ANALOG AND DIGITAL COMMUNICATION

Question Bank

UNIT 1 ANALOG COMMUNICATION

Noise: Source of Noise - External Noise- Internal Noise- Noise Calculation. Introduction to **Communication Systems**: Modulation – Types - Need for Modulation. Theory of Amplitude Modulation - Evolution and Description of SSB Techniques - Theory of Frequency and Phase Modulation – Comparison of various Analog Communication System (AM – FM – PM).

TEXT BOOK: Wayne Tomasi, "Electronic Communication Systems – Fundamental through advanced", 5/e, Pearson Education.

***: Very Very Important **: Important

PART –A

1. What is Modulation?
2. What is the use of Modulation index?
3. What are the types of Analog Modulation Techniques?
4. Define Amplitude Modulation.
5. Define Frequency Modulation.
6. Define Phase Modulation.
7. Define Angle modulation.
8. Define the modulation index for AM, FM and PM.
9. Write the mathematical expressions for Amplitude modulated wave.
10. Write the mathematical expressions for Angle modulated wave.
11. Write the mathematical expression for Frequency Modulated wave.
12. Write the mathematical expression for Phase Modulated wave.
13. What is the function of limiter in FM receiver?
14. Write the relation between carrier power and side band power of an AM-DSBFC signal.
15. In FM as the modulation index increases the required bandwidth also increases. Why?
16. What is capture effect in FM receivers? [Ans: Ability of FM to diminish the effects of interfering signal is called capture effect.]
17. Distinguish between narrow band FM and wideband FM.
18. Draw the frequency spectrum and mention the bandwidth of AM signal.
19. Define amplitude modulation.
20. What is meant by RF?
21. What are the inputs to an amplitude modulator?
22. In an AM communications system, define modulating signal, carrier, modulated wave and AM envelope
23. Describe the upper and lower sidebands and upper, lower side frequencies.
24. What is the highest modulation coefficient and percent modulation possible with a conventional AM system without causing excessive distortion?
25. For 100% modulation what is the relationship between the voltage amplitudes of the side frequencies and the carrier?
26. What effect does modulation have on the amplitude of the carrier component of the modulated signal spectrum?
27. What does AM-DSBFC stand for?

29. What the difference between a coherent and non coherent radio receiver
30. Draw the AM, FM and PM waveforms for a single frequency sinusoidal information signal.
31. Define direct FM and indirect FM.
32. Define direct PM and indirect PM.
33. Define frequency deviation and phase deviation.
34. Describe the relationship between frequency deviation, amplitude and frequency of the modulating signal.
35. Define Carrier Swing.
36. How many sets of side bands are produced when a carrier frequency is modulated by a single frequency input signal?
37. Define low, medium and high modulation index.
38. State Carson's general rule for determining the bandwidth for an angle modulated wave.
39. How is the power of an AM signal and Angle modulated signal distributed?
40. Compare FM and PM.
41. Compare AM and Angle modulation.

Problems (2 Marks)

42. If a10V carrier is amplitude modulated by two different frequencies with amplitudes 2V and 3V respectively, find the modulation index.
43. Find the bandwidth of an AM-DSBFC wave for a carrier frequency fc=100KHz and maximum modulation signal frequency fm=5KHz.
44. Find the carrier power of a AM broadcast radio transmitter that radiates 20KW for which the modulation index is 0.6.
45. For an AM-DSBFC modulator with a carrier frequency of 100KHz and maximum modulating signal frequency of 5 KHz, determine upper and lower sideband frequency and the bandwidth.
46. Determine the power of an AM-DSBFC with peak unmodulated carrier voltage of $Vc=20V_p$ and a load resistance $R_L = 20\Omega$. Assume the modulation index as 0.6.
47. What is the bandwidth required for and FM signal in which the modulating signal is 2 KHz and maximum deviation is 10 KHz.
48. A transmitter supplies 8KW to the antenna when modulated. Determine the total power radiated when modulated to 70%.
49. In an AM transmitter the carrier power is 10KW and the modulation index is 0.5. Calculate the total RF power delivered.
50. In an amplitude modulation system the carrier frequency is fc = 100 KHz. The maximum frequency of the signal is 5 KHz. Determine the lower and upper sidebands and the bandwidth of AM signal.
51. The maximum frequency deviation in an FM is 10 KHz and signal frequency is 10 KHz. Find the bandwidth using Carson's rule and modulation index.

