COMMUNICATIONS TEST 4

Number of Questions: 25 **Time: 60 min.**

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. B8ZS line code used
(A) in AMI.
(B) to provide proper synchronization when a long string of 0's has to transmit.
(C) in bipolar NRZ.
(D) All of the above

2. Aperture effect occurs in
(A) Flat Top sampling.
(B) Natural sampling.
(C) Instantaneous sampling.
(D) None of these

3. Statements on Natural sampling
(1) Practically feasible method
(2) Noise interference is minimum
(3) Sampling rate tends to infinity
(4) Aperture effect occurs
True statements is/are
(A) 1 & 2 (B) 1, 2 & 3
(C) 2 & 3 (D) 1 & 4

4. Bit stuffing is used
(A) to tailor the requirement of synchronization.
(B) to accommodate small variations in the input data rates.
(C) to raise the bit rate of incoming digital signal to equal that of a locally generated clock.
(D) All of above

5. Due to the dispersive nature of channel one phenomena occurs and that is
(A) Raised cosine spectrum
(B) Inter symbol interference
(C) Aperture effect
(D) All of the above

6. 3 messages band limited to W, W and $3W$, respectively are of be multiplexing using synchronous Time Division multiplexing. The minimum bandwidth required for transmission of this TDM signal is
(A) 9W (B) 18W
(C) 6W (D) 12W

7. An analog voltage in the range 0 to 6 V is divided in 10 equal intervals for conversion of 4 bits digital output. The maximum quantization error is _____
(A) 0.6 V (B) 0.3 V
(C) 0.03 V (D) 0.06 V

8. In a digital baseband communication system frequencies up to 3400Hz are used for signaling. Raised cosine spectrum is used for zero ISI with 100% excess bandwidth. The maximum possible signaling rate in symbol/sec is
(A) 3400 Hz (B) 6800 Hz
(C) 4000 Hz (D) 5250 Hz

9. Intermediate frequency in superheterodyne receiver is chosen 455 KHz because
(A) To reject image signal
(B) For adjacent channel selectivity
(C) For easy tracking
(D) All of the above

10. If a delta modulator is operating at $64k$ samples/sec then the minimum step size required to avoid the slope overload error is, if $x(t) = 200[r(t) - r(t-1)]$
(A) 2^{-9} (B) 2^{-7}
(C) 2^{-8} (D) 2^{8}

11. Match the list I & list II

List I	List II
NRZ	(i) Bandwidth requirement is less
RZ	(ii) Zero DC component
Split phase Manchester	(iii) Less synchronization
Polar Quaternary NRZ format	(iv) Pulse energy is more

(A) a – iv, b – iii, c – ii, d – i
(B) a – iii, b – iv, c – i, d – ii
(C) a – ii, b – iv, c – iii, d – i
(D) a – i, b – ii, c – iii, d – iv

12. If the input signal $x(t)$ is rectangular pulse of amplitude A with duration T, then the SNR for integrate & dump filter receiver is where E is the energy
(A) $\frac{E}{N_0}$ (B) $\frac{2E}{N_0}$
(C) $\frac{4E}{N_0}$ (D) $\frac{8E}{N_0}$

13. Output of a matched filter is proportional to
(A) shifted version of the autocorrelation function of the input signal to which the filter is matched .
(B) shifted version of the input itself .
(C) input pulse.
(D) None of these

14. A communication channel of bandwidth 90KHz is required to transmit binary data at a rate of 0.1 Mb/s using raised cosine spectrum. The roll off factor α is
(A) 0.9 (B) 0.1
(C) 0.5 (D) 0.8

15. If the required SNR for *PCM* having sampling rate 8000 samples/sec is 30dB and message signal having

spectral component from 300 Hz to 3400 Hz then the minimum number of bits/sample needed are
(A) 5 bits. (B) 4 bits.
(C) 3 bits. (D) 2 bits.

16. A input signal $10\cos(2\pi 500t) + 4\cos 2\pi\,(1000t)$ is sampled at a rate of 58000 samples/sec for DM system. The minimum value of step size which will avoid slope overload distortion is
(A) 0.97V. (B) 0.54V.
(C) 0.43V. (D) None of these

17. For one sample transmission channel bandwidth is high in
(A) PCM system. (B) DM system.
(C) DPCM system. (D) Adaptive DM system.

