Solution of ECE 315 Test 1 F09

1. How many impulses are there in $\delta_7(t+4)$ inside the time range $-27 < t < 43$?

   The impulses are at $\cdots -32,-25,-18,-11,-4,3,10,17,24,31,38,45\cdots$. So the answer is 10.

2. How many impulses are there in $\delta_7(3t+4)$ inside the time range $-11 < t < 10$?

   The impulses are at $\cdots -39/3,-32/3,-25/3,-18/3,-11/3,-4/3,3/3,10/3,17/3,24/3,31/3\cdots$.
   So the answer is 9.

3. What is the numerical value of $\int_2^9 9\delta((t-4)/5)dt$?

   $$\int_2^9 9\delta((t-4)/5)dt = 45\int_2^9 \delta(t-4)dt = 45$$

4. What is the numerical value of $\int_{-6}^3 5\delta(3(t-4))dt$?

   $$\int_{-6}^3 5\delta(3(t-4))dt = 5/3\int_{-6}^3 \delta(t-4)dt = 0$$

5. What is the numerical value of $\int_{-\infty}^{\infty} \text{ramp}(3t)\delta(t-4)dt$?

   $$\int_{-\infty}^{\infty} \text{ramp}(3t)\delta(t-4)dt = \text{ramp}(3\times 4) = 12$$

6. What are the numerical magnitude and phase (angle) of $6/(-1+j2)$?

   $|6/(-1+j2)| = 2.683$ and $\measuredangle 6/(-1+j2) = -2.034$ radians or 4.249 radians

7. What are the numerical magnitude and phase (angle) of $\cos(2\pi(3/8))e^{-j\pi/2}$?

   $|\cos(2\pi(3/8))e^{-j\pi/2}| = 1/\sqrt{2}$ and $\measuredangle \cos(2\pi(3/8))e^{-j\pi/2} = \pi/2$ radians or $-3\pi/2$ radians

8. (2 pts) A continuous-time function is odd. Is its time integral 1) even, 2) odd, 3) neither even nor odd or 4) impossible to know given only this information?

   Even

9. Find the numerical signal energy of $x(t) = \text{ramp}(t)[u(t) - u(t-4)]$.

$$E_x = \int_{-\infty}^{\infty} |x(t)|^2 \, dt = \int_{-\infty}^{\infty} |\text{ramp}(t)[u(t) - u(t-4)]|^2 \, dt = \int_0^4 |\text{ramp}(t)|^2 \, dt$$

$$E_x = \int_0^4 t^2 \, dt = 64 / 3 \text{ or } 21.333...$$

10. If

n	-2	-1	0	1	2	3	4
$x[n]$	8	0	-7	3	5	-4	9

and $y[n] = x[3n]$. What is the numerical value of $y[1]$?

$y[1] = x[3] = -4$

11. If $x[n] = 4\cos(2\pi n / 13)$ and $y[n] = x[5n]$, what is the numerical fundamental period of $y[n]$?

$y[n] = 4\cos(2\pi(5n)/13) = 4\cos(2\pi n(5/13))$. The fundamental period is 13.

12. If $\sum_{n=1}^{7} x[n] = 11$ and $x[n]$ is an odd function, what is the numerical value of $\sum_{n=-7}^{7} x[n]$?

The summation over symmetrical limits centered at zero of any odd discrete-time function is zero.

13. Find the numerical fundamental period of $x[n] = 4\sin(5\pi n / 8) - 8\cos(11\pi n / 10)$. If it is not periodic just write in "infinity" or ∞.

$$x[n] = 4\sin(5\pi n / 8) - 8\cos(11\pi n / 10) = 4\sin(2(5/16)\pi n) - 8\cos(2(11/20)\pi n)$$

The fundamental periods of the two individual sinusoids are 16 and 20. The overall fundamental period is the least common multiple of those which is 80.

14. One period of a periodic discrete-time signal is described by the following table. Find the numerical average signal power of the signal.

n	-4	-3	-2	-1	0
$x[n]$	8	2	-3	1	3

$$P_x = (1/5)\left(8^2 + 2^2 + (-3)^2 + 1^2 + 3^2\right) = \frac{64 + 4 + 9 + 1 + 9}{5} = 87 / 5 = 17.4$$

Solution of ECE 315 Test 1 F09

1. How many impulses are there in $\delta_7(t+4)$ inside the time range $-27 < t < 46$?

   The impulses are at $\cdots -32,-25,-18,-11,-4,3,10,17,24,31,38,45,52\cdots$. So the answer is 11.

