

EE 302 PS 21 - SOLUTIONS

Chapter 7

Questions: 11, 12, 13

Problems: None

Critical Thinking: None

Additional Problems: 1

Question 11

Successive-approximation converters; flash converters; pipelined converters. Successive-approximation converters are the most-widely used.

Question 12

The successive-approximation converter.

Question 13

The flash converter is the fastest. The analog input voltage is compared simultaneously to various references representing various quantization levels. Based on this comparison, the logic in the converter determines the binary output.

Additional Problem 1

$$V_o = -V_{\text{ref}} \frac{R_f}{R} \left(\frac{b_n}{2^1} + \frac{b_{n-1}}{2^2} + \dots + \frac{b_1}{2^n} \right)$$

1.a.

$$V_o = -(10 \text{ V}) \frac{10 \text{ k}\Omega}{100 \text{ k}\Omega} \left(\frac{0}{2^1} + \frac{0}{2^2} + \frac{0}{2^3} + \frac{0}{2^4} \right) = 0 \text{ V}$$

1.b.

$$V_o = -(10 \text{ V}) \frac{10 \text{ k}\Omega}{100 \text{ k}\Omega} \left(\frac{0}{2^1} + \frac{1}{2^2} + \frac{0}{2^3} + \frac{1}{2^4} \right) = -0.3125 \text{ V}$$

1.c.

$$V_o = -(10 \text{ V}) \frac{10 \text{ k}\Omega}{100 \text{ k}\Omega} \left(\frac{1}{2^1} + \frac{1}{2^2} + \frac{1}{2^3} + \frac{0}{2^4} \right) = -0.8750 \text{ V}$$

1.d.

$$V_o = -(10 \text{ V}) \frac{10 \text{ k}\Omega}{100 \text{ k}\Omega} \left(\frac{1}{2^1} + \frac{1}{2^2} + \frac{1}{2^3} + \frac{1}{2^4} \right) = -0.9375 \text{ V}$$

1.e. Resolution is the center-to-center distance between adjacent reconstruction bins. This can be determined by looking at the interval between the outputs caused by adjacent binary numbers. Here, we have 1110 and 1111. The voltage between their outputs is [0.0625 V](#).