Exam.Code:0937
Sub. Code: 6648

2074
B.E. (Electrical and Electronics Engineering)
Seventh Semester
PE-EE-702 (ii): 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

Q1.a. Define the term *SOC* for an ultra-capacitor. **(2)**

b. In a hydraulic energy storage system, where the energy will be stored? **(2)**

c. Define the terms energy density and power density **(2)**

d. Draw the second order equivalent circuit model of a battery. **(2)**

e. Draw the torque-speed characteristics of an internal combustion engine (ICE). **(2)**

Part-A

Q2.a. How many hybrid drive train topologies are there? Explain parallel hybrid drive train topology in detail. **(5)**

b. Explain the terms by which the vehicle performance can be described. **(5)**

Q3a. Name the scheme by which the maximum torque of a 3-phase induction motor drive system can be made constant up to its rated speed? Derive the expression for maximum torque in this case. **(1, 6)**

b. Draw its implementation scheme and its respective torque-speed characteristics? **(3)**

Q4. Write short note on following in context with electric drives:

a. DC motor drive system **(5)**

b. Permanent magnet motor drive system. **(5)**

P.T.O.

Part-B

Q5.a. Make an analogy between mechanical and electrical energy storage device for a hybrid electric vehicle having maximum power density. **(2)**

b. And develop and discuss this mechanical energy storage device in detail. **(8)**

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. Draw and explain the flow-chart for implementation of dynamic programming for the energy management scheme in HEV. **(5)**

Q7. Write short note on following: **(5)**

a. Fuel-cell based energy storage system **(5)**

b. Super-capacitor based energy storage system

x-x-x