Milwaukee School of Engineering

Electrical Engineering and Computer Science Department

EE-3032 – Practice Final Exam – Dr. Durant

November, 2019

May use 8½" × 11" note sheet. No calculator.
Tables 5.6 and 5.7 from Dr. Yagle's text will be provided.

Good luck!

Name: _____

Page 3: (17 points) _____

Page 4: (24 points) _____

Page 5: (16 points) _____

Page 6: (15 points) _____

Page 7: (12 points) _____

Page 8: (16 points) _____

Total: (100 points) _____

1. (4 points) ***Sketch*** $x(t) = r(t+2) - u(t-1) + \delta(t-2)$

2. (4 points) ***Explain*** whether $s(t) = 4 + \sin(4\pi t) + \cos(9\pi t)$ is ***periodic***. If it is, calculate its ***fundamental period***.

3. (5 points) ***Calculate S(ω)***, the Fourier transform of y(t), or explain why it cannot be done.

4. (4 points) ***Explain*** whether $y(t) = \cos(t) + \sin(t\sqrt{3})$ is ***periodic***. If it is, calculate its ***fundamental period***.

5. (3 points) ***Sketch*** $z(t) = r(t) + r(t-1) – 2u(t-2) - r(t-4) + r(t-8)$.

6. (4 points) Find the ***energy or power***, as appropriate, of $z(t)$.

7. (6 points) Let $w(t) = 7 \sin(\omega_1 t)$. ***Halve the frequency*** of the signal, then ***advance*** it 2 seconds earlier, and then ***fold it***. ***Show each step*** of your transformation.

8. (6 points) Let $v(t) = r(t-1) – 2r(t-2) + r(t+3)$. ***Decompose v(t)*** into even and odd signals such that $v(t) = v_e(t) + v_o(t)$.

9. (5 points) ***Calculate*** the ***energy or power*** as appropriate of $q(t) = (4+3j)e^{j\pi t/3}u(t)$.

10. (6 points) Let x(t) be an unknown system input and y(t) be the corresponding system output. Specifically, let $y(t) = t \times x(t-2)$. ***Prove or convincingly explain*** whether this system has each of the following properties:

    a. Linear

    b. Time-invariant

    c. BIBO stable

11. (6 points) Now, consider the system $y(t) = 3\,x(t) + 4\,x(t-1)$. ***Prove or convincingly explain*** whether this system has each of the following properties:

    a. Linear

    b. Time-invariant

    c. BIBO stable

12. (4 points) Which of the following properties are necessary for a system to have an impulse response?

    a. Causal

    b. Linear

    c. BIBO stable

    d. Time-invariant

13. (15 points) Let a system have impulse response h(t) = 2r(t) u(4-t). Let the system input be x(t) = 3u(t) – 3u(t-4). ***Find*** the ***system output*** y(t) ***using convolution***. ***Sketch*** your result.

14. (12 points) A periodic signal has the Fourier Series {2j/5, 0, 2j/3, 0, -2j, 5, 2j, 0, -2j/3, 0, -2j/5}. $\omega_0 = 6$.

    a. What is the ***DC offset*** of the signal?

    b. Is the signal ***even, odd, or neither***?

    c. ***Sketch*** the ***power spectrum*** of the signal.

    d. What is the ***power*** of the signal?

    e. What is the Fourier ***transform*** of this periodic signal? (Hint: Table 5.6)

    f. What is the ***time-domain signal*** itself?

15. (4 points) Sketch the ***magnitude response*** from -10 to 10 Hz of a ***lowpass filter*** that passes signals below 3 Hz, but blocks signals outside of this range.

16. (6 points) Determine the ***impulse response h(t)*** of this system if the ***phase shift is 0***. Hint: The transfer function H(ω) is the Fourier transform of the impulse response. You will need to evaluate an integral and simplify. Hint 2: If you simplify correctly, the result will be real.

17. (6 points) Let a system have impulse response $h(t) = 5e^{-2t}u(t)$. Let the system input be the steady state signal $x(t) = \cos(6\pi t)$. What is the ***output***?