Milwaukee School of Engineering

Electrical Engineering and Computer Science Department

EE-3221 – Midterm Test – Dr. Durant

Wednesday 20 January 2021

May use textbook (electronic or printed), calculator, 8½" × 11" note sheet

Good luck!

Name: _____

Page 2: (10 points) _____

Page 3: (15 points) _____

Page 4: (30 points) _____

Page 5: (25 points) _____

Page 6: (20 points) _____

Total: (100 points) _____

1. (5 points) Sketch the 5-component general DSP system diagram.

2. (5 points) Sketch the response of the ideal anti-aliasing filter in terms of f_s.

3. (10 points) A signal with continual, sinusoidal components at 8 kHz and 20 kHz is sampled at 30 kHz. Sketch the magnitude spectrum from $-2f_s$ to $2f_s$. The 8 kHz signal has greater amplitude; for clarity, make the components due to it taller in your diagram.

4. (5 points) Explain whether aliasing occurred in the above example.

5. (5 points) Write the non-0 portion of the sequence resulting from $x(n) = \left(\frac{-2}{3}\right)^n (u(n+2) - u(n-3))$. Clearly indicate the *n=0* position in your sequence.

6. (10 points) Based on the samples you calculated, calculate the energy of x(n).

7. (5 points) Based on the samples you calculated, write the sequence for the transformed signal w(n) = x(2n+2)

8. (10 points) Let f_s = 2000 Hz, f_1 = 800 Hz. Prove that the sampled signal is periodic and calculate its period *N*.

9. (25 points) Calculate the convolution [7 -1 6] * [2 5 3 4]. Show your work.

10. (5 points) Given the difference equation $y(n) = 0.5\, y(n-1) + 5\, x(n) - 3\, x(n-2)$, identify all the a and b coefficients of the standard form with proper subscripts.

11. (5 points) Calculate the first 5 terms of the impulse response.

12. (10 points) Explain why the system with the above difference equation is stable.