自觉遵守考场纪律 如考试作弊 此答卷无效

姓名 学号

线 封 密

东 南 大 学 考 试 卷（A卷）

课程名称 通信原理 考试学期 11-12-3 得分

适用专业 信息工程 考试形式 闭卷 考试时间长度 120分钟

（开卷、半开卷请在此写明考试可带哪些资料）

Section A(30%): True or False (Give your reason if False, 3% for each question)

1. If a random process is stationary, it is ergodic; if a Gaussian random process is stationary, then it is also strictly stationary. ( )
2. The random process $X(t)=A\cos(2\pi ft+\varphi)$, is not a wide-sense stationary process, where f is a constant and A and φ are independent random variables uniformly distributed in the ranges (-2, 2) and $(0, 2\pi)$, respectively. ( )
3. AM can improve noise performance via increasing transmission bandwidth. ( )
4. The effect of a small, constant phase error between the incoming carrier and the local oscillator in the coherent demodulation of SSB is overmodulation. ( )
5. The dimension of the power spectral density is in Watts per Hertz. ( )
6. Performance of a PCM system is only affected by quantization noise. ( )
7. Inter-symbol interference can be eliminated by a receiver filter which is matched to the catenation of the transmitter filter and channel. ( )
8. The primary motivation of pulse shaping is to avoid the ISI and to reduce the length of the impulse response. ( )
9. For binary continuous phase FSK modulation scheme, the minimum frequency spacing that allow two FSK signals representing bits 1 and 0 not to interfere with one another is $1/(2T_b)$, where T_b is the bit duration. ( )
10. As for M-FSK and M-PSK, we find that for a fixed probability of error, increasing M results in an increased channel bandwidth and a reduced power requirement. ( )

Section B(30%): Fill in the Blanks (3% for each question)

1. Two primary resources employed in communication systems are _____ and _____.
2. Arrange VSB, SSB, DSB, AM and wideband FM in the decreasing order of bandwidth required for transmission_____. Among these modulation schemes, _____is easiest for demodulation.
3. An single tone FM signal with carrier frequency f_c=1MHz is described by the equation $s(t)=50\cos(2\pi f_c t+5\sin(2000\pi t))$. The frequency deviation Δf is _____, the modulation index β is _____, and the approximate value of the transmission bandwidth B_T is _____.
4. Sampling rate of delta modulator is f_s = 80 KHz, the step size is Δ = 0.1V. The modulator is tested with a 10 kHz sinusoidal signal. To avoid slope overload, the maximum amplitude of this test signal is _____.
5. An analog signal is sampled, quantized and encoded into a binary PCM wave. The number of representation levels used is 2048. A synchronizing bit is added at the end of each codeword representing a sample of the analog signal. The resulting PCM wave is transmitted over a channel of bandwidth 28kHz, using a 8-ary PAM system with raised-cosine spectrum, where the rolloff factor is 0.75. Then, the information is transmitted at the rate _____ (bit/s) through the channel. The analog signal is sampled at the rate f_s=____(Hz). The maximum possible value for the highest frequency component f_H of the analog signal is _ _____ (Hz).
6. The transmission rate of T1 carrier system is _____ b/s.
7. There are eight analog signals, each of bandwidth B=2kHz. Samples of these signals are time-division-multiplexed, quantized and binary-coded. The step size Δ of the quantizer cannot be greater than 0.5% of the peak amplitude m_{max}. Then the minimum number of quantization levels should be_____. The transmission bandwidth B_T is _____ if Nyquist criterion pulse with roll-off factor r=1/3 are used, where the sampling rates must be at least 50% above the Nyqusit rate.
8. In a differential encoding system, a transition denotes symbol 0 and no transition denotes symbol 1. Symbol 1 is used as reference bit. If the binary sequence {0 0 0 0 1 1 0 1 1} is the output of the differential encoder, the original input data is _____.
9. A 1G bytes flash memory is used to store PCM data. Suppose that a VF (voice-frequency) signal is sampled at 8kHz and encoded PCM is to have an average SNR of at least 30dB. _____seconds of VF signal in PCM data can be stored in this flash memory. (Hint: $SNR = 1.5*2^{2R}$)
10. Bandwidth efficiency of 4-ary QAM is ___; bandwidth efficiency of 8-ary 8PSK is _____.

