



EEEN 464 – DIGITAL COMMUNICATION
LINE CODING – TEST YOUR KNOWLEDGE

SECTION 1: FUNDAMENTALS

1. What is line coding?

- a) Converting analogue signals to digital
- b) Mapping binary data to voltage/light pulses for transmission**
- c) Compressing data for efficient storage
- d) Encrypting data for security

Explanation: Line coding transforms binary bits (0s/1s) into physical signals (e.g., voltage levels) to send over wires or fiber optics.

2. Why is synchronization important in line coding?

- a) To reduce bandwidth usage
- b) To ensure the receiver correctly samples bits**
- c) To increase transmission voltage
- d) To encrypt data

Explanation: Without synchronization, the receiver can't distinguish where one bit ends and another begins, causing errors.

3. The absence of a DC component in a line code helps:

- a) Increase transmission speed
- b) Prevent signal distortion in transformers/capacitors**
- c) Simplify encoding logic
- d) Reduce error rates

Explanation: DC components cause signal drift and are blocked by components like transformers.

4. True or False: Bit rate and baud rate are always equal.

- False**

Explanation: Bit rate = data speed (bps); Baud rate = signal changes/sec. They differ in multi-level schemes (e.g., 2 bits/symbol).

5. A "self-clocking" line code:

- a) Uses an external clock signal
- b) Embeds timing information in the signal**

- c) Requires GPS synchronization
- d) Slows down transmission
Explanation: Self-clocking codes (e.g., Manchester) include regular signal transitions to help the receiver sync.

SECTION 2: LINE CODING SCHEMES

6. In Unipolar NRZ, a binary '1' is represented by:

- a) 0V
- b) **+V**
- c) -V
- d) Alternating +V/-V
**Explanation: Unipolar NRZ uses 0V for '0' and +V for '1'.*

7. Which scheme suffers from "baseline wandering"?

- a) Manchester
- b) **NRZ-L**
- c) AMI
- d) RZ
Explanation: Long sequences of identical bits in NRZ cause voltage drift (baseline wandering), making synchronization hard.

8. In Manchester encoding, a binary '1' is:

- a) High-to-Low transition at bit start
- b) **High-to-Low transition at mid-bit**
- c) Low-to-High transition at bit start
- d) Steady high voltage
**Explanation: Manchester uses mid-bit transitions: High→Low for '1', Low→High for '0'.*

9. Differential Manchester encoding differs from standard Manchester by:

- a) Using three voltage levels
- b) **Encoding data at the start-of-bit transition**
- c) Eliminating all transitions
- d) Doubling the bit rate
Explanation: Data is in the presence/absence of a transition at the bit start (not mid-bit).

10. Bipolar AMI encodes a binary '0' as:

- a) Alternating +V/-V
- b) **0V**

- c) +V
 - d) -V
- *Explanation: AMI uses 0V for '0' and alternates between +V/-V for '1's.*

11. HDB3 and B8ZS are enhancements of

- a) Manchester
 - b) **AMI**
 - c) NRZ-I
 - d) RZ
- Explanation: They modify AMI to prevent long zero sequences.*

12. Return-to-Zero (RZ) uses

- a) Full-bit pulses
 - b) **Half-bit pulses (returns to zero mid-bit)**
 - c) No pulses
 - d) Triple voltage levels
- Explanation: RZ pulses last half the bit duration, returning to zero for synchronization.*

13. NRZ-I encodes '1' as

- a) Fixed voltage
 - b) **Voltage inversion from the previous level**
 - c) Zero voltage
 - d) Positive voltage
- *Explanation: NRZ-I = "Invert on 1". A '1' flips the signal; '0' keeps it unchanged.*

14. Which scheme has no DC component?

- a) Unipolar NRZ
 - b) **Manchester**
 - c) NRZ-L
 - d) All of the above
- Explanation: Manchester's symmetrical transitions average to zero DC.*

15. For the bitstream '1100', which line code has the most transitions?

- a) NRZ-L
 - b) AMI
 - c) **Manchester**
 - d) Unipolar NRZ
- Explanation: Manchester has a transition every bit (mid-bit), while others may not.*

SECTION 3: CHARACTERISTICS & TRADE-OFFS

16. Which scheme requires the least bandwidth?

- a) RZ
- b) Manchester
- c) **NRZ-L**
- d) AMI

Explanation: NRZ-L uses 1 pulse/bit, while RZ/Manchester need 2 pulses/bit (double bandwidth).

