Digital Communication Important Questions PDF

Digital Communication usually covers sampling, quantisation and PCM with delta modulation, baseband transmission and ISI, digital modulation (ASK, FSK, PSK, QPSK, QAM), information theory and source coding, and error control coding. Common numericals are PCM bit rate and SQNR, raised cosine bandwidth, BER and bandwidth comparisons, entropy, Huffman coding, Shannon capacity and Hamming codes.

Key takeaways

- Waveform coding: sampling, quantisation, PCM bit rate, SQNR, DPCM, delta and adaptive delta modulation, line codes.
- Baseband transmission: ISI, Nyquist criterion, raised cosine pulses, eye diagram and matched filter.
- Digital modulation: ASK, FSK, BPSK, QPSK, MSK and QAM, with bandwidth and error probability.
- Information theory and coding: entropy, Huffman coding, channel capacity, Hamming, cyclic and convolutional codes.
- These are practice questions based on common syllabus topics, not verified past papers.

About these important questions

These are **practice questions** built from topics that appear in most Indian B.Tech syllabi for Digital Communication, including AKTU and universities that follow the AICTE model curriculum. They are **not verified past papers**, and we do not claim that any question will appear in your exam. Unit numbers and topic order differ between universities, so first match each unit below with your own university syllabus. For real previous papers, use your university's official archive. AKTU students can download them from the AKTU old question paper page.

Each unit lists key definitions, derivations or theory questions, numericals with short answer outlines, and long-answer questions. Use the outlines to check your method, then write full solutions yourself.

Unit 1: Sampling, Quantisation and Waveform Coding

Key definitions: sampling, quantisation, uniform and non-uniform quantisation, companding (μ-law and A-law), PCM, DPCM, delta modulation, slope overload, granular noise, adaptive delta modulation, line codes (NRZ, RZ, Manchester, AMI).

Results to remember: PCM bit rate = n x fs; for a sinusoid, SQNR ≈ 1.76 + 6.02n dB, so each extra bit adds about 6 dB.

Numericals (answer outline):

- Telephone speech sampled at 8 kHz with 8 bits per sample. Find the bit rate. Answer: 64 kbps.
- Find the number of bits needed for an SQNR of at least 40 dB. Outline: 1.76 + 6.02n ≥ 40 gives n = 7.
- Find the minimum step size to avoid slope overload in delta modulation: Δ x fs ≥ maximum slope of the signal, which is 2πfmAm for a sinusoid.
- Find the bandwidth needed for a TDM-PCM system with a given number of channels.

Long-answer questions: Explain a PCM transmitter and receiver with a block diagram. Compare PCM, DPCM and DM. Draw the waveforms of NRZ, RZ, Manchester and AMI line codes for a given bit stream.

Unit 2: Baseband Transmission

Key definitions: intersymbol interference (ISI), Nyquist criterion for zero ISI, Nyquist bandwidth, raised cosine spectrum, roll-off factor, eye diagram, matched filter, equalisation.

Numericals (answer outline):

- Find the minimum bandwidth for 10 kbps binary data with zero ISI. Answer: Rb/2 = 5 kHz.
- With a raised cosine roll-off α = 0.5, find the bandwidth for the same data. Answer: (Rb/2)(1 + α) = 7.5 kHz.

Long-answer questions: Derive the impulse response of a matched filter and show that it maximises the output SNR. Explain the eye diagram and what its opening tells you about timing and noise margins.

Unit 3: Digital Modulation Techniques

Key definitions: ASK, FSK, BPSK, DPSK, QPSK, offset QPSK, MSK, M-ary PSK, QAM, coherent and non-coherent detection, signal space and constellation diagram.

Results to remember: probability of bit error for coherent BPSK is Pe = Q(√(2Eb/N0)); coherent FSK needs about 3 dB more Eb/N0 than BPSK for the same error rate; QPSK has the same bit error probability as BPSK but needs half the bandwidth for the same bit rate.

Important questions:

- Explain the generation and coherent detection of BPSK, with waveforms.
- Explain QPSK with a constellation diagram and compare its bandwidth with BPSK.
- Explain DPSK and why it does not need a coherent carrier at the receiver.
- Compare ASK, FSK and PSK in terms of bandwidth, error probability and complexity.
- Draw the constellation of 16-QAM and explain why it is used for high data rates.

