考試科目:**通訊原理**　　　　所別: **通訊工程研究所**　　　第1/1頁

註:本次考試<u>不可以</u>參考自己的書籍及筆記；　<u>不可以</u>使用字典；　<u>可以</u>使用計算器。

1. A received signal is made up of two components, signal and noise.

    $r(t) = s(t) + n(t)$

    Since random amplitude fluctuations are introduced by turbulence in the air, the signal can be considered as a sample of a random process. Assume that both the signal and noise have zero mean value, and they are independent of each other. If the autocorrelation of signal and noise are given as $R_s(\tau) = 2e^{-|\tau|}$ and $R_n(\tau) = e^{-2|\tau|}$, respectively. Please find the autocorrelation and total power of $r(t)$. (10%)

2. A signal $m(t) = e^{-at} u(t)$ is applied to the input of a low-pass filter with a magnitude frequency transfer function $|H(w)| = b/\sqrt{w^2 + b^2}$. Determine the required relations between the constants a and b such that exactly 50% of the input signal energy, on a 1-Ω basis, is transferred to the output. (15%)

3. Assume that the bandlimited function, $s(t)$, with the Fourier transform given in Fig.1(a) is sampled at 19 samples/second. The process shown in Fig.1(b) is a process of low-pass filtering of sampled function. Where the sampling rate is 19 samples/second and $H(f)$ is an ideal lowpass filter with cutoff frequency at 11 Hz. Please sketch the Fourier transforms of the signals at points A, and B in Fig.1(b). (15%)
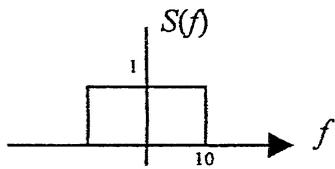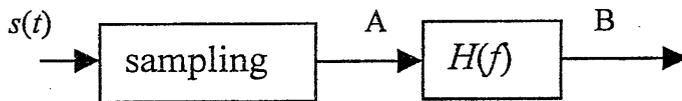

Fig.1(a)　　　　　　　　　　　　Fig.1(b)

4. Consider an audio signal comprised of the sinusoidal term

    $s(t) = 3 \cos 500t$

    (a) Find the signal-to-quantization-noise ratio if this is quantized using 10-bit PCM. (10%)
    (b) How many bits of quantization are needed to achieve a signal-to-quantization-noise ratio of at least 40 dB. (10%)

5. (a) Calulate the minimum required bandwidth for a noncoherently detected orthogonal binary FSK system. The higher-frequency signaling tone is 1 MHz and the symbol duration is 1 ms. (10%)
    (b) What is the minimum required bandwidth for a noncoherently MFSK system having the same symbol duration ? (10%)

6. It is required to transmit telephone message across Taiwan, a 400 km run. The signal level is not to be allowed to drop below 1 mW before amplification and the signal is not to be allowed to be larger than 15 volts in order to avoid amplifier overload. Assuming that the voltage attenuation in the cable is 1 dB/km and repeaters are to be located with equal spacings, then how many repeaters will be required ? (20%)