PART – B

1. Explain the principle of Amplitude Modulation and derive an expression for AM-DSBFC signal. Draw the AM waveform and frequency spectrum and explain the voltage distribution. (10) ***
2. Derive the relation between carrier power and sideband power for an AM signal and explain the power distribution. (6) ***
3. Define modulation index for FM and PM and obtain the relation between modulation index and modulating signal for FM and PM. (8) **

4. Distinguish between FM and PM by giving its mathematical analysis. (8)
5. Discuss about the sets of side frequencies produced when a carrier is frequency modulated by a single frequency sinusoid. (8)
6. Explain the bandwidth requirements of angle modulated waves. (8) **
7. Derive an expression for the average power of angle modulated wave. (6)
8. Compare the advantages and disadvantages of angle modulation with amplitude modulation.(8) ***
9. Write short notes on the various types of noise (8) *** / Explain the various types of noise in communication systems (16) ***
10. Explain the various types of Single Side Band communication systems. (8) ***
11. Compare and write the advantages and disadvantages of DSB and SSB systems. (8) ***

Problems (8 and 16 marks)

12. To a conventional AM modulator, one input is a 500KHz carrier with an amplitude of 20 V (peak). The other input is a 10KHz modulating signal that is of sufficient amplitude to cause a change in the output wave of ±7.5V (peak). Determine
    (i) Upper and lower side frequencies.
    (ii) Modulation coefficient and percent modulation.
    (iii) Peak amplitude of the modulated carrier and the upper and lower side frequency voltages.
    (iv) Maximum and minimum amplitudes of the envelope.
    (v) The expression for the modulated wave.
    (vi) Draw the output spectrum.
    (vii) Sketch the output envelope. (14)
13. For an FM modulator with deviation sensitivity K1= 4 KHz/V and a modulating signal $v_m(t) = 10\text{Sin}(2\pi 2000\ t)$, détermine,
    (i) The peak frequency deviation
    (ii) The carrier swing
    (iii) and the modulation index.
    (iv) What is the peak frequency deviation produced if the modulating signal were to double in amplitude. (8)
14. For an FM modulator with a modulation index m=1, a modulating signal $v_m(t) = V_m\text{Sin}(2\pi 1000\ t)$ and an unmodulated carrier $v_c(t) = 10\text{Sin}(2\pi 500Kt)$, determine,
    (i) The number of sets of significant side frequencies,
    (ii) Their amplitudes.
    (iii) Draw the frequency spectrum showing their relative amplitudes. (6)
15. The output of an AM transmitter is given by
    $Vm(t) = 500(1 + 0.4\ \sin 3140t)\sin(6.28x10^7 t)$. Calculate
    (1) Carrier frequency
    (2) Modulating frequency
    (3) Modulation index
    (4) Carrier power if load is 600 Ω.
    (5) Total power.

Question Bank

UNIT 3 DIGITAL COMMUNICATION

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK) Minimum Shift Keying (MSK) – Phase Shift Keying (PSK) – BPSK – QPSK – 8 PSK – 16 PSK - Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital Communication System (ASK– FSK – PSK – QAM).

TEXT BOOK: Wayne Tomasi, "Electronic Communication Systems – Fundamental through advanced", 5/e, Pearson Education.

***: Very Very Important **: Important

PART –A

1. What are the types of digital modulation techniques?
2. What is Amplitude Shift Keying?
3. What is Frequency Shift Keying?
4. What is Phase Shift Keying?
5. What is Binary Phase Shift Keying?
6. What is Quadrature/ Quarternary Phase Shift Keying?
7. What is 8-PSK?
8. What is 16-PSK?
9. What is QAM ?
10. Draw the phasor diagram of BPSK, QPSK, 8-PSK and 16- PSK.
11. Draw the phasor diagram of 8-QAM and 16-QAM.
12. What is the Minimum Nyquist Bandwidth required for ASK and FSK if the input bit rate is f_b (bps).
13. What is the Minimum Nyquist Bandwidth required for BPSK, QPSK, 8-PSK and 16-PSK if the input bit rate is f_b (bps).
14. What is / Define Information capacity?
15. Write the expression for Shannon's limit for information capacity.
16. Draw the ASK, FSK and BPSK waveforms for the data stream 110101.
17. Draw ASK and FSK signals for the binary signal s(t) = 1011001.
18. What are the advantages of QPSK over BPSK?
19. What are the advantages of BPSK over 8-PSK?
20. What are the advantages of QAM over PSK?
21. Define bandwidth efficiency.

