Assignment 8 Solution

Digital Communication System-I

May 2023

1. (d) Please see the lecture slides.
2. (c) Here, $M = 2, h = m/p = 2/3$ and $L = 4$. Since $m = 2$ is even, the total number of states are pM^{L-1}, where $p = 3$. Thus, the number of states are 24.
3. (d) Please see the lecture slides.
4. (a) The Viterbi algorithm is a computationally efficient method of finding the path through the trellis with the best metric, that is the maximum likelihood path, which minimizes the Hamming distance.
5. (b) The complexity of Viterbi decoder grows exponentially not linearly with the increase in memory of the system.
6. (b) For the Viterbi decoding algorithm applied to CPM signals, we discard the paths with longer Euclidean distance.

   Viterbi algorithm is a sequential trellis search algorithm that performs ML sequence detection
7. (d) The distnace bound ($d_B^2(h)$) is higher for higher L, *i.e.*, $L = 6$, for a partial responsed CPM signal with raised cosine pulse.
8. (d) $\frac{E_b}{N_0} = 5$ dB $= 10^{0.5} \approx 3.1623$.

   The error rate performances for CPM can be approximated by

$$P_M = K\delta_{min} Q\left(\sqrt{\frac{E_b}{N_0}\delta_{min}^2}\right) = Q\left(\sqrt{3.1623 \times 2}\right) K_{\delta_{min}} = 6 \times 10^{-3} K_{\delta_{min}}.$$

9. (a) Please see the lecture slides.
10. (d) This upper bound for CPFSK with M = 2 is

$$d_B^2(h) = 2\left(1 - \frac{\sin 2\pi h}{2\pi h}\right) = 2\left(1 - \frac{\sin(4\pi/3)}{4\pi/3}\right) = 2.4135.$$