ECE 215

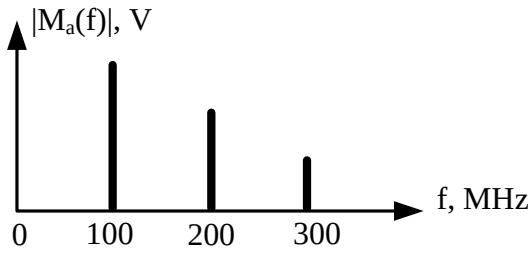
Practice Problems

1. What is aliasing and how can it be prevented?

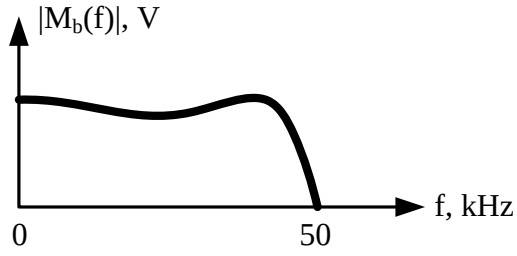
2. What are the three steps for converting an analog signal into digital?

3. Given the following spectra, determine the minimum sampling frequency.

a.



b.



4. Find the number of levels and resolution for an 8-bit ADC with V_{max} = 6 V and V_{min} = -4V.

5. Given a cosine input $v_{in}(t) = 1 + 3cos(360° 50kt)V$, answer the following questions:

   a. What is the Nyquist sampling frequency for this input signal?

   b. Which of these sampling frequencies would you use: 75 kHz, 90 kHz, or 120 kHz?

   c. What are the minimum and maximum values of the input signal?

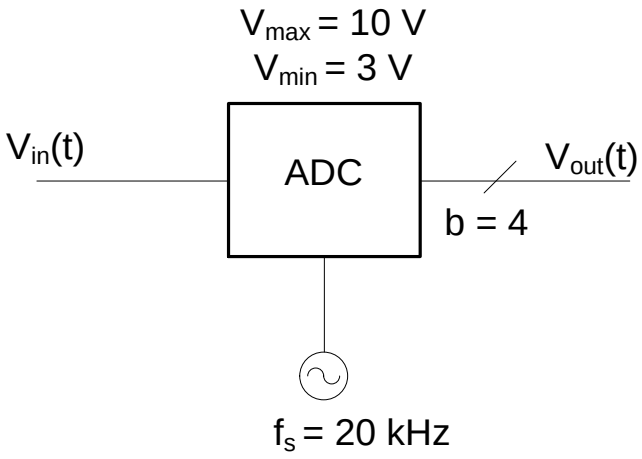
   d. Which of the following ADCs would work with this signal?

- Vmax = 5 V and Vmin = -3 V
- Vmax = 5 V and Vmin = -1 V
- Vmax = 3 V and Vmin = -3 V

   e. Using the V_{max} and V_{min} from part d, how many bits would be required to achieve a resolution of 600 mV or better?

   f. Given the number of bits calculated in part e, what is the actual resolution of the ADC?

6. An input signal, $v_{in}(t) = 6 + 5cos(360° 6kt) + 3cos(360° 15kt)V$, is to be digitized using the ADC below. Note: the 15 kHz portion of the signal is mainly noise and does not carry any useful information. Is this a good ADC for this signal? Why or why not? If not, what could you do to make this ADC work with this signal?



7. You want to convert v(t) to binary numbers to be stored. Your ADC has a Vmax=.5V and a Vmin=-.5V and a 3-bit output.

$$v(t) = 200 + 400\cos(360 * 200kt)\, mV$$

a. Draw the amplitude spectrum of v(t).

b. How would you prepare the signal? Design the transducer interface.

c. What sampling rate would you choose?

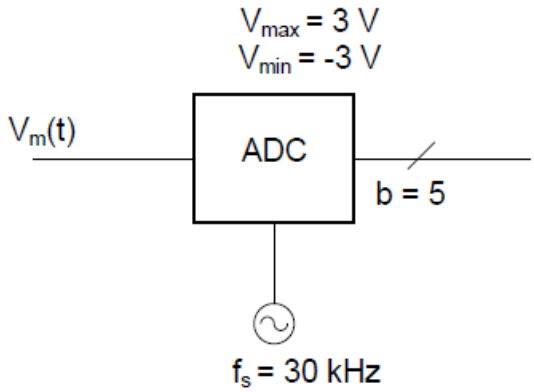
d. What is the resolution?

e. What is the encoded output if the input is 315mV?

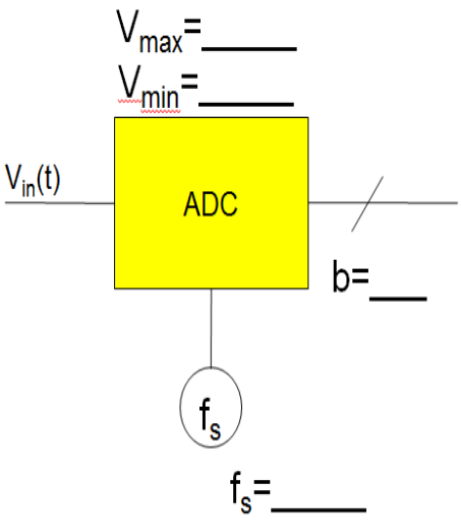
8. What is the resolution of a 10-bit ADC with Vmax = 5V and Vmin = -3 V?

9. Given the following signal, create an ADC to capture it with 5 bit ADC and determine its resolution.
$V(t) = \cos(360^0*8k*t) + 2*\cos(360^0*15k*t)$ V

10. sing this ADC encode 1.62 V



11. Given $v_{in}(t) = 4+4\cos(360^0 \times 2kt)V$, and max QE = 200 mV, find the unknowns in the figure below



If a value of 1.6 V is measured, what would be the QE and the encoded value?