Unit 4: Information Theory and Source Coding

Key definitions: information content I = log2(1/p), entropy, information rate, joint and conditional entropy, mutual information, channel capacity, source coding theorem, Shannon-Hartley theorem, coding efficiency.

Numericals (answer outline):

- A source emits four symbols with probabilities 1/2, 1/4, 1/8 and 1/8. Find the entropy. Answer: H = 0.5(1) + 0.25(2) + 2 x 0.125(3) = 1.75 bits/symbol.
- Find the Huffman code for the same source and its efficiency. Answer: code lengths 1, 2, 3, 3, average length 1.75 bits, efficiency 100%.
- A channel has B = 3 kHz and SNR = 1023 (about 30 dB). Find the capacity. Answer: C = 3000 x log2(1024) = 30 kbps.
- Find the capacity of a binary symmetric channel with crossover probability p: C = 1 - H(p).

Long-answer questions: Derive the entropy of a binary source and show that it is maximum at p = 0.5. Explain Shannon-Fano and Huffman coding with an example.

Unit 5: Error Control Coding and Spread Spectrum

Key definitions: linear block codes, generator and parity check matrices, syndrome, Hamming distance, minimum distance, Hamming codes, cyclic codes, generator polynomial, convolutional codes, trellis diagram, Viterbi decoding, spread spectrum, DSSS, FHSS, processing gain.

Results to remember: a code with minimum distance dmin can detect dmin - 1 errors and correct $\lfloor (d_{min} - 1)/2 \rfloor$ errors. The (7, 4) Hamming code has dmin = 3, so it corrects one error.

Numericals (answer outline):

- For a given (7, 4) generator matrix, find all codewords, the parity check matrix and the syndrome of a received word, and correct the error.
- Find the codeword of a (7, 4) cyclic code for a given message using the generator polynomial $g(x) = 1 + x + x^3$.
- Draw the state diagram and trellis of a rate 1/2 convolutional encoder and decode a received sequence with the Viterbi algorithm.

Long-answer questions: Explain DSSS and FHSS, their processing gain and their resistance to jamming.

How to score well in Digital Communication

- Draw block diagrams for PCM, DM and each modulator and detector. They carry many marks.
- Learn the BER and bandwidth table for ASK, FSK, BPSK and QPSK.
- For coding questions, show the matrix work clearly: G, H, the codewords, the syndrome and the corrected word.
- For entropy and Huffman questions, write the probability table and the code tree.

Short-answer (2-mark) questions for Digital Communication

Short questions test definitions and one-line results. Practise answering each in two to four lines:

1. State the sampling theorem.
2. What is quantisation noise?
3. What is companding?

4. What causes slope overload in delta modulation?
5. What is ISI?
6. State the Nyquist criterion for zero ISI.
7. What is a matched filter?
8. Why is QPSK more bandwidth efficient than BPSK?
9. Define entropy of a source.
10. State the Shannon-Hartley theorem.
11. What is the Hamming distance between 1011 and 1110? (Answer: 2.)
12. What is processing gain in spread spectrum?

A 7-day revision plan for Digital Communication

Use this plan in the last week before the exam. Adjust it to the units and weightage in your own syllabus.

- **Day 1 (Unit 1, Sampling, Quantisation and Waveform Coding):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 2 (Unit 2, Baseband Transmission):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 3 (Unit 3, Digital Modulation Techniques):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 4 (Unit 4, Information Theory and Source Coding):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 5 (Unit 5, Error Control Coding and Spread Spectrum):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 6:** attempt one full three-hour practice paper made from these questions, or an official previous paper from your university archive.
- **Day 7:** go through your formula sheet, the short-answer list and every question you got wrong in the practice paper.

Frequently asked questions

Which topics in Digital Communication are most scoring?

Information theory numericals (entropy, Huffman coding, channel capacity) and linear block codes follow fixed methods and are scored easily. PCM and DM numericals are also common.

How do I prepare digital modulation for the exam?

For each scheme, learn the waveform, block diagram of the modulator and detector, constellation, bandwidth and bit error probability. A comparison table helps with short and long answers.

Is Digital Communication useful for jobs?

Yes. It is part of the GATE ECE syllabus and is the base for telecom, networking, embedded systems and signal processing roles. Coding and information theory ideas also help in data compression and machine learning.

Are these questions from real past papers?

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