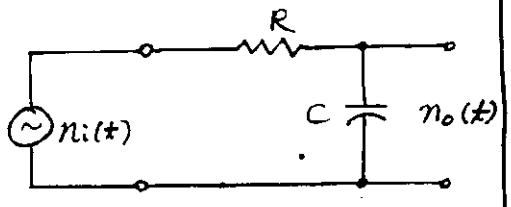
八十五學年度國立台灣工業技術學院研究所碩士班招生考試

所別：電子工程技術研究所　　組別：系統組　　科目：通信系統

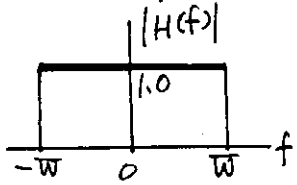
1. (15%) In a communication system, the signal is $s(t) = 20\cos 2\pi t$, Noise of power spectral density $S_n(f) = e^{-3|f|}$ is added to the signal, and the resulting sum forms the input to a filter, $H(f)$.
   (a) Find SNR at the input to the filter.
   (b) If the filter is low-pass with $H(f) = 1$ for $|f| < 2$, find the SNR improvement and express this in decibels.
   (c) If the filter is band-pass with $H(f) = 1$ for $0.9 < |f| < 1.1$, find the SNR improvement and express this in decibels.

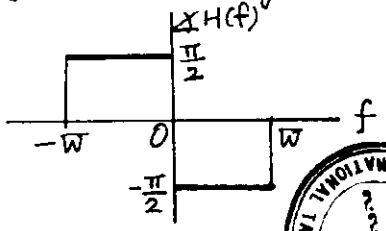
2. (20%) The input to the low-pass RC filter shown in figure is white Gaussian noise with power spectral density $S_{ni}(f) = \frac{1}{2}N_0$, $-\infty < f < \infty$.



   (a) Determine the power spectral density of the output.
   (b) Determine the output autocorrelation function.
   (c) Find the average power at the filter output.
   (d) Determine the probability density function of output voltage.

3. (10%) Consider an ideal low-pass and 90°-phase shifter described by its frequency response $H(f)$ as shown in figure. Find its impulse response, $h(t)$.





4. (10%) An DSB-LC amplitude modulator has the output
   $x(t) = 30\cos 2\pi(200)t + 6\cos 2\pi(180)t + 6\cos 2\pi(220)t$
   Determine the modulation depth (factor) and the power efficiency.

5. (15%) Consider the decayed exponential pulse $g(t) = A\exp(-at)u(t)$, ($u(t)$ is the unit step function)
   (a) Find the energy of the signal $g(t)$.
   (b) Find the percentage of the total energy of $g(t)$ contained inside the frequency band $-W \le f \le W$, when $W = a/2\pi$.
   (c) Find and sketch the signal energy contained inside the frequency band $-W \le f \le W$ in terms of various W.

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6. (15%) Twenty-four voice signals are sampled uniformly, using flat-top sampling operation, and then time-division multiplexed. The sample pulse width is 1 μs. The multiplexing operation includes provision for synchronization by adding an extra pulse of sufficient amplitude and also 1 μs duration. Each voice signal is band-limited to 3.4 kHz.
   (a) Find the frequency response of the equalizer required to compensate for the aperture effect arising from the use of flat-top samples.
   (b) Assuming a sampling rate of 8 kHz, calculate the spacing between successive pulses of the multiplexed signal.
   (c) Repeat your calculation in (b) assuming the use of Nyquist rate sampling.

7. (15%) On the basic binary digital transmission principle, give the reasons for the conclusion that 3dB better noise performance in the sequence of PSK, FSK and ASK (OOK) modulation techniques.