Marks Obtained:

KATHMANDU UNIVERSITY
End semester Examination
August/September 2017

Level : B. E.
Year : III
Course : ETEG 304
Semester : II
Exam. Roll No. :
Time: 30 mins.
F.M. : 10
Registration No.:
Date SEP 0 7 2017

SECTION "A"
[20 Q.× 0.5= 10 marks]

Tick (√) the appropriate answer.

1. In uniform quantization process, _____.
   a. step size remains same
   b. step size varies according to the values of the input signal
   c. quantizer has linear characteristics
   d. quantizer has logarithmic characteristics

2. The characteristics of compressor in μ-law companding are _____.
   a. continuous in nature
   b. logarithmic in nature
   c. linear in nature
   d. discrete in nature

3. One of the disadvantages of PCM is _____.
   a. it requires large bandwidth
   b. noise level is very high
   c. it cannot be decoded easily
   d. complexity of system is very high

4. In digital transmission, the modulation technique, which requires minimum bandwidth, is _____.
   a. PCM
   b. DPCM
   c. PAM
   d. Delta modulation

5. In Delta Modulation, the bit rate is _____.
   a. N times the sampling frequency
   b. N times the modulating frequency
   c. N times the Nyquist criteria
   d. N times the synchronization frequency

6. Matched filter may be optimally used only for _____.
   a. Gaussian noise
   b. Transit time noise
   c. Flicker noise
   d. Pink noise

7. The information rate R for given average information is _____. Assume H = 2 and the signal is analog having band limit B Hz.
   a. 8 B bits/sec
   b. 4 B bits/sec
   c. 2 B bits/sec
   d. 16 B bits/sec

8. The code in convolution coding is generated by using _____.
   a. NAND
   b. AND logic
   c. OR logic
   d. EX-OR logic

9. ASK modulated signal has the bandwidth _____.
   a. same as the bandwidth of baseband signal
   b. half the bandwidth of baseband signal
   c. double the bandwidth of baseband signal
   d. 2N times the bandwidth of baseband signal

10. At a given probability of error, binary coherent FSK is inferior to binary coherent PSK by _____.
a. 6 dB b. 3 dB c. 2 dB d. 0 dB

11. Assume bit rate of digital communication system is R kbps. The modulation used is 32-QAM. Hence, the minimum bandwidth required for ISI free transmission is _____.
a. R/10 Hz b. R/10 KHz c. R/5 Hz d. R/5 KHz

12. A video transmission system transmits 625 picture frames per second. Each frame consists of a 400 x 400 pixel grid with 64 intensity levels per pixel. The data rate of the system is _____.
a. 16 Mbps b.100 Mbps c. 600 Mbps d.6.4 Gbps

13. Flat top sampling of low pass signals _____.
a. gives rise to aperture effect b. implies oversampling
c. leads to aliasing d. introducing delay distortion

14. Increased pulse width in the flat top sampling leads to _____.
a. attenuation of high frequencies in reproduction
b. attenuation of low frequencies in reproduction
c. greater aliasing errors in reproduction
d. no harmful effects in reproduction

15. Four independent massages have bandwidths of 100 Hz, 100 Hz, 200 Hz and 400 Hz, respectively. Each is sampled at the Nyquist rate. Transmission is done using Time Division Multiplexing. The transmitted rate (in Hz) is _____.
a. 1600 b.800 c. 400 d.200

16. A signal is sampled at 8 KHz and is quantized by using 8-bit uniform quantizer. Assuming SNRq for a sinusoidal signal, the correct statement for PCM signal with a bit rate of R is _____.
a. R= 32 $kbps$, $SNRq = 25.8\ dB$
b. R = 64 $kbps$, $SNRq = 49.8\ dB$
c. R= 64 $kbps$, $SNRq = 55.8\ dB$
d. R= 32 $kbps$, $SNRq = 49.8\ dB$

