KATHMANDU UNIVERSITY
End Semester Examination
July/August, 2024

Marks Scored:

Level : B.E.
Year : III

Course : ETEG 320
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date : 28 JUL 2024

SECTION "A"

[20 Q. × 0.5 = 10 marks]

Choose and encircle in the most appropriate option from each set of choices

1. For a message signal $m(t) = 2\cos(6000\pi t)$, the bandwidth of the SSB-SC signal will be
   a. 1500 Hz b. 3000 Hz c. 4500 Hz d. 6000 Hz

2. As compared to standard AM, DSB-SC is
   a. Bandwidth efficient b. power efficient
   c. Simple d. None of the above

3. Which of the following modulation techniques is preferred in TV broadcasting?
   a. Standard AM b. DSB-SC c. SSB-SC d. VSB-SC

4. The local oscillator of the synchronous detector must generate a signal which is synchronized with the carrier signal of the transmitter in
   a. amplitude b. frequency c. phase d. both (b) and (c)

5. The frequency deviation of an FM signal depends on
   a. The amplitude of the message signal
   b. The frequency deviation of the message signal
   c. The phase of the message signal
   d. Both (b) and (c)

6. The phase modulator can be used to generate the FM signal if the message signal is first passed through
   a. A differentiator b. an integrator
   c. a mixer d. a frequency multiplier

7. The maximum frequency deviation allowed in a commercial FM broadcasting is
   a. 55 kHz b. 65 kHz c. 75 kHz d. 85 kHz

8. Non-coherent detection technique is not applicable for
   a. BASK b. BFSK c. BPSK d. both (a) and (b)

9. For 64-ary QAM, a single symbol carries
   a. 1 bit b. 2 bits c. 4 bits d. 6 bits

10. The channel encoder in a digital communication system
    a. Increases the bit rate b. decreases the bit rate
    c. Does not affect the bit rate d. none of the above

11. To reconstruct an analog message signal of frequency 4 kHz from its samples, the number of samples taken per second must be
    a. Equal to 8000 b. Greater than 8000
    c. Less than 8000 d. Greater than or equal to 8000

12. The following system requires minimum transmission bandwidth
    a. PAM b. PCM c. DPCM d. DM

13. For uniform quantization with step size Δ, the average quantization noise power is
    a. Δ^2 b. $12\Delta^2$ c. $\Delta^2/12$ d. $\Delta^2/2$

14. In T1 TDM-PCM telephony system, a T1-multiplexed signal consists of
    a. 20 VF signals b. 24 VF signals c. 30 VF signals d. 34 VF signals

15. The auto-correlation function of a White Gaussian noise is a
    a. Unit step function b. unit impulse function
    c. Exponential function d. none of the above

16. The noise performance of an analog communication system is better if figure of merit is
    a. Equal to 1 b. greater than 1 c. less than 1 d. equal to 0

17. The capacity of an AWGN channel having infinite bandwidth is
    a. infinite b. zero c. finite d. undefined

18. The entropy of an information source producing four symbols with probabilities 0.4, 0.3, 0.2 and 0.1 is approximately
    a. 1.2 bits/symbol b. 1.3 bits/symbol
    c. 1.4 bits/symbol d. 1.5 bits/symbol

19. For a Hamming code, what is the minimum distance required to correct up to 2 errors?
    a. 2 b. 3 c. 4 d. 5

20. Cyclic codes
    a. Obey linearity property b. obey cyclic property
    c. Are a subclass of linear block codes d. all of the above

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Semester : I
F. M. : 40

SECTION "B"
[4 Q. × 10 = 40 marks]

Attempt ANY FOUR questions. Symbols have their usual meanings. Urgent appropriate assumptions are permissible. Marks are indicated inside brackets.

1.
a. Given the message signal $m(t)$ and carrier signal $c(t) = A_c \cos(16 * 10^5 \pi t)$, analyze the standard AM in frequency domain. [4]
b. Discuss the synchronous detection technique to demodulate DSB-SC signal. [4]
c. Justify the use of pre-emphasis network and de-emphasis network in FM. [2]

2.
a. What is single-tone FM? Find its expression for message signal $m(t) = A_m \cos(2\pi f_m t)$ and carrier signal $c(t) = A_c \cos(2\pi f_c t)$. [1+3]
b. b. Determine the bandwidth of a narrow-band FM signal which is generated by a 3.4 kHz audio signal modulating a 98.8 MHz carrier. [2]
c. Why is VSB modulation best suited for TV broadcasting? Explain the working principle of VSB modulator and demodulator. [1+3]

3.
a. How is QPSK superior to BPSK? Describe the process to generate QPSK signal. [1+3]
b. A binary receiver system receives a bit rate of 1 Mbps. The waveform amplitude is 5 mV and the noise power spectral density is $0.5 * 10^{-11}$ W/Hz. Calculate the average bit error probability for ASK, FSK, and PSK. Use erfc table or $erfc(z) = \frac{e^{-z^2}}{\sqrt{\pi z}}$. [4]
c. Find the Nyquist rate and the Nyquist interval for the signal$x(t) = \cos(4000\pi t)\cos(2000\pi t)$. [2]

4.
a. Explain the several components of a PCM system. [4]
b. How is delta modulation better than PCM? Discuss the process of generating a DM signal. [1+3]
c. Describe the equivalent noise bandwidth of a lowpass filter. [2]

5.
a. An information source X generates five symbols x_1, x_2, x_3, x_4, and x_5 with probabilities $P(x_1) = 0.4, P(x_2) = 0.19, P(x_3) = 0.16, P(x_4) = 0.15$, and $P(x_5) = 0.1$. Perform Huffman source coding to generate a code and calculate its efficiency.[3+1]
b. Differentiate between block codes and convolutional codes. The generator polynomial for a $(\mathbf{7}, \mathbf{4})$ cyclic Hamming code is given by $g(D) = 1 + D + D^3$ Determine the systematic code vector for the message block $(\mathbf{1}, \mathbf{0}, \mathbf{1}, \mathbf{0})$. [2+4]