6648

Total no. of Pages : 02
Total no. of Questions : 07

B.E. (EEE) (Sem.-7th)

ELECTRICAL AND HYBRID VEHICLES

Subject Code: PC-EE-702(ii)

Time: 3 Hrs. Max. Marks: 50

INSTRUCTIONS TO CANDIDATE:

(i) **Question 1 is compulsory. Attempt any four questions selecting at least two questions from each part.**

(ii) **Assume suitably missing data, if any.**

Q1.a. Relate the torque capacity of 2000 rpm (MP_{2000}) of the torque converter with capacity factor with appropriate expression. Also show the characteristics of this capacity factor on torque-ratio and speed-ratio. **(2)**

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

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

d. Make the analogy between the governing equations for capacitor and flywheel. **(2)**

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

Part-A

Q2. Starting from the force equations acting on a hybrid vehicle, develop the amount of energy, E^{+}_{pwt} that the power train of this vehicle will develop during acceleration. **(10)**

Q3.a. Develop the second order mathematical model of the battery. **(5)**

b. Write short note on Switched reluctance motor. **(5)**

Q4.a. Develop the expressions for electromagnetic torque (*Te*), maximum torque (*Tem*) and the slip at which maximum torque occurs for a three-phase induction machine. Refer all the parameters on stator side while making this analysis. Draw the torque-speed characteristics of this machine in all its operating modes. **(4, 2, 1, 1)**

b. Also, draw the torque-speed characteristics of three-phase induction motor drive system which is relevant to internal combustion engine (*ICE*). **(2)**

Part-B

Q5.a. Develop the hybrid energy storage system for a electric vehicle having two separate *DC/DC* converters being fed by *PEMFC*, super-capacitor and a battery. **(3)**

This combination of energy storage systems and converters is feeding the three-phase *AC* machine. The overall system must support the regenerative braking mode of the machine.

Develop the control strategy for a hybrid fuel cell power system for a *HEV*. Explain the working of this control strategy through appropriate flow-chart representation. **(7)**

(10)

