engineering)
Seventh Semester
PE-EE-702: Electrical and Hybrid Vehicles

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: *Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Part. Assume suitably missing data, if any.*

x-x-x

Q1a. Name the methods used to achieve constant torque and constant power operation in a DC machine. **2**

b. Compare the speed–torque characteristics of an ICE vehicle and a hybrid electric vehicle. **2**

c. Show the different regions of speed-torque characteristics of a Switched Reluctance Motor. **2**

d. Name the main drivetrain components of a hybrid electric vehicle (HEV). **2**

e. Compare the various energy storage devices w.r.t. energy-density and power-density. **2**

Part-A

Q2a. Derive the power equation for electric vehicle starting from its equation of motion. **5**

b. Classify hybrid electric vehicles based on their mechanical transmission systems and explain the architecture and operation of the latest hybrid electric vehicle. **1, 4**

Q3. Explain the torque-speed characteristics of an induction machine with V/f control approach with the help of appropriate analytical expressions. **10**

Q4. A 100 kW, 500 V, 2000 rpm separately excited DC motor is energized from 400 V, 50 Hz,3- phase source through a 3-phase full converter. The voltage drop in conducting thyristors is 2 V. The DC motor parameters are:

Ra=0.1 ohms, Km=1.6 V-s/rad, La=8 mH.

Rated armature current = 210 amperes. No-load armature current =10% of rated current. Armature current is continuous and ripple free. **5,5**

i) Find the no-load speed at firing angle of 30°.

ii) Find the firing angle for a speed of 2000 rpm at rated armature current. Determine also the supply power factor.

Part-B

Q5a. Derive the mathematical relationships governing the mechanical transmission of motion between a vehicle wheel and a flywheel for: **3,2**

(i) direct coupling (without gears), and

(ii) geared coupling (with gears).

b. Develop the third-order model of a battery for an electrical and hybrid vehicle. **5**

P.T.O.

Q6.a.	Formulate the supervisory control problem for optimizing the energy management in a hybrid electric vehicle (HEV) by taking a suitable example. Develop its performance index which minimizes its fuel consumption, system dynamic equation, global and local constraints	**5**
b.	Develop the flow-chart for implementation of dynamic programming for the energy management scheme in HEV.	**4**
c.	What is the major drawback of dynamic programming for energy management scheme?	**1**

Q7 Write short notes on the following

a.	Ultra capacitor.	**5**
b.	PEMFC.	**5**

x-x-x