18. Four analog signal having bandwidths 2400Hz, 1200Hz, 900Hz and 600Hz are sampled at the rate of 4800Hz, encoded with 12 bits word and time division multiplexed. The bit rate for the time division multiplexed signal is
(A) 232.4 k bits/sec. (B) 122.4 k bit/sec.
(C) 230.4 k bit/sec. (D) 120.4 k. bit/sec

19. In a PCM system, the signal $m(t) = 4 \sin (200\ \pi t + 3\cos 200\pi t)$ is sample at Nyquist rate. The samples are following by a uniform quantizer with step size of 0.5V. The minimum data rate of the PCM system in bits/sec is
(A) 100 bits/sec (B) 200 bits/sec
(C) 1 k bits/sec (D) 500 k bits/sec

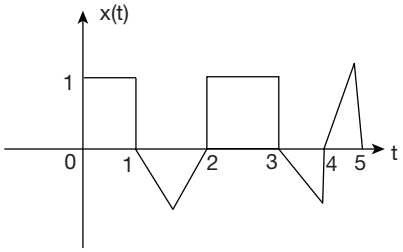
20. The Nyquist sampling rate for the signal $S(t) = \text{sinc}200t\ \text{sin}c700t$ is given by
(A) 1200Hz (B) 900Hz
(C) 600Hz (D) 500Hz

21. A voice signal band limited to 3.5 kHz and peak voltage between +3V to –3V, is sampled at the Nyquist rate. Each sample is quantized and represented by 6 bits
The SNR at quantizer O/P is _____
(A) 12dB (B) 37.76dB
(C) 48dB (D) 60dB

22. A random signal is distributed in between 4V to +4V. SNR required for uniform quantization is 33.5dB. The step size of quantization will be
(A) 250×10^{-3}V (B) 125×10^{-3}V
(C) 500×10^{-3}V (D) 100×10^{-3}V

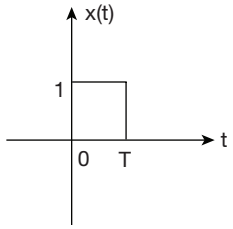
23. A superheterodyne radio receiver with intermediate frequency of 455 KHz is turned to a station operating 1500 KHz. The image frequency will be at
(A) 910 kHz (B) 1045 kHz
(C) 2410 kHz (D) 590 kHz

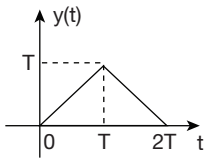
24. A signal $x(t)$ given in figure is applied at the input of matched filter with impulse response $h(t)$. The $h(t)$ is non zero in the internal 0 – 5 sec. The slope of $h(t)$ in the internal $2 < t < 3$ sec is

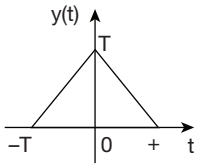


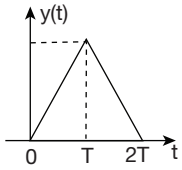
(A) 1 (B) 0
(C) –1 (D) None

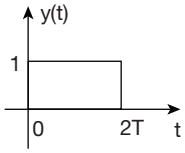
25. A signal $x(t)$ is applied at the input of the matched filter. The output of matched filter will be



(A)


(B)


(C)


(D)


Answer Keys

1. D	**2.** A	**3.** A	**4.** D	**5.** B	**6.** A	**7.** B	**8.** A	**9.** D	**10.** C
11. A	**12.** B	**13.** A	**14.** D	**15.** A	**16.** B	**17.** A	**18.** C	**19.** C	**20.** B
21. B	**22.** B	**23.** C	**24.** B	**25.** A					

Hints and Explanations

1. An case of bipolar NRZ or AMI signal the transmitted signal is equal to zero when a binary '0' is to be transmitted

As per *U.S* T_1 standard, not more than 15 O's can be send with proper synchronization
So when ever more than 0's are come in succession

then they will replace by special sequence
0 0 0 0 0 0 0 0 consecutive zeros
1 0 0 V 1 0 0 V special sequence. Choice (D)

2. Aperture effect occurs in flat top sampling.
Choice (A)

3. In Natural sampling noise interference is minimum & it is practically feasible process
⇒ sampling rate satisfies Nyquist criteria
Aperture effect occurs in Flat top sampling.
Choice (A)

