

# Assignment

## GATE-EC-39

EE23BTECH11034 - Prabhat Kukunuri

### I. QUESTION

Consider a polar non-return to zero (NRZ) waveform, using  $+2V$  and  $-2V$  for representing binary '1' and '0' respectively, is transmitted in the presence of additive zero-mean white Gaussian noise with variance  $0.4 V^2$ . If the a priori probability of transmission of a binary '1' is 0.4, the optimum threshold voltage for a maximum a posteriori (MAP) receiver (rounded off to two decimal places) is \_\_\_\_\_ V.

**Solution:**

Symbol	Value	Description
$v_{th}$	$\frac{a_1 + a_2}{2} + \frac{\sigma_n^2}{a_1 - a_2} \ln \left( \frac{P(0)}{P(1)} \right)$	optimum threshold value
$P(0)$	0.6	Probability of error when 0 is transmitted
$P(1)$	0.4	Probability of error when 1 is transmitted
$\sigma_n^2$	$0.4V^2$	Variance of the noise
$a_1$	$E[X + N]$	voltage of transmission for binary 1
$a_2$	$E[X + N]$	voltage of transmission for binary 0

TABLE 0  
VARIABLE DESCRIPTION

$$a_1 = E[X + N] \quad (1)$$

$$a_1 = E[X] + E[N] \quad (2)$$

$$\text{Given mean noise is zero } (E[N] = 0) \quad (3)$$

$$a_1 = E[2] \quad (4)$$

$$a_1 = 2 \quad (5)$$

Similarly,

$$a_2 = E[X + N] \quad (6)$$

$$a_2 = E[-2] + E[N] \quad (7)$$

$$a_2 = -2 \quad (8)$$

Optimum threshold voltage is,

$$v_{th} = \frac{2 - 2}{2} + \frac{0.4}{2 - (-2)} \ln \left( \frac{0.6}{0.4} \right) \quad (9)$$

$$v_{th} = 0.04V \quad (10)$$