

## Practice Exam II

### Part I- Short answer questions

1. [5] The transfer function of a system is  $H(s) = \frac{1}{s+2}$ . Which one of the following statements is true for this system?

- a) The system is unstable.
- b) The dc gain for this system is 0.5.
- c) The system behaves like a highpass filter.
- d) The impulse response of this system is  $h(t) = e^{2t}u(t)$ .

2. For the signal  $x(t) = \text{tri}(t)$ , what is  $\int_{-\infty}^{\infty} X(f)df$ ?

- a) 0
- b) 1
- c)  $\frac{1}{2}$
- d) 2

3. For the signal  $x(t) = \cos(200\pi t) + 25\sin(500t)$ , the Nyquist sampling rate is

- a) 1000 radians/sec
- b)  $400\pi$  radians/sec
- c) 250 radians/sec
- d)  $100\pi$  radians/sec

4. Let  $X(f)$  be the Fourier transform of a real signal  $x(t)$ . Then it can be concluded that

- a)  $|X(f)|$  is odd and  $\angle X(f)$  is even.
- b)  $|X(f)|$  is even and  $\angle X(f)$  is odd.
- c)  $|X(f)|$  is even and  $\angle X(f)$  is even.
- d)  $|X(f)|$  is odd and  $\angle X(f)$  is odd.

5. Determine whether the following statements are true or false.

- a) The spectrum of a periodic signal is discrete.
- b) For a periodic signal, if  $\int_{-\infty}^{\infty} x(t)dt = 0$ , then  $X[0] = 0$  in the Fourier series expansion.

- c) The transfer function of the linear differential equation model,  $\frac{d^3 y(t)}{dt^3} + 5 \frac{dy(t)}{dt} + y(t) = 2 \frac{dx(t)}{dt} + x(t-1)$  is  $H(s) = \frac{2s+1}{s^3+5s+1}$ .
- d) The periodic signal  $x(t) = \sum_{k=-\infty}^{\infty} X[k]e^{j2\pi kt}$  is passed through a filter with  $H(f) = \text{rect}\left(\frac{f}{3}\right)$ , the Fourier transform of the output is  $Y(f) = \sum_{k=-1}^1 X[k]\delta(f-k)$ .
- e) If the input to a LTI system is a sinusoid, then the steady-state output of the system is also a sinusoid at the same amplitude.

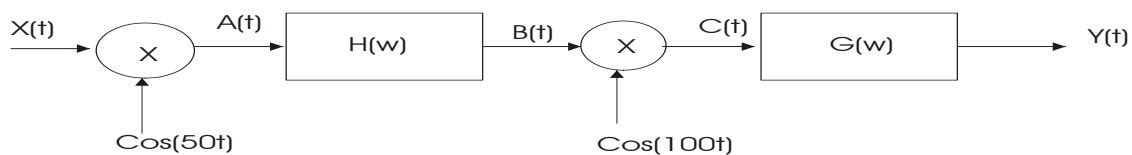
## Part II- Partial Credit Section

1. For the system in the figure, sketch  $A(\omega), B(\omega), C(\omega), Y(\omega)$ .

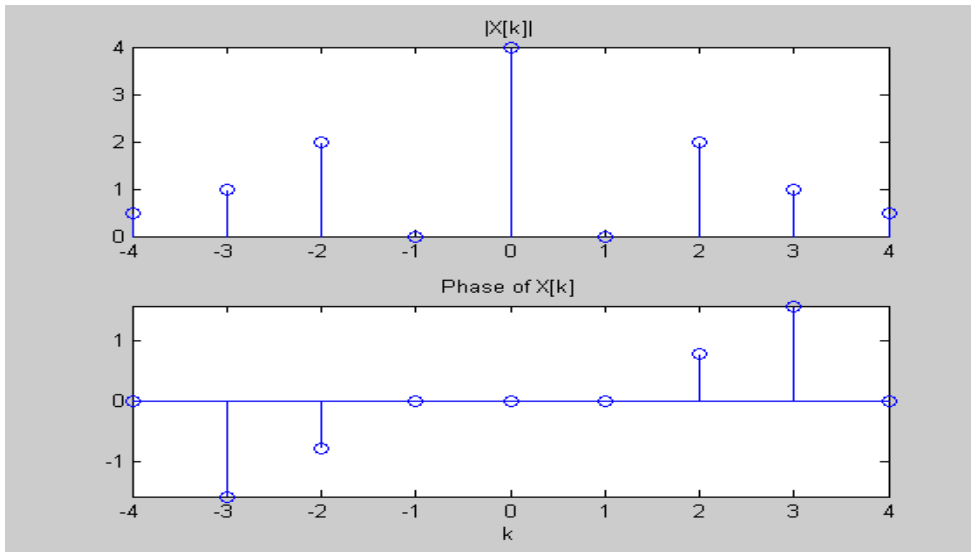
$$X(\omega) = \text{tri}\left(\frac{\omega}{10}\right)$$

$$H(\omega) = \begin{cases} 1, & -50 \leq \omega \leq -40, 40 \leq \omega \leq 50 \\ 0, & \text{otherwise} \end{cases}$$

$$G(\omega) = \begin{cases} 1, & -100 \leq \omega \leq 100 \\ 0, & \text{otherwise} \end{cases}$$



2. For the following Fourier series coefficients;



Note:  $\angle X[2] = 45^\circ$   
 $\angle X[3] = 90^\circ$

- Find the power in the periodic signal.
- Is this signal odd symmetric, even symmetric or neither?
- Assuming that the fundamental frequency of this signal is 10Hz, what is  $x(t)$ ?
- If this signal is passed through an ideal lowpass filter with cutoff frequency 25Hz, what would be the steady-state response?