

Name: \_\_\_\_\_

Student Number: \_\_\_\_\_

*Do NOT begin until told to do so*  
*Make sure that you have all pages before starting*  
*You may not leave the room during the exam*  
**No** calculators, open book, 1 page notes

## ACADEMIC INTEGRITY:

Students have the responsibility to know and observe the requirements of The UNCC Code of Student Academic Integrity (1997-99 Catalog page 336). This code forbids cheating, fabrication or falsification of information, multiple submission of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonesty.

Unless otherwise noted:

Show all work, even for multiple choice  
 Multiple choice answers should be within 5% of correct value  
 $\mathcal{F}\{\}$  denotes either continuous Fourier transform  
 $\mathcal{F}^{-1}\{\}$  denotes inverse Fourier transform  
 $\omega$  denotes the continuous-time frequency variable  
 $*$  denotes linear convolution  
 $x^*(t)$  denotes the conjugate of  $x(t)$

Useful constants, etc:

$$\begin{array}{cccc}
 \epsilon \approx 2.72 & \pi \approx 3.14 & 1/e \approx 0.37 & \sqrt{2} \approx 1.41 \\
 \sqrt{3} \approx 1.73 & \sqrt{5} \approx 2.22 & \sqrt{7} \approx 2.64 & \sqrt{10} \approx 3.16 \\
 \ln[2] \approx 0.69 & \ln[4] \approx 1.38 & \ln[55] \approx 4.0 & \ln[256] \approx 5.6 \\
 \log_{10}[2] \approx 0.30 & \log_{10}[3] \approx 0.48 & \log_{10}[55] \approx 4.0 & \log_{10}[10] \approx 1.0 \\
 \log_{10}[0.1] \approx -1.0 & \log_{10}[0.5] \approx -0.3 & \log_{10}[e] \approx 0.43 & \cos(\pi/4) \approx 0.79
 \end{array} \tag{1}$$

$$\cos(A)\cos(B) = \frac{1}{2}\cos(A - B) + \frac{1}{2}\cos(A + B)$$

$$e^{j\theta} = \cos(\theta) + j\sin(\theta)$$

$$\cos^2(A) = \frac{1}{2} + \frac{1}{2}\cos(2A)$$

5 Points Each (Circle the best answer)

1. If  $h(t) = \text{sinc}(2\pi t)$  is the impulse response of a system, the bandwidth of the system is

- (a) 1 Hz                      (b) 2 Hz                      (c)  $2\pi$  Hz                      (d) None above

2. Given DSB-LC signal  $y(t) = (10 + 0.2\cos(10t))\cos(10000t)$ , the modulation index is  $\mu =$

- (a) 0.2                      (b) 10                      (c) 50                      (d) None above

3.  $e^{j\pi/4} =$

- (a)  $j$                       (b)  $j + 1$  Hz                      (c)  $\frac{1+j}{\sqrt{2}}$                       (d) None above

4. The output  $y(t)$  of a nonlinear system is  $y(t) = x^3(t)$ . If the input signal is  $\cos(20\pi t)$ , the highest frequency component in the output is:

- (a)  $10\pi$  radian/second                      (b) 20 Hz                      (c) 30 Hz                      (d) None above

5 Points Each (Circle the best answer)

5. The convolution,  $\delta(t - 2) * \text{sinc}(t/3) =$

- (a)  $\delta(\text{sinc}(\frac{t-2}{3}))$       (b)  $\text{sinc}(t/3 - 2)$       (c)  $\text{sinc}(\frac{t-2}{3})$       (d) None above

6. The Hilbert transform of  $\cos(t)$  is

- (a)  $j \cos(t)$       (b)  $-j \cos(t)$       (c)  $\sin(t)$       (d) None above

7. Let  $x(t) = \cos^2(10\pi t)$ .  $D_0$  in the exponential Fourier series expansion of  $x(t)$  is  $D_0 =$

- (a) 0      (b) 1      (c)  $j$       (d) None above

8. The signal  $\cos(100t)e^{-|2t|}$  is an energy signal.

- (a) True      (b) False

5 Points Each (Circle the best answer)

9. An RC filter is distortionless for any input signal.

- (a) True (b) False

10. The frequency response of a filter is  $H(\omega) = \text{rect}(\omega/4)e^{-j10\omega}$ . The time delay through the filter is:

