Practice Exam II Solutions

Part A

1. b

($H(s) = 0.5$ when s=0)

2. b

($\int_{-\infty}^{\infty} X(f)df = x(0) = tri(0) = 1$)

3. b

(The two frequencies in the signal are 200π and 500 radians/sec. Nyquist rate is twice the highest frequency in the signal. Therefore, Nyquist rate of sampling for this signal is 400π)

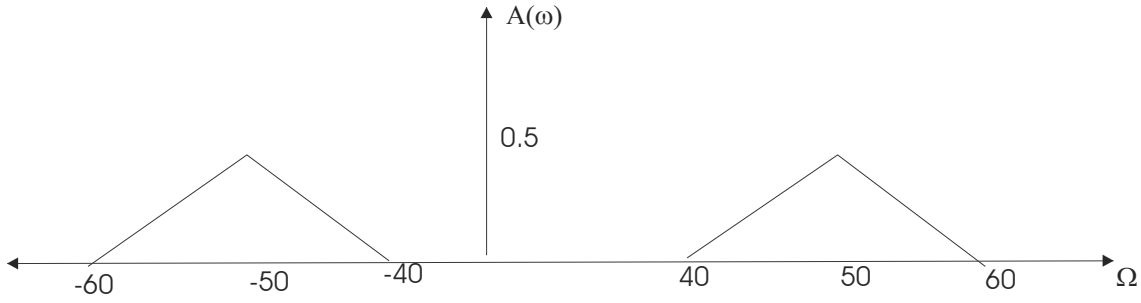
4. b

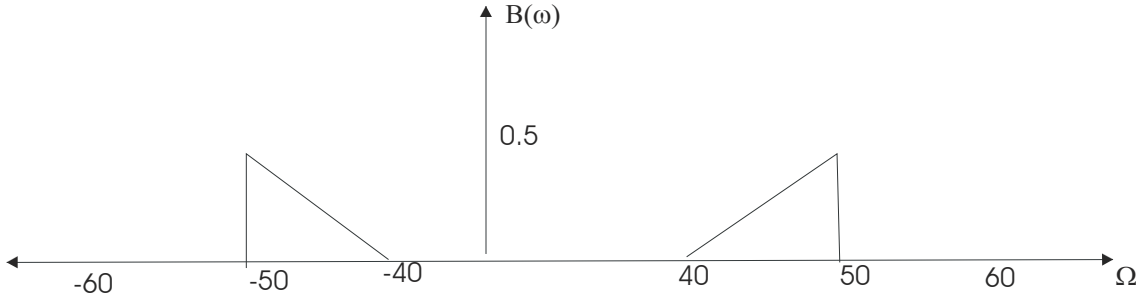
5. T
   T
   (If the average of the signal is zero, X[0]=0)
   F
   (The time-shift in the input should be taken into account.)
   T
   F
   (The output is a sinusoid at the same input frequency.)

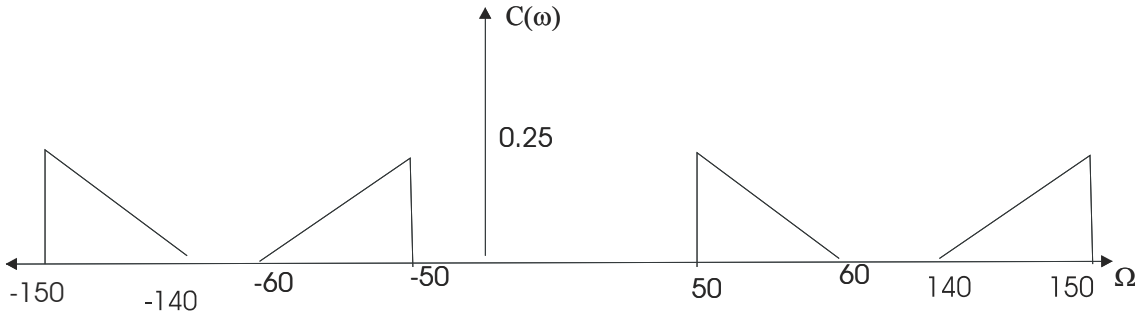
Part B

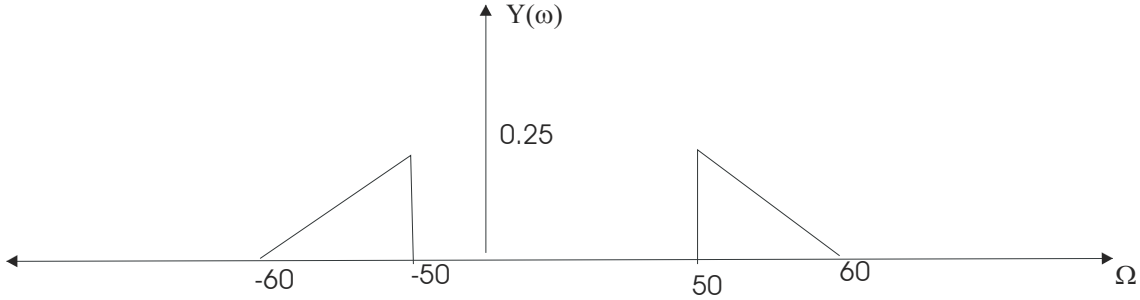
1. Modulation property: $x(t)\cos(\omega_0 t) \leftrightarrow 0.5[X(\omega+\omega_0) + X(\omega-\omega_0)]$

Note that the frequencies are in radians/sec and not in Hz.
Filtering is equivalent to multiplication in the frequency domain.


A(ω)
0.5
-60
-50
-40
40
50
60
Ω


B(ω)
0.5
-60
-50
-40
40
50
60
Ω


C(ω)
0.25
-150
-140
-60
-50
50
60
140
150
Ω


Y(ω)
0.25
-60
-50
50
60
Ω

2. a) $P = \sum_{k=-4}^{4} |X[k]|^2 = 2(0.5)^2 + 2(1)^2 + 2(2)^2 + (4)^2 = 26.5W$

b) Neither, since coefficients are not purely imaginary or real.

c) $x(t) = 4 + 4\cos(40\pi t + 45^0) + 2\cos(60\pi t + 90^0) + \cos(80\pi t)$

d) $y(t) = 4 + 4\cos(40\pi t + 45^0)$

The phase of the filter is zero and the magnitude is one, therefore it passes frequencies up to 25Hz unaffected.