4. digital signals are bit stuffed for synchronization and of accommodate small variations in the input data rates
Synchronization is done via increasing the bit rate of input signal equal to locally generated clock signal.
Choice (D)

5. When the data is transmitted with the dispersive kind of channel then each received pulse is affected some what by adjacent pulses this form of interference is called Inter. symbol interference. Choice (B)

6. $f_{s1} = 2 \times w = 2w$
$f_{s2} = 2 \times w = 2w$
$f_{s3} = 2 \times 3w = 6w$
Because synchronous TDM is used so
$(B.W)_{min}\ B = n \times N \times 2f_m/2$
$= 3 \times 1 \times 2 \times 3 = \frac{18}{2}$ W. = 9W Choice (A)

7. Step size $S = \frac{V_{max} - V_{min}}{No.of\ levels} = \frac{6}{10} = 0.6$V

We know that

Maximum quantization error $= \frac{S}{2} = \frac{0.6}{2}$

= 0.3V. Choice (B)

8. We know that $(1 + \alpha)\ R_b = 2$W
Here $\alpha = 1$
So $2R_b = 2$W
$R_b = W$
$R_b = 3400$Hz. Choice (A)

9. Intermediate frequency 455 KHz in superheterodyne receiver is a compromise between two conflicting factors-
(1) adjacent channel selectivity and easy tracking for which IF should be low
(2) Image signal rejection for which IF should be high. Choice (D)

10. To avoid slope overload error

$\frac{S}{T_s} \geq \frac{d}{dt}\ x(t)$

$S \times 64 \times 1024 \geq 200$

$S \geq \frac{200}{64 \times 1024}$

$S \geq \frac{2^8}{2^6 \times 2^{10}}$

$S \geq 2^{-8}$. Choice (C)

11. NRZ format it is not returning to zero in between the pulse. So pulse width is more and pulse energy is also in more
RZ format: It goes to zero in half at the bit internal. So in Comparision to RZ less synchronization needed even for long string of 1's & 0's
Split phase manchester: For any symbol the pulse takes positive as well as negative value. So zero *DC* component for symbol and for whole code also.
Polar Quaternary: for two bits one symbol is transmitted So band width requirement is less. Choice (A)

12. Energy $E = \int_{-\infty}^{+\infty} x^2(t)dx$

$E = \int_0^T A^2 dt$

So SNR at the output of integrate & dump tilter receiver is

$\left(\frac{S}{N}\right)_0 = \frac{A^2T}{N_0/2} = \frac{2E}{N_0}$. Choice (B)

13. Impulse response of matched filter

$H(t) = \frac{2k}{N_0}\ x(T-t)$

Output $x_0(T) = \frac{2k}{N_0} \int_{-\infty}^{+\infty} |X(f)|^2\ e^{-j2\pi fT}.e^{j2\pi ft}df$

$x_0(T) = \frac{2k}{N_0} \int_{-\infty}^{+\infty} |x(f)|^2\ .e^{j2\pi f(t-T)}df$

$x_0(t) = \frac{2k}{N_0} \int_{-\infty}^{+\infty} |\Psi(f)e^{-j2\pi f(t-T)}\ df$

$x_0(t) = \frac{2k}{N_0} R(t-T)$. Choice (A)

14. $T_b = \frac{1}{0.1} \times 10^{-6} = 10^{-5}$ sec

We know that $1 + \alpha = 2\ F_B T_b$
$= 2 \times 90 \times 10^3 \times 10^{-5} = 180 \times 10^{-2}$; $1 + \alpha = 1.8$
⇒ $\alpha = 0.8$. Choice (D)

15. $\left(\frac{S}{N}\right)_{odB} = 1.76 + 20 \log q \geq 30$

$\text{Log}\ q \geq \frac{1}{20}\ (30 - 1.76) = 1.412$

$q \geq 25.82$
so minimum no. of quantization levels are 26
$n = [\log_2 q] = [\log_2 26]$
= 4.7 = 5 bits/sample. Choice (A)

16. $m(t) = 10\cos(2\pi 500t) + 4\cos(2\pi 1000t) = m_1(t) + m_2(t)$

To avoid slope overload $\left|\frac{dm_1(t)}{dt}\right|_{max} \geq \Delta_1 f_s$

Where Δ_1 = step size

f_s = sampling frequency

$$\Delta_1 \geq \frac{10 \times 2\pi \times 500}{58000} = \frac{10\pi}{58} = 0.54\text{V}$$

$$\text{Now } \Delta_2 = \frac{\left|\frac{dm_2(t)}{dt}\right|_{max}}{f} = \frac{8000\pi}{58000} = \frac{\pi}{58} = 0.43\text{V}$$

Hence larger step size out of two will be the required step size = 0.54V. Choice (B)

17. PCM system have very maximum transmission channel bandwidth for one sample

$\Rightarrow$ In DM uses only one bit/sample

$\Rightarrow$ DPCM uses difference of two sample bits used in PCM

$\Rightarrow$ Adaptive DM is also using one bit/sample.

