《现代通信技术》半期考试试题（双语，闭卷，卓越工程师班）

考试时间 100 分钟　2024 年 11 月 1 日

学生姓名：_____学号：_____得分：_____

一、 Fill in the Blanks (24%)

1. In a communication system, two primary resources are employed: _____ and _____.
2. There are two main performance measures in communication systems: ____ and _____.
3. Multiplexing is the process of combining several message signals for their simultaneous transmission over the same channel. Three commonly used methods of multiplexing are FDM, _____ and _____.
4. The received signal in communication system includes information-bearing signal, random interference and channel noise, so it is _____ in nature. So we analyze it in terms of average power and _____.
5. For AM wave, if $|k_a m(t)|<1$ for all t, the envelope of modulated signal $s(t)$ is linear with the modulating signal $m(t)$, therefore, we can use ____ to recover the message signal in the receiver. If $|k_a m(t)|>1$ for any t, carrier phase reversals （载波相位反转 ）happen, and this is called as _____.
6. Narrowband Noise n(t) can be represented in terms of envelope and phase. The phase follows _____ distribution, and the envelope follows _____ distribution.
7. A single-tone sinusoidal modulating signal is amplitude modulated (AM), we can get a maximum figure of merit equal to _____. This means that, other factors being equal, an AM system must transmit _____ times as much as average power as a suppressed-carrier system to achieve the same quality of noise performance.
8. In a superheterodyne AM radio receiver, the intermediate-frequency (IF) is 0.455MHz. If the frequency of desired station is 0.8MHZ, then the frequency of image interference is _____.Coherent detector is composed of a product modulator followed by a ____ .
9. A stationary process X(t) is input to a linear time invariant system, the output stationary process is denoted as Y(t). If the power spectral density of X(t) is $S_X(f)$, and the frequency response of the system is H(f), then the power spectral density of Y(t) is _____. If the mean of X(t) is μ_x, then the mean of Y(t) is :_____.
10. If the mean of $m(t)$ is zero, and its power is p , then the power of $x(t)=5[1+m(t)]\cos(2000\pi t)$ is _____; the power of $x(t)=5\cos(2000\pi t+10m(t))$ is _____ .
11. In FM system, the technique of Pre-emphasis and De-emphasis refers to Pre-emphasizing the high-frequency components of the message signal only in the transmitter, and de-emphasizing the high-frequency components of the _____and _____ in the receiver. So the output SNR can be increased effectively.
12. 设一数字传输系统传输二进制码元的速率为 800 波特，则该系统的信息速率是___；若改为传送 16 进制码元，码元速率不变，则这时的信息速率为_____。

二、 名词解释与简答 （20%）

(1) AWGN

(2) Shannon's information capacity theorem

(3) Why does traditional TV signal employ VSB instead of SSB? Why can traditional TV use envelope detector?

(4)对信号 m(t)分别进行 AM、DSB、SSB 以及 FM 和 PM 调制，请写出这五种调制的已调信号时域表示式。

三、（12%）高斯白噪声的功率谱密度 $\frac{N_0}{2}=10^{-9}\ w/\mathrm{Hz}$（瓦特每赫兹），通过一个窄带带通滤波器，输出噪声记为 n(t)。已知该滤波器的中心频率为 100kHZ，带宽为 1kHz。试求：n(t)的功率谱密度和功率；n(t)的同相分量与正交分量的功率谱密度与功率。

四、（16%）画出 AM、SSB 的调制与解调原理框图，并从带宽、功率、抗噪声性能等方面对这两种调制进行分析对比。

五、（16%）A carrier wave of frequency 1000MHz is frequency-modulated by a sinusoidal wave of amplitude 10 volts and frequency $f_m=20kHz$. The frequency sensitivity k_f of the modulated signal is 10kHz per volt.

(1) Determine frequency deviation Δf, and bandwidth of the FM signal by using Carson's rule.

(2) Repeat your calculations, assuming that the amplitude of the modulating signal is doubled.

(3) Repeat your calculations, assuming that the modulation frequency f_m is doubled.

(4) Repeat your calculations, assuming that the carrier wave frequency is doubled.

六、**Design and analysis**（12%）

Consider a modulated signal

$$s(t)=A_c[1+k_a m_1(t)]\cos[2\pi f_c t+2\pi k_f\int m_2(t)dt]$$

Where s(t) is the modulated signal, $m_1(t)$ and $m_2(t)$ are modulating signals.

(1) Design a system that can generate this modulated signal and recover the modulating signals from the modulated signal. Please show the block diagram of the modulator and demodulator.

(2) Analyze the principle of modulation and demodulation.