Exam.Code:0937
Sub. Code: 33784

2125

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

Q1.a. Draw any one power-plant characteristics along with load characteristics of a electric vehicle (EV). **(2)**

b. Name the various power-train components of a hybrid electric vehicle (*HEV*). **(2)**

c. Why *PEMFC* is always preferred over *SOFC* in *HEVs*? **(2)**

d. Compare graphically Fuel-cell, battery and super-capacitor on a power-density and energy-density diagram. **(2)**

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

Part-A

Q2.a Develop the expressions rms value of source current, I_{sr}, thyristor current I_{Tr}, and average value of thyristor current, I_{TA} for the electrical vehicle with three-phase full converter based DC drive system. **(6)**

b. Also, draw the wave-shapes for the output voltage, v_o, i_A *and* i_{T1} for the firing angle of 30^0. **(4)**

Q3. Develop the amount of energy, E^{+}_{pwt} generated by the power train of the hybrid electrical vehicle during acceleration period **(10)**

Q4.a Develop the expressions for starting torque, $T_{e.st}$ and maximum torque, $T_{e.m}$ for stator voltage and frequency control operation of three-phase induction machine. **(3, 3)**

b. A three-phase 20 kW,4-pole, 50 Hz, 400 V delta connected induction motor has the following per-phase parameters referred to stator: **(2,2)**

$r_1 = 0.6$ ohms, $r_2 = 0.4$ ohms, $x_1 = x_2 = 1.6$ ohms

Its magnetizing reactance is neglected. If this motor is operated at 200 V, 25 Hz with direct-on-line starting, calculate current at the instant of starting and under maximum torque conditions.

P.T.O.

Part-B

Q5a. Show mathematically the mechanical transfer motion between the vehicle wheel and flywheel: **(5)**

i) with and **ii)** without gears.

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

Q6. **(10)**

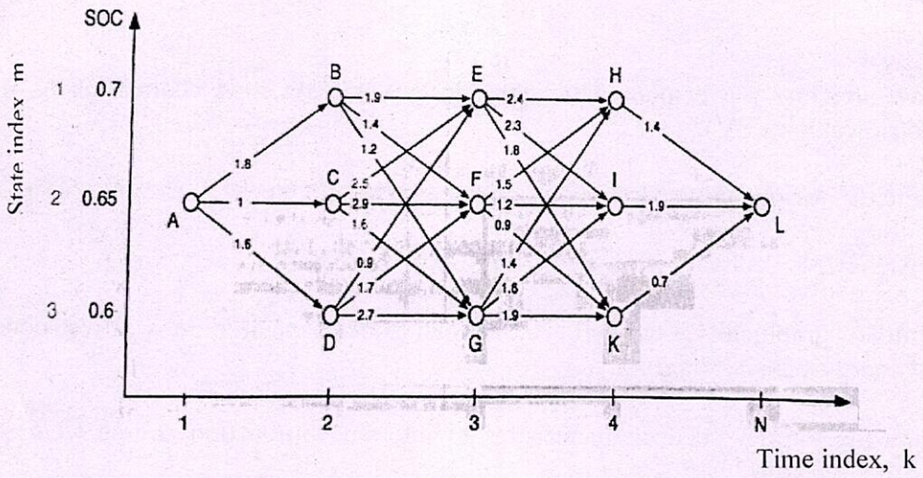

Figure-1

Figure 1 shows the possible arc-costs between state index, *SOC* and time index, *k* of a series *HEV* for moving from point *A* to *L*. Applying the dynamic programming this energy management problem, find out the cost-to-go *Y(x, k)*, optimal control matrix *u** and *u*(x, k)* of this vehicle.

Q7. Write short notes on: **(5, 5)**

a. Switched reluctance motor

b. Super-capacitor

x-x-x