

This is the final examination worth 50%. Please read each question carefully. There are 20 questions worth a total of 50 marks. You should attempt to answer all questions. This is a closed-book examination. The time allocated for this exam is two hours. Calculators are NOT permitted.

Important: It is not necessary to provide long answers to any question. Your answers should be precise and concise.

1. A general sine wave is expressed using the following formula: $A \sin(2\pi f t + \phi)$.

- (a) What do the values A , f and ϕ represent?
- (b) Is the sine wave an example of a periodic or an aperiodic signal?

[1 + 1 = 2 marks]

2. For the following function:

$$s(t) = 2 \sin(2\pi(3f)t) + 5 \sin(2\pi f t) + \sin(2\pi(2f)t),$$

plot its **amplitude frequency-domain** (i.e. $S(f)$ versus f) function. What is the absolute bandwidth of this signal?

[2 marks]

3. A QAM modem modulates a signal using six phases, two of which have two amplitudes. The modem is used to transmit a digital signal at 1200 bps.

- (a) Using the Nyquist Theorem ($C = 2B \log_2(M)$), what is the theoretical bandwidth required for this modem? Note: a calculator should not be required for your answer.
- (b) Under what channel conditions is it possible to transmit this signal within the calculated theoretical bandwidth?

[1 + 1 = 2 marks]

4. Transmission media can be classified as guided or unguided. Explain what these terms mean and provide two examples of each.

[2 marks]

5. There are two types of configuration for wireless transmission: directional and omnidirectional.

- (a) What element of the carrier signal dictates this configuration and under what conditions is the carrier signal ideal for each of these configurations?
- (b) For each of the directional and omnidirectional configurations give an example application.

[1 + 1 = 2 marks]

6. What is the difference between bit rate and baud rate? Give an example where both are the same and an example where they are different.

[2 marks]

7. Draw a diagram of the binary bit stream 0100011010 after modulation with:

- (a) amplitude-shift keying, and
- (b) frequency-shift keying.

Briefly explain each modulation technique.

[2 marks]

8. An audio signal with a bandwidth of 8 kHz is to be encoded into a pulse amplitude modulation (PAM) signal.

- (a) At what rate should the signal be sampled for perfect reconstruction?
- (b) If the PAM signal is then converted into a pulse code modulated (PCM) signal, is perfect reconstruction possible? Explain the reason for your answer.

[1 + 1 = 2 marks]

9. What is the difference between synchronous and asynchronous data transmission? Provide an example where each are used.

[2 marks]

10. The three key mechanisms in data link control are *flow control*, *error detection* and *error correction*. Briefly explain why each of these mechanisms is required. Briefly state the methods used to implement each of these mechanisms.

[2 marks]

11. List the three standard methods for automatic repeat request (ARQ) and briefly state how each maintains an error free connection.

[2 marks]

12. Figure 1 shows a two way exchange of HDLC protocol frames. Unless otherwise indicated in the Figure, all frames contain data. Draw this figure again and include the frame types and sequence numbers for all frames. You must replace the # in the RR and REJ frames with the appropriate value(s).

[2 + 2 = 4 marks]

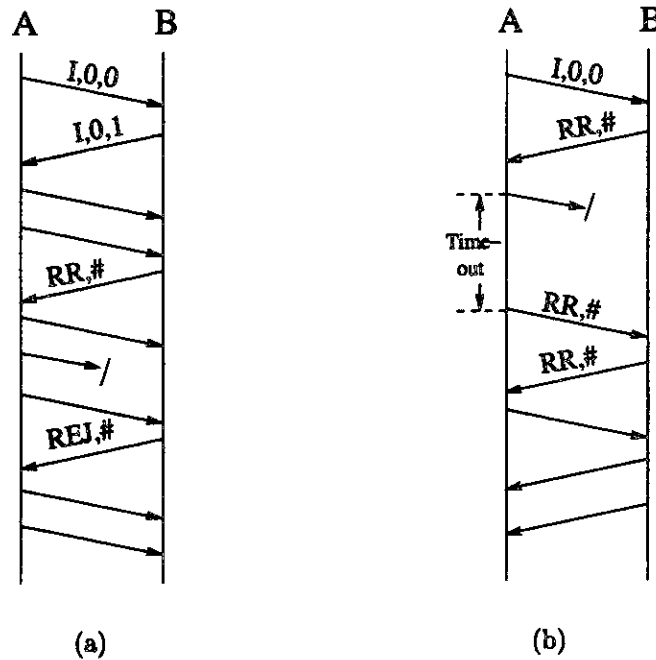


Figure 1: A two way HDLC protocol exchange.

13. Figure 2 shows the structure of a HDLC frame.

- (a) Briefly describe the purpose of each of the fields in the HDLC frame.
- (b) The HDLC protocol defines three types of frame. List these frame types and provide a brief description of their use in data link control.
- (c) Could HDLC be used as a data link control protocol for a multiple station peer-to-peer LAN? Explain the reason for your answer.

[2 + 2 + 2 = 6 marks]

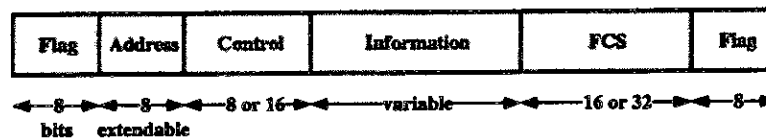


Figure 2: The HDLC Frame Structure.

14. Using block diagrams, briefly explain the operation of a frequency-division multiplexer (FDM) and a time-division multiplexer (TDM).

[2 marks]

15. What is the difference between a TDM and statistical TDM?

[1 marks]

16. Is data link control required when transmitting a time-division multiplexed signal over a point-to-point link? Briefly state why it is, or isn't required.

[1 marks]

17. Describe the terms *physical topology* and *logical topology* in relation to a LAN.

[2 marks]

18. With the aid of diagrams, describe the operational principle behind the following:
(a) a passive repeater hub, (b) an active switching hub.

[2 marks]

19. An organisation has two separate LANs, a 200 station Ethernet LAN and a 30 station Token Ring LAN.

(a) To improve performance of the Ethernet LAN, the organisation decides to divide the LAN into two sub LANs. Should this be done with a repeater or a bridge?

(b) Upon splitting the LAN, the resulting configuration did not improve the speed. What would be the reason for this and how might it be improved?

(c) A bridge is used to connect one of the Ethernet sub LANs with the Token Ring LAN. Is this bridge required to make changes to the LLC PDU contained within the MAC frames? Which parts of a frame require modification by the bridge?

[1 + 2 + 1 = 4 marks]

20. Two popular LAN systems in use today are IEEE 802.3 Ethernet (CSMA/CD) and IEEE 802.5 Token Ring LANs. Using diagrams briefly explain the basic operation of:

(a) the CSMA/CD protocol, and

(b) the token ring protocol.

[3 + 3 = 6 marks]

END OF EXAMINATION