Problems (2 Marks)

22. Determine the peak frequency deviation and minimum bandwidth for a binary FSK signal with a mark frequency of 49 KHz, a space frequency of 51 KHz.
23. Determine the Nyquist rate for analog input frequency of (a) 4 KHz, (b) 10KHz.
24. Find the baud and minimum bandwidth required to pass 10 Kbps binary signal using ASK.
25. What is the relation between bit-rate and baud for ASK and FSK systems?
26. A typical dial up phone connection has a bandwidth of 3 KHz and a signal to noise ratio of 3 dB. Calculate the Shannon's Limit for Information Capacity.

PART – B

1. Write the advantages and disadvantages of digital communication over analog communication.(8)**

2. Write about ASK and its bandwidth requirements. (8)

3. With neat block diagrams, explain Binary FSK modulator and demodulator system and discuss the bandwidth requirements. (16) **

4. Explain the generation and detection of BPSK system with the help of block diagrams. Also obtain the minimum double sided Nyquist bandwidth. (16) ***

5. With suitable diagrams explain the operation of QPSK modulator and demodulator. Also explain the bandwidth considerations for QPSK system. [Transmitter, Receiver Block diagram, truth table, phase diagram and constellation diagram] (16) ***

6. Explain the generation and detection of 8-PSK system with the help of block diagrams. Also obtain the minimum double sided Nyquist bandwidth. (16) ***

7. Define QAM. Illustrate the concept of 8-QAM transmitter. [Block diagram, Truth table, Phase diagram, Constellation diagram] (8) ***

8. Compare BPSK, QPSK, 8-PSK and 16-PSK modulation schemes in terms of bandwidth and efficiency. (8) **

Problems (16 Marks)

9. Determine the (1) peak frequency deviation and (2) minimum bandwidth, for a binary FSK signal with mark frequency of 45 KHz and an input bit rate of 3 Kbps. (4)

10. For a BPSK modulator with a carrier frequency of 70 MHz and an input bit rate of 10 Mbps, determine
    (i) Maximum and minimum upper and lower side frequencies
    (ii) Sketch the output spectrum
    (iii) Minimum Nyquist bandwidth and baud rate. (16)
    [This question had been asked for 8 marks, 12 marks, 16 marks in the university exam]

11. For a QPSK modulator with an input data rate equal to 12 Mbps and a carrier frequency of 100 MHz, determine the following
    (i) Minimum double sided Nyquist bandwidth
    (ii) Baud rate
    (iii) Sketch the output spectrum (8)

12. For a QPSK modulator with an input data rate equal to 10 Mbps and a carrier frequency of 75 MHz, determine the minimum double sided Nyquist bandwidth.(4)

13. Determine the bandwidth and baud for an FSK signal with a mark frequency of 32KHz, a space frequency of 24KHz and a bit rate of 4Kbps. (3)
14. Define bandwidth efficiency. For an 8-PSK system, operating with information bit rate of 24 kbps, determine (i) Baud (ii) Minimum bandwidth (iii) Bandwidth efficiency. (4)

Question Bank

UNIT 2 DATA AND PULSE COMMUNICATION

Data Communication: History of Data Communication - Standards Organizations for Data Communication- Data Communication Circuits - Data Communication Codes - Error Detection and Correction Techniques - Data communication Hardware - serial and parallel interfaces.
Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM) - Comparison of various Pulse Communication System (PAM – PTM – PCM).

TEXT BOOK: Wayne Tomasi, "Electronic Communication Systems – Fundamental through advanced", 5/e, Pearson Education.
***: Very Very Important **: Important

PART –A

1. Write any four Standards Organizations for Data Communication.
2. Write any four data communication codes.
3. Write the various modes of Data communication.
4. Write about Simplex , Half Duplex and Full Duplex modes of Data communication.
5. Define odd parity and even parity.
6. What is VRC and LRC.
7. What is forward error correction?
8. What is CRC?
9. What is DTE?
10. What is DCE?
11. List the features provided by serial interface.
12. What are the four most common methods of pulse modulation techniques?
13. What is PAM?
14. What is PWM?
15. What is PPM?
16. What is PCM?
17. Draw the block diagram of a PCM system.
18. What is the purpose of sample and hold circuit.
19. Define aperture error and acquisition time.
20. Compare natural sampling and flat top sampling.
21. Define droop. What causes it?
22. State Nyquists Sampling Theorem.
23. What is fold over distortion or aliasing? When does it occur?
24. Define quantum, quantization and quantization error.
25. Define coding efficiency.