2. How many impulses are there in $\delta_7(3t+4)$ inside the time range $-10 < t < 10$?

   The impulses are at $\cdots -39/3,-32/3,-25/3,-18/3,-11/3,-4/3,3/3,10/3,17/3,24/3,31/3\cdots$.
   So the answer is 8.

3. What is the numerical value of $\int_2^9 9\delta((t-4)/3)\,dt$?

   $$\int_2^9 9\delta((t-4)/3)\,dt = 27\int_2^9 \delta(t-4)\,dt = 27$$

4. What is the numerical value of $\int_{-6}^{3} 5\delta(3(t-4))\,dt$?

   $$\int_{-6}^{3} 5\delta(3(t-4))\,dt = 5/3\int_{-6}^{3} \delta(t-4)\,dt = 0$$

5. What is the numerical value of $\int_{-\infty}^{\infty} \text{ramp}(5t)\delta(t-4)\,dt$?

   $$\int_{-\infty}^{\infty} \text{ramp}(5t)\delta(t-4)\,dt = \text{ramp}(5\times 4) = 20$$

6. What are the numerical magnitude and phase (angle) of $6/(-1-j2)$?

   $|6/(-1-j2)| = 2.683$ and $\measuredangle 6/(-1+j2) = 2.034$ radians or -4.249 radians

7. What are the numerical magnitude and phase (angle) of $\cos(2\pi(3/8))e^{j\pi/2}$?

   $\left|\cos(2\pi(3/8))e^{j\pi/2}\right| = 1/\sqrt{2}$ and $\measuredangle \cos(2\pi(3/8))e^{j\pi/2} = -\pi/2$ radians or $3\pi/2$ radians

8. (2 pts) A continuous-time function is odd. Is its time integral 1) even, 2) odd, 3) neither even nor odd or 4) impossible to know given only this information?

   Even

9. Find the numerical signal energy of $\mathrm{x}(t) = \mathrm{ramp}(t)[\mathrm{u}(t) - \mathrm{u}(t-7)]$.

$$E_{\mathrm{x}} = \int_{-\infty}^{\infty} |\mathrm{x}(t)|^2\,dt = \int_{-\infty}^{\infty} |\mathrm{ramp}(t)[\mathrm{u}(t) - \mathrm{u}(t-7)]|^2\,dt = \int_{0}^{7} |\mathrm{ramp}(t)|^2\,dt$$

$$E_{\mathrm{x}} = \int_{0}^{7} t^2\,dt = 343/3 \text{ or } 114.333...$$

10. If

n	-2	-1	0	1	2	3	4
$\mathrm{x}[n]$	8	0	-7	3	5	2	9

and $\mathrm{y}[n] = \mathrm{x}[3n]$. What is the numerical value of $\mathrm{y}[1]$?

$\mathrm{y}[1] = \mathrm{x}[3] = 2$

11. If $\mathrm{x}[n] = 4\cos(2\pi n/17)$ and $\mathrm{y}[n] = \mathrm{x}[5n]$, what is the numerical fundamental period of $\mathrm{y}[n]$?

$\mathrm{y}[n] = 4\cos(2\pi(5n)/17) = 4\cos(2\pi n(5/17))$. The fundamental period is 17.

12. If $\sum_{n=1}^{7} \mathrm{x}[n] = 8$ and $\mathrm{x}[n]$ is an odd function, what is the numerical value of $\sum_{n=-7}^{7} \mathrm{x}[n]$?

The summation over symmetrical limits centered at zero of any odd discrete-time function is zero.

13. Find the numerical fundamental period of $\mathrm{x}[n] = 4\sin(5\pi n/9) - 8\cos(11\pi n/10)$. If it is not periodic just write in "infinity" or ∞.

$$\mathrm{x}[n] = 4\sin(5\pi n/9) - 8\cos(11\pi n/10) = 4\sin(2(5/18)\pi n) - 8\cos(2(11/20)\pi n)$$

The fundamental periods of the two individual sinusoids are 18 and 20. The overall fundamental period is the least common multiple of those which is 180.

14. One period of a periodic discrete-time signal is described by the following table. Find the numerical average signal power of the signal.

n	-4	-3	-2	-1	0
$\mathrm{x}[n]$	8	2	-5	1	3

$$P_{\mathrm{x}} = (1/5)\left(8^2 + 2^2 + (-5)^2 + 1^2 + 3^2\right) = \frac{64+4+25+1+9}{5} = 103/5 = 20.6$$

Solution of ECE 315 Test 1 F09

1. How many impulses are there in $\delta_7(t+4)$ inside the time range $-24 < t < 43$?

   The impulses are at $\cdots -25,-18,-11,-4,3,10,17,24,31,38,45\cdots$. So the answer is 9.