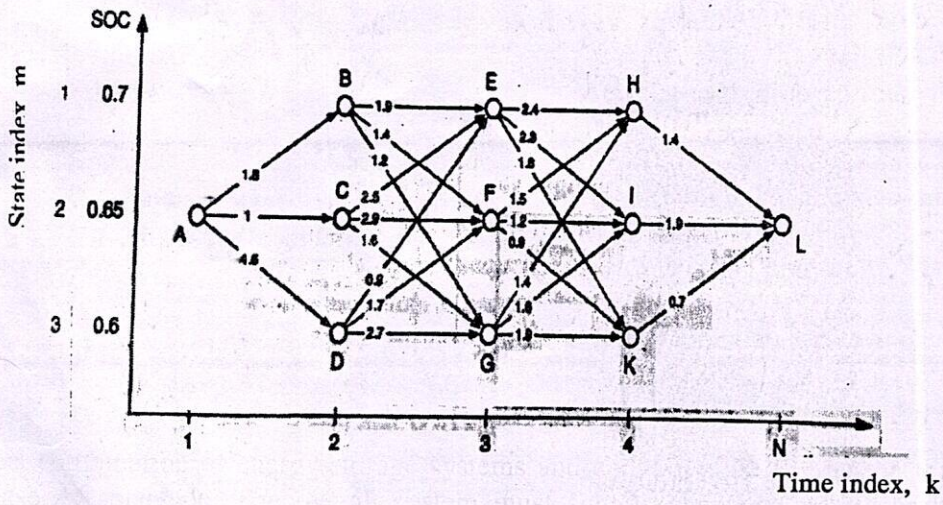


Figure-1

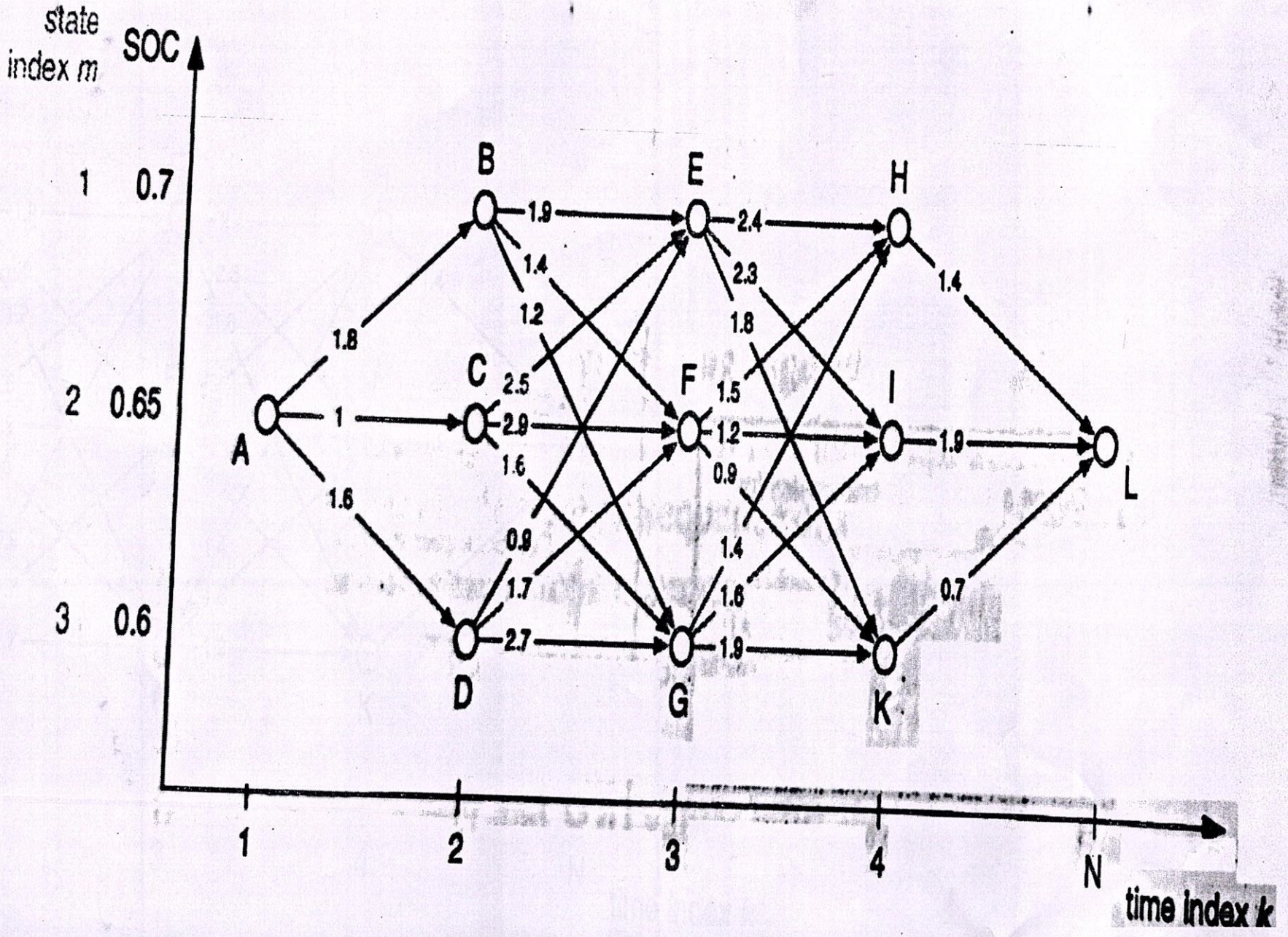
Figure 1 shows the possible arc-costs between state index, *SOC* and time index, *k* of a series *HEV* for moving from point *A* to *L*. Applying the dynamic programming this energy management problem, find out the cost-to-go *Y(x, k)*, optimal control matrix u^* and $u^*(x, k)$ of this vehicle.

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

PEMFC

Super-capacitor

-End-


state index m
SOC
1
0.7
2
0.65
3
0.6
A
B
C
D
E
F
G
H
I
K
L
1.8
1
1.6
1.9
1.4
1.2
2.5
2.9
1.6
0.9
1.7
2.7
2.4
2.3
1.8
1.5
1.2
0.9
1.4
1.6
1.9
1.4
1.9
0.7
1
2
3
4
N
time index k