17. Long sequences of zeros cause synchronization issues in

- a) Manchester
- b) **AMI**
- c) RZ
- d) Differential Manchester

Explanation: AMI sends 0V for '0', so long zeros lack transitions for synchronization.

18. Error detection is possible in

- a) NRZ-L
- b) **Bipolar AMI**
- c) Unipolar NRZ
- d) All schemes

Explanation: AMI detects errors if two consecutive '1's have the same polarity (violation).

19. True or False: Manchester encoding is used in classic Ethernet (10BASE-T).

- True**

Explanation: 10 Mbps Ethernet uses Manchester for self-clocking.

20. Which scheme is most resilient to noise?

- a) Unipolar NRZ
- b) **Differential Manchester**
- c) NRZ-I
- d) RZ

Explanation: Differential schemes ignore absolute voltage levels, relying on transitions for noise immunity.

SECTION 4: ANALYSIS & COMPARISON

21. Encode '1010' using NRZ-L:

- a) +V, -V, +V, -V

- b) **+V, -V, +V, -V**
 - c) 0V, +V, 0V, +V
 - d) -V, +V, -V, +V
- *Explanation: NRZ-L: '1' = +V, '0' = -V (or vice versa).*

22. Encode '110' using Manchester:

- a) H→L, H→L, L→H
 - b) **H→L, H→L, L→H**
 - c) L→H, L→H, H→L
 - d) H→L, L→H, H→L
- *Explanation: '1' = H→L, '0' = L→H. Always mid-bit transitions.*

23. In AMI, the sequence '101010' is encoded as:

- a) +V, 0V, -V, 0V, +V, 0V
 - b) **+V, 0V, -V, 0V, +V, 0V**
 - c) +V, -V, +V, -V, +V, -V
 - d) 0V, +V, 0V, -V, 0V, +V
- Explanation: AMI alternates polarity for '1's and uses 0V for '0's.*

24. Which code guarantees a transition every bit?

- a) NRZ-I
 - b) **Manchester**
 - c) AMI
 - d) Unipolar NRZ
- Explanation: Manchester always transitions mid-bit for clocking.*

25. A scheme with 4 voltage levels can transmit:

- a) 1 bit/symbol
 - b) **2 bits/symbol**
 - c) 3 bits/symbol
 - d) 4 bits/symbol
- *Explanation: 4 levels = $\log_2(4) = 2$ bits/symbol.*

SECTION 5: ADVANCED CONCEPTS

26. The "bipolar violation" in AMI indicates

- a) A zero sequence
- b) **An error**
- c) End of transmission

- d) High bandwidth
Explanation: Two consecutive '1's with the same polarity break AMI rules, signaling errors.

27. Which code replaces long zeros with special pulses?

- a) NRZ-I
- b) **HDB3**
- c) Manchester
- d) RZ
Explanation: HDB3 (High-Density Bipolar 3) inserts pulses to break >3 zeros.

28. For optical fiber, which line code is preferred?

- a) Manchester
- b) **NRZ**
- c) AMI
- d) RZ
Explanation: NRZ's simplicity and low bandwidth suit high-speed fiber links (e.g., 100G Ethernet).

29. True or False: RZ has better synchronization than NRZ but uses more bandwidth.

- **True**
Explanation: RZ's mid-bit zero return aids synchronization but requires twice NRZ's bandwidth.

30. Which factor does NOT affect line code choice?

- a) Bandwidth
- b) Error detection
- c) **Colour of the cable**
- d) Synchronization
Explanation: Cable colour is irrelevant! Bandwidth, synchronization, and error resilience drive the choice.