2. How many impulses are there in $\delta_7(3t+4)$ inside the time range $-14 < t < 10$?

   The impulses are at $\cdots -46/3.-39/3,-32/3,-25/3,-18/3,-11/3,-4/3,3/3,10/3,17/3,24/3,31/3\cdots$.
   So the answer is 10.

3. What is the numerical value of $\int_2^9 7\delta((t-4)/5)dt$?

   $$\int_2^9 7\delta((t-4)/5)dt = 35\int_2^9 \delta(t-4)dt = 35$$

4. What is the numerical value of $\int_{-6}^3 5\delta(3(t-4))dt$?

   $$\int_{-6}^3 5\delta(3(t-4))dt = 5/3\int_{-6}^3 \delta(t-4)dt = 0$$

5. What is the numerical value of $\int_{-\infty}^{\infty} \text{ramp}(8t)\delta(t-4)dt$?

   $$\int_{-\infty}^{\infty} \text{ramp}(8t)\delta(t-4)dt = \text{ramp}(8\times 4) = 32$$

6. What are the numerical magnitude and phase (angle) of $6/(-2+j)$?

   $|6/(-2+j)| = 2.683$ and $\measuredangle 6/(-1+j2) = -2.668$ radians or 3.615 radians

7. What are the numerical magnitude and phase (angle) of $\cos(2\pi(3/8))e^{-j3\pi/4}$?

   $|\cos(2\pi(3/8))e^{-j3\pi/4}| = 1/\sqrt{2}$ and $\measuredangle \cos(2\pi(3/8))e^{-j3\pi/4} = \pi/4$ radians or $-7\pi/4$ radians

8. (A continuous-time function is odd. Is its time integral 1) even, 2) odd, 3) neither even nor odd or 4) impossible to know given only this information?

   Even

9. Find the numerical signal energy of $\mathrm{x}(t)=\mathrm{ramp}(t)[\mathrm{u}(t)-\mathrm{u}(t-3)]$.

$$E_{\mathrm{x}}=\int_{-\infty}^{\infty}|\mathrm{x}(t)|^2\,dt=\int_{-\infty}^{\infty}\left|\mathrm{ramp}(t)[\mathrm{u}(t)-\mathrm{u}(t-3)]\right|^2 dt=\int_{0}^{3}|\mathrm{ramp}(t)|^2\,dt$$

$$E_{\mathrm{x}}=\int_{0}^{3}t^2\,dt=27/3 \text{ or } 9$$

10. If

n	-2	-1	0	1	2	3	4
$\mathrm{x}[n]$	8	0	-7	3	5	7	9

and $\mathrm{y}[n]=\mathrm{x}[3n]$. What is the numerical value of $\mathrm{y}[1]$? $\mathrm{y}[1]=\mathrm{x}[3]=7$

11. If $\mathrm{x}[n]=4\cos(2\pi n/21)$ and $\mathrm{y}[n]=\mathrm{x}[5n]$, what is the numerical fundamental period of $\mathrm{y}[n]$?

$\mathrm{y}[n]=4\cos(2\pi(5n)/21)=4\cos(2\pi n(5/21))$. The fundamental period is 21.

12. If $\sum_{n=1}^{7}\mathrm{x}[n]=11$ and $\mathrm{x}[n]$ is an odd function, what is the numerical value of $\sum_{n=-7}^{7}\mathrm{x}[n]$?

The summation over symmetrical limits centered at zero of any odd discrete-time function is zero.

13. Find the numerical fundamental period of $\mathrm{x}[n]=4\sin(5\pi n/8)-8\cos(11\pi n/6)$. If it is not periodic just write in "infinity" or ∞.

$\mathrm{x}[n]=4\sin(5\pi n/8)-8\cos(11\pi n/6)=4\sin(2(5/16)\pi n)-8\cos(2(11/12)\pi n)$

The fundamental periods of the two individual sinusoids are 16 and 12. The overall fundamental period is the least common multiple of those which is 48.

14. One period of a periodic discrete-time signal is described by the following table. Find the numerical average signal power of the signal.

n	-4	-3	-2	-1	0
$\mathrm{x}[n]$	8	9	-3	1	3

$$P_{\mathrm{x}}=(1/5)\left(8^2+9^2+(-3)^2+1^2+3^2\right)=\frac{64+81+9+1+9}{5}=164/5=32.8$$