Choice (A)

18. All the four signals are sampled at 4800Hz

So $f_s = 4800 \times 4 = 19200$Hz

Bit rate $R_b = nf_s$

$= 12 \times 19200 = 230400$Hz

$= 230.4\ k$ bits/sec. Choice (C)

19. $m(t) = 4\sin 200\pi t + 3\cos 200\pi t$

Peak amplitude of $m(t) = \sqrt{25} = 5$

$$\Delta = \frac{V_{max} - V_{min}}{2^n} = Vpp/2^n$$

$$\Rightarrow \quad 0.5 = \frac{10V}{2^n}$$

$$\Rightarrow \quad 2^n = \frac{10}{0.5} = 20$$

$\Rightarrow \quad n = 4.3$

So $n \sim 5$

$R_b = nf_s$

$R_b = 5 \times 200 = 1000$ bits/sec $= 1\ k$ bits/sec.

Choice (C)

20. $$S(t) = \frac{1}{2}\left[\frac{2\sin 200\pi t \sin 700\pi t}{\pi^2 t^2}\right]$$

$$= \frac{1}{2\pi^2 t^2}\left[\cos(500\pi t) - \cos(900\pi t)\right]$$

maximum frequency component

$$f_m = \frac{900\pi}{2\pi} = 450\text{Hz}$$

Nyquist sampling rate

$F_{smin} = 2f_m = 900$Hz. Choice (B)

21. $(SNR)_{dB} \approx 6N + 1.76$

$N = 6$ bits

$SNR = 6 \times 6 + 1.76 = 37.76$ dB. Choice (B)

22. We know that

$(SNR)_{dB} = 1.761 + 6.02N$

$33.5 = 1.761 + 6.02N \Rightarrow 6.02N = 31.739$

$N = 5.27$

$N \approx 6$

$$S = \frac{V_{max} - V_{min}}{2^6}$$

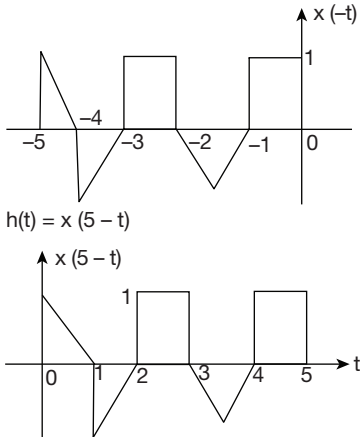
$$= \frac{8}{2^6} = 125 \times 10^{-3}.$$ Choice (B)

23. We know that

$F_{si} = f_s + 2IF = 1500 + 2 \times 455 = 1500 + 910$

$= 2410$ kHZ Choice (C)

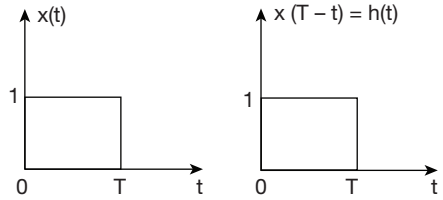
24.



So slope of $h(t)$ in the internal 2 to 3 sec is zero.

Choice (B)

25.



$y(t) = x(t) \otimes h(t)$

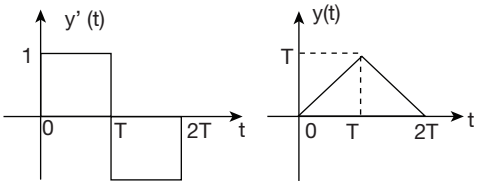
$$y^1(t) = x(t) \otimes \frac{d}{dt}h(t)$$

$= x(t) \otimes [\delta(t) - \delta(t - T)]$

$= x(t) - x(t - T)$

$$y(t) = \int y'(t)\ dt$$

so $y'(t) = y(t)$



Choice (A)