V1

Last Name: _____ First Name: _____ Group: _____

EE311

Exam

Important note: In multiple choices, a wrong answer is counted negatively

Exercise 1 (5 points)
Classify the following signals as energy signals, power signals or neither. Compute their energy and power.

(a) $x(t) = 7u(t)$

E = ____∞____ P = ____24.5 W___ Type = ___Power__

(b) $x(t) = 5\text{sinc}\,t$

E = ____25 J____ P = ___0_____ Type = ___Energy__

(c) $x(t) = 2\cos 10t + 4\sin 20t$

E = ___∞____ P = _____10 W_____ Type = ___Power___

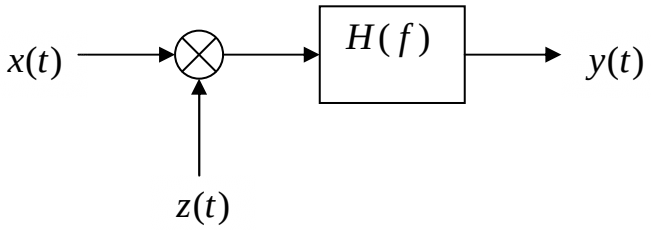
(d) $x(t) = 6$

E = ___∞_____ P = ____36 W_____ Type = __Power___

(e) $x(t) = e^{t}u(t)$

E = ___∞_____ P = _____∞_____ Type = ___Neither_

Exercise 2 (4 points)
Consider the following system:



Where $x(t) = \cos\left(2\pi 10^4 t\right)$, $z(t) = \sum_{n=-\infty}^{+\infty} \delta\left(t - nT_s\right)$, $f_s = \frac{1}{T_s} = 15\text{ kHz}$, $H(f) = T_s \Pi\left(\frac{f}{2W}\right)$.

1. If W = 7.5 kHz, the resulting signal is:

(a) $y(t) = \cos\left(2\pi 10^4 t\right)$ (b) $y(t) = \cos\left(2\pi 10^3 t\right)$

(c) $y(t) = \cos\left(2\pi 10^4 t\right) + \cos\left(2\pi 10^3 t\right)$ (ⓓ) $y(t) = \cos\left(2\pi \times 5 \times 10^3 t\right)$

2. If W = 12 kHz, the resulting signal is:

(a) $y(t) = \cos\left(2\pi 10^4 t\right)$ (b) $y(t) = \cos\left(2\pi \times 5 \times 10^4 t\right) + \cos\left(2\pi 10^6 t\right)$

(ⓒ) $y(t) = \cos\left(2\pi 10^4 t\right) + \cos\left(2\pi \times 5 \times 10^3 t\right)$ (d) $y(t) = \cos\left(2\pi 10^3 t\right) + \cos\left(2\pi 10^5 t\right)$

Exercise 3 (4 points)

The following AM signal $x(t) = A\left[1+0.5\cos\left(2\pi f_m t\right)\right]\cos\left(2\pi f_0 t\right)$ is filtered by a bandpass filter $H(f) = \dfrac{1}{1+ j\dfrac{f-f_0}{f_m}}$ for $f \geq 0$. The resulting signal is:

(a) $x(t) = A\left[1+\dfrac{0.5}{\sqrt{2}}\cos\left(2\pi f_m t\right)\right]\cos\left(2\pi f_0 t - \dfrac{\pi}{4}\right)$

(b) $x(t) = \dfrac{A}{\sqrt{2}}\left[1+0.5\cos\left(2\pi f_m t - \dfrac{\pi}{4}\right)\right]\cos\left(2\pi f_0 t\right)$

(c) $x(t) = A\left[1+\dfrac{0.5}{\sqrt{2}}\cos\left(2\pi f_m t\right)\right]\cos\left(2\pi f_0 t\right)$

(ⓓ) $x(t) = A\left[1+\dfrac{0.5}{\sqrt{2}}\cos\left(2\pi f_m t - \dfrac{\pi}{4}\right)\right]\cos\left(2\pi f_0 t\right)$

(Hint: Remember the bandpass filtering of bandpass signal)

Exercise 4 (4 points)

The signal $x(t) = 10\cos\left(2\pi 10^4 t + 4\sin\left(200\pi t\right)\right)$ is filtered by an ideal bandpass filter with transfer function $H(f) = \Pi\left(\dfrac{f-10^4}{500}\right) + \Pi\left(\dfrac{f+10^4}{500}\right)$. The power of the output signal is approximately:

(a) 50 W (ⓑ) 21.58 W (c) 100 W (d) 52.67 W

Exercise 5 (2 points)

1. A power meter measures a value of – 23 dBm. This value corresponds to:

(ⓐ) 5 µW (b) 5 mW (c) 15 µW (d) 100 µW

2. An rms voltmeter measures a value of 26 dBV. This value corresponds to:

(a) 50 V (ⓑ) 20 V (c) 2 V (d) 100 V

Exercise 6 (2 points)

An AM signal is displayed on an oscilloscope. We measure 20 V_{pp} at a peak of modulation and 10 V_{pp} at a trough. Compute the value of the carrier amplitude and the value of the modulation index.

A = __7.5 V_or 15 V_{pp}_____ m = ____1/3_____

Exercise 7 (1 point)

An AM signal is to be demodulated with an envelop detector. The carrier frequency is 100 kHz. The modulating signal is sinusoidal and has a frequency of 10 kHz. The resistance has a value of 1 kΩ and the capacitance has a value of 100 nF. The observed distortion is called:

(ⓐ) Slope overload (b) Amplitude overload (c) Envelop overload (d) Slope deficiency

Bessel Functions

$J_n(x)$									
x **n**	**0.5**	**1**	**2**	**3**	**4**	**6**	**8**	**10**	**12**
0	0.9385	0.7652	0.2239	- 0.2601	-0.3971	0.1506	0.1717	-0.2459	0.0477
1	0.2423	0.4401	0.5767	0.3391	-0.0660	-0.2767	0.2346	0.0435	-0.2234
2	0.0306	0.1149	0.3528	0.4861	0.3641	- 0.2429	-0.1130	0.2546	-0.0849
3	0.0026	0.0196	0.1289	0.3091	0.4302	0.1148	-0.2911	0.0584	0.1951
4	0.0002	0.0025	0.0340	0.1320	0.2811	0.3576	-0.1054	-0.2196	0.1825
5	—	0.0002	0.0070	0.0430	0.1321	0.3621	0.1858	-0.2341	-0.0735
6		—	0.0012	0.0114	0.0491	0.2458	0.3376	-0.0145	-0.2437
7			0.0002	0.0025	0.0152	0.1296	0.3206	0.2167	-0.1703
8			—	0.0005	0.0040	0.0565	0.2235	0.3179	0.0451
9				0.0001	0.0009	0.0212	0.1263	0.2919	0.2304
10				—	0.0002	0.0070	0.0608	0.2075	0.3005
11					—	0.0020	0.0256	0.1231	0.2704
12						0.0005	0.0096	0.0634	0.1953
13						0.0001	0.0033	0.0290	0.1201
14						—	0.0010	0.0120	0.0650