1) Discuss the effect of modulation index (β) of FM bandwidth. Show the spectrum for small β and large f_m and large β and small f_m where f_m is the modulating signal frequency.
2) The pulse rate in a DM system is 56 kbps. The input signal is $5\cos(2\pi 1000t) + 2\cos(2\pi 2000t)$. Find the minimum value of step size which will avoid slope overload distortion. What would be the disadvantage of choosing a value of larger than the minimum?
3) Find the step size delta 'δ' required to prevent slope overload noise for the case when the input signal is a sine wave, in the design of a DM system. Comment on the value of δ to be used to take care of granular noise.
4) A 25 MHz carrier is modulated by a 400-Hz audio sine wave. If the carrier voltage is 4 V and the maximum deviation is 10 kHz, write the equation of this modulated wave for (i) FM and (ii) PM. If the modulating frequency is now changed to 2 kHz, all else remaining constant, write the new equation for (iii) FM and (iv) PM
5) A digital communication system is to carry a single voice signal using linearly quantised PCM. What PCM bit rate will be required if an ideal anti-aliasing filter with a cut-off frequency of 3.4KHz is used at the transmitter and the signal to quantization noise ratio is to be kept above 50dB.
6) What is waveform coding? Explain its salient characteristics. Draw the RZ-Unipolar, NRZ-Bipolar, MANCHASTER, NRZ-Unipolar for the data stream 11100101011.
7) Obtain the transfer function and impulse response of matched filter.
8) What is companding? Why is it used? Why is it preferable to quantizing with tapered steps? Illustrate with typical companding curves.
9) What are the advantages of DPCM? Explain with the help of neat sketches the DPCM transmitter and receiver. How SNR is improved in DPCM compared to PCM.
10) Signals $g_1(t) = 10^4 rect(10^4 t)$ and $g_2(t) = \delta(t)$are applied as the inputs of an ideal low-pass filters $H_1(\omega) = rect(\omega/40000\pi)$ and $H_2(\omega) = rect(\omega/20000\pi)$
11) The output $y_1(t)$ and $y_2(t)$ of these filters as shown in Fig.1 are multiplied to obtain the signal $y(t) = y_1(t)y_2(t)$. Find the Nyquist rate of $y_1(t)$, $y_2(t)$ and $y(t)$.

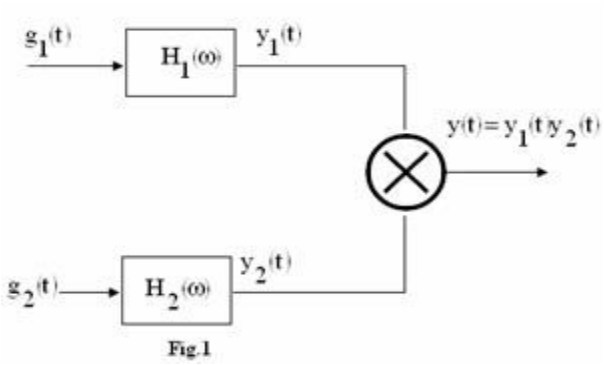


Fig.1

12) Three analog signals, having bandwidths 1200 Hz, 600 Hz, 600 Hz are sampled at their Nyquist rates, encoded with 12 bit words, and time division multiplexed. Find the bit rate for the multiplexed signal.

13) In an FM system, when the audio frequency (AF) is 500 Hz and the AF voltage is 2.4 V, the deviation is 4.8 kHz. If the AF voltage is now increased to 7.2 V, what is the new deviation? If the AF voltage is raised to 10 V while the AF is dropped to 200 Hz, what is the deviation? Find the modulation index in each case.

14) Calculate the percentage power saving when the carrier and one of the sideband are suppressed in an AM wave modulated to a depth of (i) 100 % and (ii) 50%.

15) Consider the cosine wave $g(t) = \cos(2\pi f_0 t)$. Plot the spectrum of the sampled signal $g_\delta(t)$ derived by sampling $g(t)$ at the times $t_n = nT_s$, where n = 0, ±1, ±2, ±3 ..., and $f_s =$ (i) f_0 (ii) $2f_0$.

16) For a sinusoidal signal, illustrate the process of Delta Modulation (DM) both graphically and mathematically. Also draw the block diagrams of DM transmitter and receiver systems. Discuss the limitations of DM.

