- 1. What are the main procedures to PCM modulate an audio signal?
- A bit stream of 50kbps is transmitted over a telephone line. If binary FSK modulation is applied with a frequency separation of 20kHz, find the bandwidth of the transmit signal.
 plot the amplitude spectrum of the transmitted signal.
- 3. Design a PCM/TDM system to multiplex four 2.4kbps digital inputs signal and two analog inputs that each has a bandwidth of 600Hz. Assume that the analog samples will be quantized into 16 levels.
- 4. What are the main advantages of GMSK that led to its adoption for second generation GSM mobile telephones? Plot a block diagram of GMSK's modulator.
- 5. What are the main procedures to pulse code modulate an audio signal of limited bandwidth (3kHz) such that the first null bandwidth of the resulted PCM signal not exceeds 48kHz.
- 6. An information stream of 9800 bps is transmitted over a telephone line at a center frequency 1800Hz. If ASK modulation is applied,
- 7. find the bandwidth and the spectral efficiency to transmit the desired bit rate
- 8. Plot a block diagram of a demodulator that can perform well over noisy channel.
- 9. PCM/TDM scheme is used to multiplex the signals of 6 users, where four of them have a limited band of 5kHz and the others have a limited band of 7kHz. This scheme produce a signal composed of successive frames using 80 quantization levels. Determine the sampling rate and the bandwidth. Plot a block diagram of the multiplexing scheme. Note: each frame starts and ends with a pattern sequence of 3bits for the synchronization purpose.
- 10. Find the transmitted phase sequence from DPSK modulator, if the information sequence is 101001.
- 11. Can you apply non-coherent demodulation to recover the information in FSK signal? How?
- 12. Consider the given constellation diagramDefine the modulation type and sizeComplete the constellation diagram



If an information bit stream of 3 kb/s is used to modulate a carrier frequency of 5MHz using 8-QAM, find the bandwidth and the spectral efficiency

14. If a narrow band interference signal exists with a DS spread spectrum signal as shown below, how does the system resists?



- 15. \pm 4volt binary signal is transmitted equiprobably over an additive white Gaussian noise channel of zero mean and a variance of $1v^2$. What is the optimum decision threshold level? Next, calculate the probability of error of transmitting such binary transmission.
- 16. The bit stream {0,1,1,0,0,0,1,0} is to be sent through a channel using one of the following line coding schemes. Give the name of each scheme and compare the schemes in terms of bandwidth.



- 17. PCM/TDM scheme is used to multiplex the signals of 8 users, where four of them are limited to band of 5kHz and the others to 9kHz. The TDM signal composed of successive frames with total bandwidth not greater than 450kHz, using 100 quantization levels. Each frame ends with a sequence of 4bits for the synchronization purpose. Plot the whole block diagram, and determine the sampling rate and the bit interval.
- 18. Briefly what are the effects of increasing the constellation size M on the bandwidth, the circuits and the error performance of FSK? Next, plot a block diagram for 4-FSK non-coherent demodulator.

19. A communication system adapts its scheme to transmit only the [O] points when channel is bad and the full constellation when channel is good. The information bit rate is fixed at 4Mbps.



- 20. Define the constellation type and size used for the two channel states.
- 21. How is different the bandwidth and the spectral efficiency under the two channel states?
- 22. Design a PCM/TDM system to multiplex four 300 bits/s digital inputs signal and one analog input that has a bandwidth of 500 Hz. Assume that the analog samples will be quantized into 16 levels.
- 23. List five main features of spread spectrum systems.
- 24. Using a block diagram show CDMA multiplexing of three users?. How can you recover the information signal of the first user at the receiver side?
- 25. Give a signal constellation diagram for 16-QAM with a mapping table (only two examples).
- 26. An information stream of 9800 bps is transmitted over a telephone line at a center frequency 1800Hz. If 8-PSK modulation is applied, find the bandwidth and the spectral efficiency to transmit the desired bit rate plot the amplitude spectrum of the transmitted signal.
- 27. Plot a block diagram of the modulator.
- 28. Two equally likely polar and unipolar signals are shown below. Compare the power consumption and the probability of error of the following signals with binary interval of 100 μ sec. Assume an additive white Gaussian noise with one sided PSD =2*10⁻⁵ Watt/Hz., is presented in the channel.



29. Design TDM/PCM system to accommodate Four analog sources where 32 quantization levels are used to generate the PCM words for each analog source. 5-bit synchronization word is used for each output frame. Assume the sources have the following specifications Source 1 & 2: 3 KHz

Source 3 & 4: 5 KHz

- Find the bandwidth of the multiplexed signal. What is the effect of using a low pass raised cosine filter at the output?
- Find the signal-to-quantization noise ratio.