PART – B

1. Explain the advantages and disadvantages of digital transmission. (6)***
2. Write short notes on the history of data communications and about the standards and organizations for data communication. (16)
3. Write short notes on data communication codes. (8) ***
4. Explain the various Error Detection techniques. (16) ***
5. Explain the various Error Correction techniques. (8) ***
6. Describe the processing steps to convert a „k" bit message word to „n" bit codeword (n>k). Introduce an error and demonstrate how error can be corrected with an example. [Nov/Dec2012] ***
7. Describe the physical, electrical and functional characteristics of RS 232 interface [Serial-Interface] (10) ***
8. Describe the features and purposes of serial interfaces. (6) ***
9. With neat block diagram explain the concept of UART transceiver operation.(16) [serial to parallel and parallel to serial interface] ***
10. What are parallel interfaces? Describe in detail about Centronics parallel interfaces.(8)[parallel interface] ***
11. Explain in detail the characteristics of IEEE 488 Bus.(10) [parallel interface] ***
12. With neat block diagram explain the generation and detection of PAM signals. ***
13. Draw and explain the Sample and Hold circuit.(8) ***
14. Compare natural sampling and flat top sampling. (6) ***
15. With neat block diagram explain the generation and detection of PWM and PPM signals (16) ***
16. With neat block diagrams explain the transmitter and receiver of Pulse Code Modulation (PCM) system.(8) ***
17. Compare the various pulse communication systems (8) ***

ALL THE SOLVED PROBLEMS IN THE TEXT BOOK – Wayne Tomasi. CHAPTER-10

Question Bank

UNIT 4 SOURCE AND ERROR CONTROL CODING

UNIT IV: SOURCE AND ERROR CONTROL CODING (9)

Entropy, Source encoding theorem, Shannon fano coding, Huffman coding, mutual information, channel capacity, channel coding theorem, Error Control Coding, linear block codes, cyclic codes, convolution codes, viterbi decoding algorithm.

TEXT BOOK:

1. Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons, 2004
3. H.Taub, D L Schilling and G Saha, "Principles of Communication", 3rd Edition, Pearson Education, 2007.

***: Very Very Important **: Important

PART –A

1. State Shannon's Theorem.
2. State Shannon's fundamental theorem of Information theory.
3. Define Entropy.
4. State the difference between source coding and channel coding.
5. Mention any two error control codes.
6. Define Hamming Code.
7. Given a 4 bit code d = [1011] message, if a linear systematic (7,4) code is generated with redundancy bits r = [100], form the 7 bit code.
8. Distinguish between random error and burst error.
9. What is the code rate of a convolutional encoder?
10. Compare Block code and Convolution code.
11. What are the properties of Cyclic Codes?

PART –B

1. Explain the terms Average Information and Information Rate (8)***
2. An analog signal is band limited to 4000 Hz, Sampled at Nyquist Rate and samples are quantized into 4 levels Q_1 , Q_2 , Q_3 , Q_4 are assumed to be independent and occur with probabilities $P_1 = P_4 = 1/8$, $P_2 = P_3 = 3/8$, find the information rate of the source.(8) **
3. Let X be a discrete random variable taking values $x_1, x_2, x_3, \ldots\ldots, x_m$, with probabilities $p_1, p_2, p_3, \ldots\ldots, p_m$. Define entropy H(X) and Information rate R. If X takes 4 values x_1, x_2, x_3, x_4, with probabilities 1/8, 3/8, 3/8, 1/8, what is the information rate R if the source rate is 100 symbols per second. (8) **
4. An analog signal band limited to 10 khz is quantized in 8 levels of PCM system with probabilities of 1/4, 1/5, 1/5, 1/10, 1/10, 1/20, 1/20 and 1/20 respectively. Calculate the entropy and the rate of information. (10) **
5. For a discrete message source transmitting 4 messages with probability ¼, ¼, ¼, ¼ determine the entropy of the source. (8) ***
6. Write a note on Channel capacity. (6)