17) A 20kW carrier wave is amplitude modulated at 80% depth of modulation by a sinusoidal modulating signal. Calculate the sideband power, total power and the transmission efficiency of the AM wave.

18) Eight voice signals, each limited to 4 kHz and sampled at Nyquist rate are converted into binary PCM signal using 256 quantization levels. Compute the bit transmission rate for the time division multiplexed signal.

19) A PCM system uses a uniform quantizer followed by a 7-bit binary encoder. The bit rate of the system is equal to 50×10^6 b/s. (i) What is the maximum message bandwidth for which the system operates satisfactorily? (ii) Determine the output signal to quantization noise ratio when a full load sinusoidal modulating wave of frequency 1 MHz is applied to the input.

20) Explain Quadrature Phase Shift Keying using proper mathematical expressions and using neat signal space diagrams explain the concept of constellation points and decision boundary.

21) With proper mathematical expressions and neat diagrams explain the operation of a correlation receiver.

22) Draw and explain coherent binary phase shift keying transmitter and Receiver. Also plot its constellation diagram and determine minimum distance between its constellation points.

23)

a. Consider the signals $S_1(t), S_2(t), S_3(t)$ and $S_4(t)$ defined as follows.

$$S_1(t) = \begin{cases} 1 \; for \; 0 \le t \le T/3 \\ 0 \qquad otherwise \end{cases} \qquad S_2(t) = \begin{cases} 1 \; for \; 0 \le t \le 2T/3 \\ 0 \qquad otherwise \end{cases}$$

$$S_3(t) = \begin{cases} 1 \; for \; T/3 \le t \le T \\ 0 \qquad otherwise \end{cases} \qquad S_4(t) = \begin{cases} 1 \; for \; 0 \le t \le T \\ 0 \qquad otherwise \end{cases}$$

Using the Gram-Schmidt orthogonalization process find an orthogonal basis for this set of signals.

b. Determine the impulse response of matched filters.

24) Explain the Pre-emphasis and De-emphasis.

25) If the input to a receiver consists of the QPSK signal plus white Gaussian noise and the bit rate is 2400 bits per second, then find the minimum transmission bandwidth required for the communication system.

26)

The ramp signal $x(t) = at$ is applied to a delta modulator that operates with a sampling period T_S and step size $\Delta = 2\delta$.

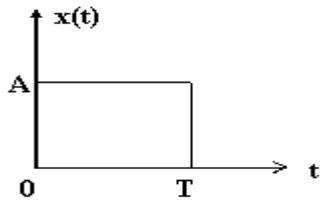
(i) Show that slope-overload distortion occurs if $\delta < aT_{S,}$.

(ii) Sketch the modulator output for the following three values of step size.

- $\delta = 0.75\, aT_S$
- $\delta = aT_S$

27) If the input to a receiver consists of the QPSK signal plus white Gaussian noise and the bit rate is 2400 bits per second, then find the minimum transmission bandwidth required for the communication system.

28) Determine the impulse response and output of Matched filter, if input x(t) is



29) A continuously operating coherent BPSK system has a data rate of 1000 bits/sec. The single-sided noise power spectral density is $N_0 = 10^{-10}$W/Hz. If the value of the received average signal power is adjusted to be 10^{-6} W, What is the average bit error probability?

30) A 100-Hz sinusoid x (t) is sampled at 240 Hz. Has aliasing occurred? How many full periods of x (t) are required to obtain one period of the sampled signal?

31) Consider an audio signal with spectral components limited to the frequency band 300 to 3300 Hz. Assume that a sampling rate of 8000 samples per second will be used to generate a PCM signal. Assume that the ratio of peak signal power to average quantisation noise power at the output needs to be 30 dB.

(i) What is the minimum number of uniform quantisation levels needed? And what is the minimum number of bits per sample needed?

(ii) Compute the bit duration.

32) Consider an FM signal v(t) given by

$v(t) = 10\cos\left(2\pi 10^7 t + 2.405 \sin 2\pi 10^3 t\right) \text{Volt}$ with t in seconds. This signal appears across a 75 Ω resistor. Find

(i) The expression for the modulating signal.

(ii) The index of frequency modulation.

(iii) The bandwidth of the FM signal by Carson's rule.

(iv) The power in the carrier component.

(v) The total power in all the sidebands.