- 30. An information stream of 9800 bps is transmitted over a cable line at a center frequency 250kHz. If 4-FSK scheme is applied with $\Delta f = 20$ kHz:
- Make a frequency assignment for each of the possible 2-bit data combinations.
- Find the bandwidth of the transmitted signal
- Plot a block diagram of a coherent demodulator scheme.
- 31. What are the main advantages of GMSK that led to its adoption for second generation GSM mobile telephones? Show how GMSK may be generated.
- 32. What are the main procedures to delta modulate an audio signal of limited bandwidth (3kHz)? Find the first null bandwidth of the resulted signal.
- 33. Consider 8-PSK scheme. Sketch the spectrum produced by the schemes when the 3 kb/s modulates a carrier frequency 2 kHz. Find the average transmitted power.
- 34. List the following modulation schemes in ascending order according to error performance: coherent ASK, non-coherent FSK, PSK, DPSK, and MSK.
- 35. 9600 bps transmission over a telephone line is desired. For this purpose the line must be specially conditioned to allow signal transmission over the range 300 to 3000Hz. Show that 16-PSK with 12.5 percent sinusoidal roll off shaping will provide the desired bit rate. The carrier is chosen in the center of the band at 1650Hz.
- 36. Design and plot a block diagram of a TDM system to multiplex four 1.1Kbps digital inputs signal and one analog input that has a bandwidth of 600 Hz. Assume that the analog signal is applied to PCM and quantized into 16 levels. Find the bandwidth at each stage in the system.
- 37. A communication system adapts its scheme to transmit only the [O] points when the channel is bad and the points [] when the channel is good. The information bit rate is fixed at 4Mbps. Define the constellation type and size used for the two channel states. How is different the bandwidth and the power under the two channel states?



- 38. Design and plot a block diagram of a TDM system to multiplex four 1.1Kbps digital inputs signal and one analog input that has a bandwidth of 600 Hz. Assume that the analog signal is applied to DM. Find the bandwidth at the output.
- 39. Plot a block diagram for a DS spread spectrum transmitter and receiver. The information is applied as digital signal. Find the bandwidth of the transmitted signal.
- 40. PCM/TDM scheme is used to multiplex the signals of 6 users, where four of them have a limited band of 5kHz and the others have a limited band of 7kHz. This scheme produce a signal composed of successive frames with total bandwidth **not greater** than 360kHz, using 80 quantization levels. Determine the sampling rate and the bit interval. Note: each frame starts and ends with a pattern sequence of 3bits for the synchronization purpose.
- 41. Find the transmitted phase sequence from the DPSK modulator, if the information sequence is 101001.
- 42. Information bit rate 10kbps is used to phase modulate (BPSK) a carrier frequency. Now we wish to apply FHSS to this PSK scheme, using PN code with chip rate 100kbps. How do you satisfy 20*10³hops/sec?
- 43. Consider an 8-FSK scheme with $f_c = 250$ kHz, $\Delta f = 15$ kHz. Find the bandwidth of the transmitted signal.
- 44. Illustrate either by text or plot, the difference between FDM and FHSS.
- 45. Consider an MFSK scheme with f_c = 250kHz, Δf = 15kHz and M=8:
 Make a frequency assignment for each of the possible 3-bit data combinations.
 - Find the bandwidth of the transmitted signal
- 46. Plot a block diagram of Continuous Phase MFSK modulator and coherent demodulator scheme.
- 47. Find the spectral efficiency of MSK signal. Prove that the phase of MSK signal changes continuously and linearly with time.
- 48. List the multiple access techniques in communication systems you already have studied, and briefly show the main difference(s) between them.
- 49. How OFDM overcomes ISI over wireless channels?
- 50. Assume two users are multiplexed using CDMA where the set of available PN code is: [1,-1,-1,1,-1,1], [1,1,-1,-1,1].