7. Define Channel capacity and derive channel capacity for binary symmetric channel. (8) ***

8. Derive an expression for channel capacity. (8) ***

9. Mention the source coding theorem. Consider five messages S0, S1, S2, S3, S4 given by the probabilities 1/2 , 1/4, 1/8, 1/16, 1/16. Use Shannon –Fano algorithm and Huffman coding algorithm to develop an efficient code. Compare the coding efficiency(16) ***

10. Given the Parity Check matrix H of a (7,4) code ***

    Hamming Code H = $\begin{bmatrix} 1110 & 100 \\ 1101 & 010 \\ 1011 & 001 \end{bmatrix}$

    Show that $GH^T = 0$ where G is the generator matrix.
    Also find the code for 4 bit message 1101. (8)

11. Consider (6, 3) linear block code with generator matrix ***

    G = $\begin{bmatrix} 100 & 011 \\ 010 & 101 \\ 001 & 110 \end{bmatrix}$

    (a) Find the parity check matrix H.
    (b) Determine the code word corresponding to the message u = (1 0 1)
    (c) What is the minimum distance of the code? (3 + 2 + 3)

12. Explain in detail about Repeated Code (8) **

13. Write short notes on burst error correcting code. (8)

14. Explain in detail about Cyclic code. (8) ***

15. Explain convolutional encoder with an example (8) **

16. With an example explain the generation of convolutional codes. (8)

17. What are the various methods of convolutional decoding? Explain any one method in detail. (8)

18. With suitable example explain Viterbi Decoding Algorithm. ***

Question Bank

UNIT 5 MULTI-USER RADIO COMMUNICATION

UNIT V: MULTI-USER RADIO COMMUNICATION (9)

Advanced Mobile Phone System (AMPS) - Global System for Mobile Communications (GSM) – Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse - Channel Assignment and Hand - Overview of Multiple Access Schemes - Satellite Communication - Bluetooth.

TEXT BOOK:

1. Wayne Tomasi, "Advanced Electronic Communication Systems", 6th Edition, Pearson Education, 2009.
2. Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons, 2004
3. H.Taub, D L Schilling and G Saha, "Principles of Communication", 3rd Edition, Pearson Education, 2007.

***: Very Very Important **: Important

PART –A

1. What is meant by multiple access? What are the different types of multiple accessing techniques?
2. What is the difference between multiple access and multiplexing?
3. List the advantages of Digital TDMA multiple accessing system over Analog AMPS-FDMA multiple accessing system.
4. Write the full form of PCS, AMPS, GSM, ISDN.
5. Define TDMA and FDMA.
6. Define CDMA and SDMA.
7. What is cellular radio?
8. What is frequency reuse?
9. What is co-channel interference?
10. Write the significance of co-channel reuse ratio.
11. What is near-far-effect?
12. What are the methods by which the capacity of a cellular telephone system can be increased?
13. What is cell splitting?
14. What is meant by sectoring?
15. What is hand-off or handover?
16. What are the basic processes involved in hand-off process?
17. What is multi path propagation?
18. Define Doppler shift.
19. What is GSM and IS-95.
20. Draw the frame structure of GSM.
21. Give one example each for TDMA and CDMA wireless communication systems.

PART –B

1. Write short notes on Advanced Mobile Phone System (AMPS). (8)
2. Write short notes on Global System for Mobile Communications (GSM). (8) ***
3. Write short notes on Code division multiple access (CDMA). (8) ***
4. Write short notes on Cellular Concept and Frequency Reuse. (8) ***
5. Write short notes on Channel Assignment and Hand over. (8)
6. Write short notes on Satellite Communication. (8) ***
7. Write short notes on Bluetooth. (8) ***
8. Write short notes on multiple access techniques. (8)
9. Compare various multiple access techniques.[TDMA, FDMA, CDMA] (8) ***
10. Compare the merits and demerits of TDMA and FDMA multiple access schemes. (8)
11. Explain TDMA and CDMA wireless communication systems, with typical examples for each. [OR Explain GSM and IS -95] [OR Explain TDMA and FDMA methods used in wireless communicatio] [Nov/Dec 2012] (8) ***
12. Explain in detail about CDMA. (8) [May/June 2012]
13. Write the advantages and disadvantages of geosynchronous satellites.(8)
    [refer page 1005 of Wayne Tomasi, “Electronic Communication Systems – Fundamentals Through Advanced”, 5th Edition, Pearson Education, 2009]