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Section C(40%): Calculations (10% for each question)

1. A stationary, Gaussian process x(t) with zero mean and power spectral density $S_x(f)$ is applied to the filtering scheme shown in Figure 1. The frequency responses of these two filters are shown in Figure 2. The x(t) at the low_pass filter output is denoted by y(t).
   (a) Find the power spectral density and the autocorrelation function of y(t).
   (b) Find the mean and variance of y(t).
   (c) What is the rate at which y(t) can be sampled so that the resulting samples are essentially uncorrelated?

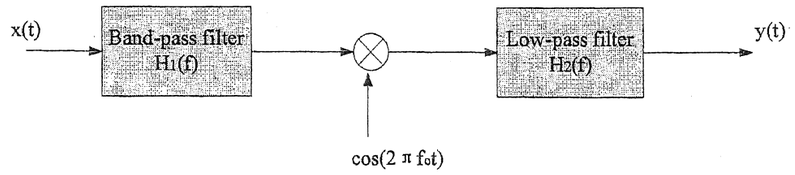


Figure 1(a)

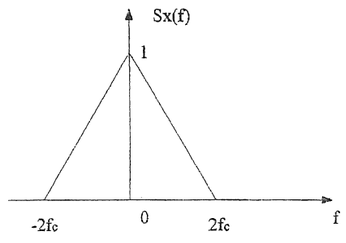
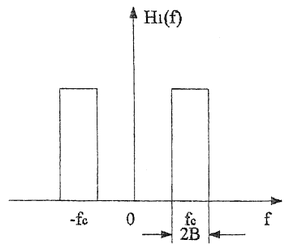


Figure 1(b)



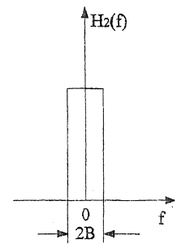
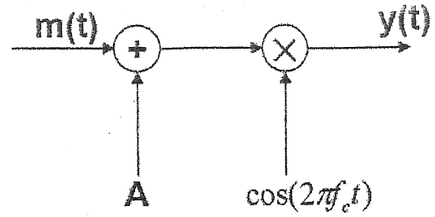


Figure 2

2. Consider the following modulation system:



Assume that a tone message, $m(t) = \cos(20\pi t)$ is transmitted using this modulation system with f_c = 500Hz

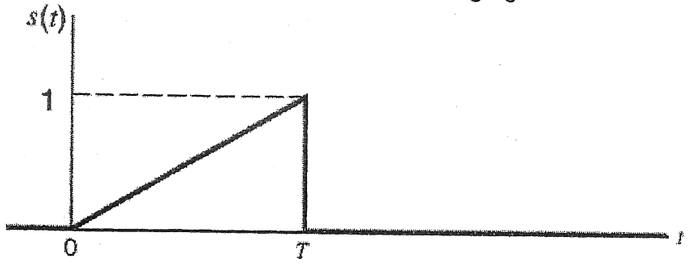
(a) Assuming that A =2
   i) What type of modulation does this correspond to ?
   ii) Sketch the spectrum of the output signal.

(b) Assuming that A =0
   i) What type of modulation does this correspond to ?
   ii) Sketch the spectrum of the output signal.

(c) Assuming that A =0
   i) How would you modify the given modulation system such that the output signal is $y(t) = \cos(980\pi t)$?(hint : you might need to add an additional component to the given system.)
   ii) What type of modulation does this correspond to ?

3. In a certain system, we suppose the 2-ary sequences are first encoded using differential encoding, and then modulated using DSB modulation of which the carrier's frequency is $f_c=1/T_b$, where T_b is the duration of each encoding signal g(t). Assuming the reference bit is 1 and a signal transition is used to designate symbol 0 while no transition is used to designate symbol 1.The amplitude of the differential encoding is A and the probabilities of 0 and 1 are equal.
   (a) Given an incoming binary data stream 01001011, sketch the waveform of the signal after the differential encoding and the waveform of the signal after the DSB modulation.
   (b) According to the generation and detection of the pass-band data transmission, derive the signal-space representation of the output and then give the decision threshold directly.
   (c) Give the coherent receiver's block diagram of the system and the error probability in AWGN channel. The power density function of the noise in channel is $N_0/2$.

4. Consider signal s(t) shown in the following figure



   (a) Determine the impulse response of a filter matched to this signal function of time.
   (b) Sketch the matched filter output as a function of time.
   (c) What is the peak value of the output.