- (a) 4 radian/second (b) 4 seconds (c) 10 seconds (d) None above

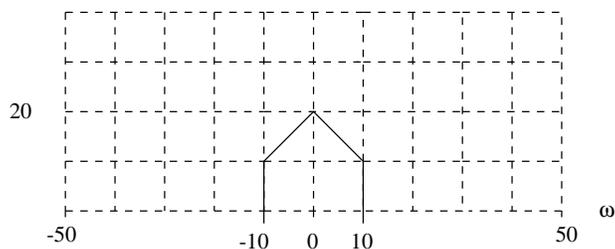
11. Let the autocorrelation function of signal  $y(t)$  be given as  $R_y(\tau) = 3e^{-2|\tau|} \text{rect}(\tau)$ . The power  $P_y$  of this signal is then:

- (a)  $3e^{-2|\tau|} \text{sinc}(\tau)$  (b) 3 (c)  $3e^{-2}$  (d) None above

12. Let the power spectral density of signal  $y(t)$  be given as  $S_y(\omega) = 4 \text{rect}(\omega) + 2\text{rect}(\omega/2)$ . The power  $P_y$  of this signal is then:

- (a) 3 (b)  $4/\pi$  (c) 7 (d) None above

13. For the following questions, let  $y(t) = x(t) \cos(30t)$ , where  $X(\omega) = \mathcal{F}\{x(t)\}$  is given below.

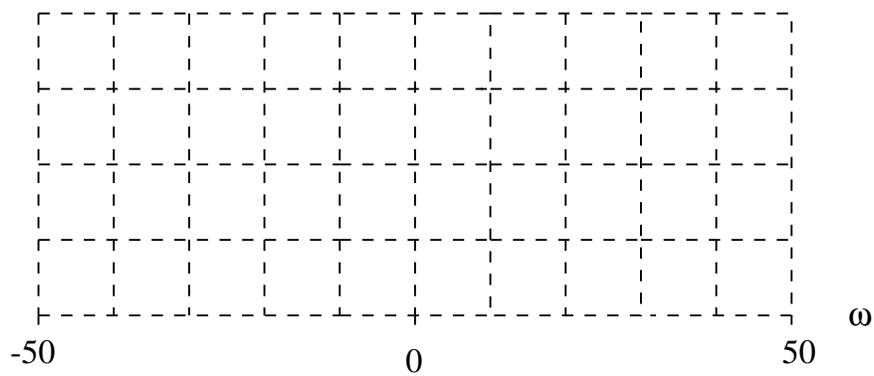


10 points

Find  $Y(\omega) = \mathcal{F}\{y(t)\}$  in terms of  $X(\omega)$ .

10 points

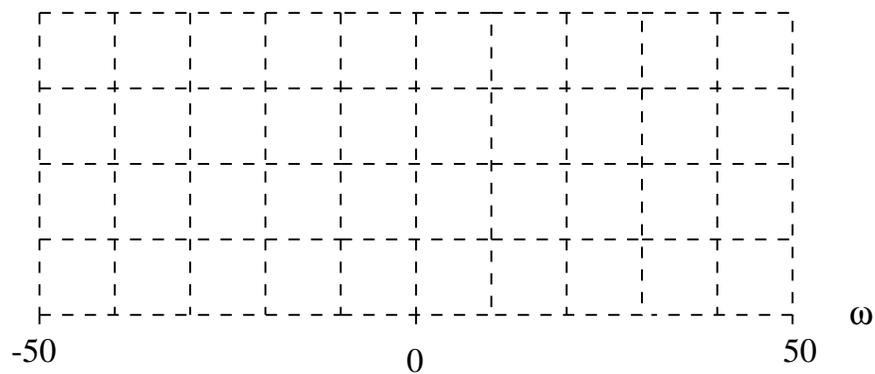
Plot  $|Y(\omega)|$  below. Be sure to label the axes.



14. For the following questions, DSB-LC signal is given as  $y(t) = (1 + .2\cos(5t))\cos(40t)$ .

10 points

Plot  $|Y(\omega)|$  below. Be sure to label the axes.



10 points

Sketch the block diagram of a demodulator for  $y(t)$ . Be sure to indicate the bandwidth of any ideal filters you use in the block diagram.