17. A sinusoidal signal with peak to peak amplitude of 1.536 V is quantized into 128 levels using a midrise uniform quantizer. The quantization noise power is _____.
a. 0.768 V^2 b. $48 \times 10{-}6V^2$ c. $12 \times 16{-}6V^2$ d. 3.072 V^2

18. A source alphabet consists of N symbols with the probability of the first two symbols being the same. A source encoder increases the probability of the first symbol by a small amount. After encoding, the entropy of the source will _____.
a. increases b. remains the same c. increases only if N = 2 d. decreases

19. A source generates three symbols with probability 0.25, 0.25, 0.50 at a rate of 3000 symbols p second. Assuming independent generation of symbols, the most efficient source encoder would have average bit rate of _____.
a. 6000 bits/sec b. 4500 bits/sec c. 3000 bits/sec d.1500 bits/

20. A source produces 4 symbols with probability 1/ 2 , 1 /4 , 1/ 8 and 1/ 8. For this source, a practical coding scheme has an average codeword length of 2 bits/symbols. The efficiency the code is _____.
a. 1 b.7/8 c. 1/2 d.1/4

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SECTION "B"

Attempt *ANY FOUR* questions. Missing data may be suitably assumed. Each symbol carries their usual meaning.

1. a. What are the basic constituents of a digital communication system? Explain the fundamental limitations of a digital communication system. [3]
   b. Explain the difference between baseband transmission and band-pass transmission with suitable example. [2]
   c. A band-limited signal x(t) is sampled by a train of rectangular pulses of width τ and period T.[5]
      i. Find an expression for the sampled signal.
      ii. Determine the spectrum of the sampled signal and sketch it.

2. a. Derive an expression for signal to quantization noise ratio for a PCM system, which employs linear (i. e. uniform) quantization technique. Given that, input to the PCM system is sinusoidal signal. [4]
   b. Assume a sine wave of frequency f_m and amplitude A_m applied to a delta modulator having step size Δ. Show that the slop overload distortion will occurs if $A_m > \frac{\Delta}{2\pi f_m T_s}$, Here T_s is the sampling period. [3]
   c. It is required to transmit 90 Mbps data in an authorised bandwidth of 20 MHz. Which modulation techniques would you consider? Explain why? [3]

3. a. Assume that data bit sequence of digital communication system consists of following string of bits, 1 0 1 1 0 1 1 0 1 1 0 0. What will be the nature of waveform transmitted by QPSK transmitter? [2]
   b. In a binary transmission, one of the messages is represented by a rectangular pulse x(t). Another message is transmitted by the absence of the pulse. Evaluate the signal to noise ratio at t = T. Assuming white noise with psd equal to $N_0/2$. Also sketch the impulse response of the matched filter and output of the matched filter. [8]

4. a. A telegraph source having two symbols, dot and dash. The dot duration is 0.2 sec. The dash duration is 3 times the dot duration. The probability of the dot's occurring is twice that of the dash, and the time between symbols is 0.2 sec. Calculate the information rate of the telegraph source. [5]
   b. A Discrete Memory-less Source has an alphabet of 8 letters x_i, where i = 1, 2,... 8 and probability of occurrence of each letters are 0.25, 0.20, 0.15, 0.12, 0.1, 0.08, 0.05 and 0.05 respectively. Determine an optimum binary code for the source. [5]

5. a. For a (6, 3) block codes, [6]
   i. Realize an encoder for code generation.
   ii. Verify that this code is a single error correcting code.
   iii. If the received codeword is 100 011, find the transmitted data word.

   The generator matrix G is given by: $G = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 & 0 \end{bmatrix}$

   b. A Discrete Memory-less Source X has four symbols x_1, x_2, x_3, x_4 with probabilities 0.4, 0.3, 0.2 and 0.1. [1+3]
   i. Calculate H(x)
   ii. Find the amount of information contained in the messages x_1, x_2, x_1, x_3 and x_4, x_3, x_3, x_2 and compare with the H(x) obtained in part (i).