大同大學 九十八 學年度研究所碩士班入學考試題

考試科目：通訊原理　　所別：通訊工程研究所　　

註：本次考試不可以參考自己的書籍及筆記；　不可以使用字典；　可以使用計算器。

1. (15%)Consider the sinusoidal signal：$x(t)=A\cos(w_0t+\theta)$
   (a) Calculate the average power.
   (b) Give the power spectral density $S_x(f)$ of $x(t)$.
   (c) Compute the autocorrelation function $R_{xx}(\tau)$ of $x(t)$.

2. (15%)Consider a nonlinear system with the input-output characteristic
   $$y(t)=a_1x(t)+a_2x^2(t)$$
   and with the input
   $$x(t)=A_1\cos(w_1t)+A_2\cos(w_2t)$$
   What frequencies will be observed in the output $y(t)$? And calculate the amplitudes of the corresponding frequencies.

3. (15%)Given a signal
   $$x(t)=\cos(300\pi t+0.2\pi)-4\sin(250\pi t+0.3\pi)+2\cos(C\cdot\pi t+0.75\pi)$$
   (a) Determine the value of C that make $x(t)$ is periodic.
   (b) What is the fundamental period T of $x(t)$ if the constant C is given as in (a)?

4. (20%)A quadrature modulation system is shown in Fig. prob-4(a). If $x(t)$ is a bandpass signal with bandwidth $2B$ and $H(w)$ is a lowpass filter with bandwidth $2B$, then please sketch the spectrum of $r(t)$, $s(t)$, and $y(t)$. The spectrum of $x(t)$ and the response of $H(w)$ are given in Fig. prob-4(b) and Fig. prob-4(c), respectively.

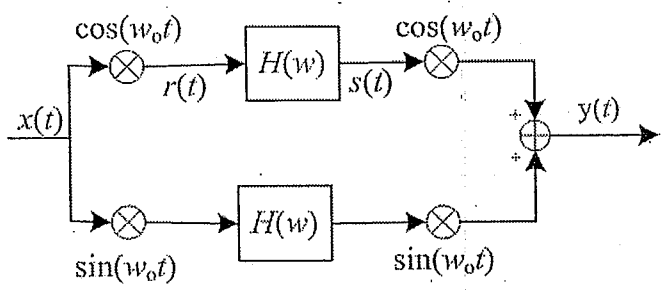


Fig. Prob-4(a)

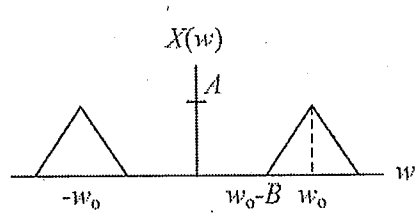


Fig. Prob-4(b)

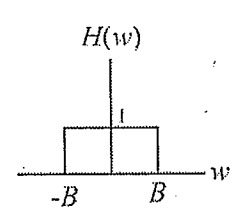
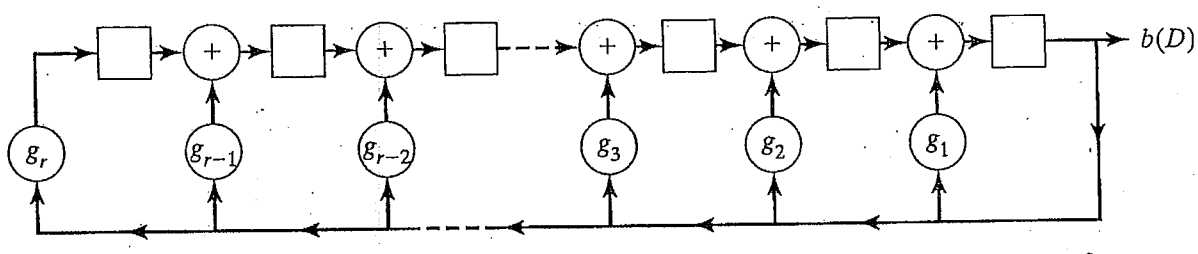


Fig. Prob-4(c)

5. (15%) (a) What is Nyquist bandwidth? (Note that, not to be confused with Nyquist frequency.)
   (b) If the bandwidth of a transmission channel is R Hz, what is the maximum symbol rate that can be transmitted through the channel without intersymbol interference (ISI)?
   (c) If the desired bit rate is $10R$ bits/sec and an M-QAM technique is adopted, what is the value of M?

6. (20%)For a general linear feedback shift-register shown below,



   (a) If the feedback connections and the initial state $a(D)$ are given as [25] and $a(D)=1+D^2$. Please draw the circuit implementation of the linear feedback shift-register.
   (b) Please calculate the output sequence of $b(D)$ by long division of polynomial method. Determine the period of $b(D)$.