- Plot a block diagram of the CDMA system.
- How can you recover the information signal of the first user at a receiver side? Explain.
- 51. Twenty-three analog signals, each with a bandwidth of 3.4 KHz, are sampled at an 8 KHz rate and multiplexed together with a synchronization channel (8 KHz) into a TDM PAM signal. Draw a block diagram for the system indicating the frequency of the commutator and the overall pulse rate of the TDM PAM signal.
- 52. Rework the earlier problem for a TDM PCM system where an 8-bit quantizer is used to generate the PCM words for each of the analog inputs and an 8-bit synchronization word is used in the synchronization channel.
- 53. Design a TDM PCM system that will accommodate **four** 300 bits/s (synchronous) **digital inputs** and **one analog input** that has a bandwidth of 500 Hz. Assume that the analog samples will be encoded into 4-bit PCM words.
- 54. Design a TDM system that will accommodate **two** 2400 bits/s synchronous **digital inputs** and **an analog input** that has a bandwidth of 2700 Hz. Assume that the analog input is sampled at 1.11111 times the Nyquist rate and converted into 4-bit PCM words. Draw a block diagram for your design and indicate the data rate at various points on your diagram
- 55. Design a time-division multiplexer that will accommodate 11 sources. Assume that the sources have the following specifications: Source # 1: Analog, 2 KHz bandwidth Source # 2: Analog, 4 KHz bandwidth Source # 3: Analog, 2 KHz bandwidth Source # 4-11: Digital, synchronous at 7200 bits/s
- 56. Number of analog signals each bandlimited to 4kHz are sampled, quantized into 64 levels and multiplexed in PCM/TDM scheme with 4 digital signal of data rate 12kbps. The multiplexed signal is transmitted over a cable with a bandwidth 48kHz. Find the number of the analog users in the scheme, and plot a block diagram of the multiplexing scheme.
- 57. A baseband transmission channel has a raised–cosine frequency response with a roll-off factor 0.4. The channel has an (absolute) bandwidth of 120 KHz. An analog signal is converted to binary PCM with 32-level quantization and applied to a binary ASK modulator before being transmitted over the channel. What is the maximum bandwidth of the analog signal?
- 58. An information signal of 96kbps rate modulates a carrier frequency based on 16-QAM. Plot a block diagram of the modulator and provide:
- constellation diagram
- mapping table (with only few enters as examples)

- 59. An information signal of 96kbps rate modulates a carrier frequency based on 16-QAM. Find the bandwidth of the signal at each stage and the spectral efficiency.
- 60. An information signal of 96kbps rate modulates a carrier frequency based on MSK. Find the bandwidth of the signal at each stage and the spectral efficiency.
- 61. An adaptive modulator scheme is used to modulate a carrier signal of 4MHz with an information signal 60kbps. It transmits only the black points when channel is bad and the gray points when the channel is good. **For each channel state**, find

- the modulation type.
- the spectral efficiency.
- the average transmitted power.
- 62. An information stream of 9800 bps is transmitted over a telephone line. If 16-PSK modulation is applied and raised cosine LPF is used in modulator circuit
- find the total bandwidth of the transmit signal if the filter's roll off factor β is 0.4.
- plot the spectrum of the transmitted signal if $\beta=0$.
- 63. Find the transmitted phase sequence from the DPSK modulator, if the information sequence is 101001.
- 64. What is the main objective of a match filter? Show in a block diagram the time domain implementation of the matched filter.
- 65. Assume two users are multiplexed using CDMA where a set of PN code is available: [1,-1,-1,1,-1,1], [1,1,-1,-1,1], [1,1,-1,1,1],
- 66. How can you recover the information signal of the first user at a receiver side? Explain.
- 67. A binary signal 10v or 0v is transmitted with probabilities 0.7 & 0.3 respectively, over 100 kHz bandwidth. Find the optimum decision threshold level at the receiver, if two-sided power spectral density of AWGN 10-5 Watt/Hz is assumed.
- 68. What factors should be considered to choose a line coding? Based on those factors, which of these signals above you would work with
- 69. Design a PCM/TDM system to multiplex four 300 bits/s digital inputs signal and one analog input that has a bandwidth of 500 Hz. Assume that the analog samples will be quantized into 16 levels. Find the signal to quantized noise ratio
- 70. Information bit rate 10kbps is used to phase modulate (BPSK) a carrier frequency. Now we wish to apply FHSS to this PSK scheme, using PN code with chip rate 100kbps. How do you satisfy 20*10³hops/sec? Plot a block diagram for transmitter/receiver scheme.
- 71. Find the impulse response of a matched filter

- 72. What are the effects of increasing the constellation size of M-FSK signaling?
- 73. What is the similarity and difference between GMSK and MSK?
- 74. Show the difference between the following multiple access systems: TDMA, CDMA, FDMA. Then, define an application for each access system
- 75. To use noncoherent detection at a receiver, what modulation type you would recommend at the transmitter?
- 76. Sketch the waveform if Manchester line coding is applied on the bit sequence 110100.
- 77. An analog signal with limited band of 4kHz is converted to binary PCM with 100-level quantization before being used to modulate a carrier signal of 1MHz, and next passed through a raised–cosine low pass frequency response with a roll-off factor 0.4, and next passed through a raised–cosine band pass frequency response with a roll-off factor (0.4). Find the bandwidth of the filter, the bandwidth of the transmitted signal and the spectral efficiency if QPSK is considered.
- 78. List the followings multi-level modulation types in ascending order corresponding to their error performance; 32-PSK, 32-FSK, 32-QAM, 32-DPSK.
- 79. Define briefly GMSK modulation type. Why it is used in GSM cellular telephone systems?
- 80. Depict that DM can be considered as a compression method for the audio signals.
- 81. For the DS/SS scheme illustrated below which type of modulation is preferred to be used? Why?

