Tutorial 6 Soft decision decoding

1 (a) What distinguishes hard decision decoding from soft decision decoding?

(b) Sketch the diagram of a BSC soft decision decoder with 8 levels. Suggest suitable values for the levels to be used for decoding.

2 (a) A binary input 4-output discrete memoryless channel (DMC) has the statistics given in the metric table, Table 1

r_i / v_i	O_1	O_2	I_2	I_1
0	-0.4	-0.52	-0.7	-1
1	-1	-0.7	-0.52	-0.4

Table 1

Work out a modified integer metric table, that transforms the values in Table 1 to a range from 0 to 10. (Use the formula $M(r_i \mid v_i) = \sum_{i=0}^{N-1} c_2[\log P(r_i \mid v_i) + c_1]$ where the entries in the table are $\log P(r_i|v_i)$ and c_1 and c_2 are real numbers to transform the range into the required integer metric range.)

(b) Using the rate ½, memory 2 code with generators (7,5), the sequence of outputs obtained from the DMC is
$I_2, O_2, O_1, I_2, I_1, I_2, O_1, O_2, I_2, O_1, O_1, O_2, I_2, O_1, I_1, I_2$.
Use a trellis decoder with the soft decision ML Viterbi algorithm to find the data sent.

3. The 8-level system outputs are used from the AWGN channel Using ML, the received sequence is

2, -3, -2, 0, 3, 2, -3, -2, 2, -2, -4, -3, 0, -3, 3, 2

Use a trellis decoder, and give in a tabular form the evolution of the metric values with respect to the decoding stages, and obtain the decoded information sequence.