

Part 1: (33 points - 3 points for each problem)

- (A) 1. SSH is a (A) software (B) protocol (C) hardware (D) network architecture
B
- (D) 2. The known port for the domain name service is (A) 22 (B) 23 (C) 25 (D) 53
- (C) 3. Which is the personal area networks standard?
(A) IEEE 802.3 (B) IEEE 802.11 (C) IEEE 802.15 (D) IEEE 802.16
- (D) 4. Which is not a connection-oriented network?
(A) X.25 (B) ATM (C) POTS (D) none of the above
- (C) 5. One symbol is sent at every 125 μ sec. Supposed QAM-128 is used. What is the transfer rate?
(A) 28.8 Kbps (B) 33.6 Kbps (C) 56 Kbps (D) none of the above
- (B) 6. Television channels are 6-MHz wide. How many bits per second can be sent on a noiseless television channel if four-level digital signals are used?
(A) 18 Mbps (B) 24 Mbps (C) 36 Mbps (D) none of the above
- (A) 7. Which is a modulation method?
(A) phase (B) analog (C) digital (D) none of the above
- (C) 8. Transmission lines suffer from three major problems. Which is not one of them?
(A) attenuation (B) distortion (C) diffraction (D) noise
- (B) 9. Which is not used in GSM?
(A) FDM (B) CDMA (C) TDM (D) none of the above
- (A) 10. Which is not an issue to be concerned with at the data link layer?
(A) routing (B) framing (C) error control (D) flow control
- (B) 11. A bit string, 01111101111110, needs to be transmitted at the data link layer. What is the string to be transmitted after bit stuffing?
(A) 011111011111010 (B) 0111110011111010 (C) 011111001111110 (D) none of the above

Part 2: (67 points)

1. (15 pts.) Briefly explain these terminologies. If they are acronyms, also write what they stand for.
- (a) **Socket** A socket is an endpoint for communication over a network or an abstraction through which an application can send and receive data.
 - (b) **ADSL** (Asymmetric Digital Subscriber Line) is a technology for transmitting digital information at a high bandwidth on existing phone lines to homes and businesses. It is called asymmetric because the upstream bandwidth is lower than downstream.
 - (c) **QAM** (Quadrature Amplitude Modulation) is a method of combining amplitude and phase modulation to transmit more bits per symbol.
 - (d) **CDMA** (Code-Division Multiple Access) allows transmissions over entire frequency spectrum. Multiple simultaneous transmissions are separated using coding theory.
 - (e) **Direct sequence spread spectrum** It is an approach to spread spectrum modulation for digital signal transmission over the airwaves. A data signal at the point of transmission is combined with a higher data-rate bit sequence (also known as a chipping code). The redundant enables the original data to be recovered if data bits are damaged during transmission.

2. (8 pts.) Complete the following table listing the seven layers in the OSI 7-Layer Reference Model. Then, identify the four layers used in the TCP/IP protocol suite (write TCP/IP beside them). Finally, identify where the following protocols belong: HTTP, UDP, IP, SMTP.

Layer	Layer Name	TCP/IP suite	Protocol
7	Application Layer	TCP/IP	HTTP, SMTP
6	Presentation Layer		
5	Session Layer		
4	Transport Layer	TCP/IP	UDP
3	Network Layer	TCP/IP	IP
2	Data Link Layer	TCP/IP	
1	Physical Layer		

3. (8 pts.)
- What is the main difference between connectionless and connection-oriented protocols?
 - Give an example for each protocol respectively.
 - What is a reliable communication?

Ans:

- A connection-oriented protocol requires that communication parties set up a link before the communication whereas the connectionless protocol does not.
 - Connection-oriented protocol: TCP, Connectionless protocol: UDP
 - The reliable communication is the communication where messages are guaranteed to reach their destination complete and uncorrupted and in the order they were sent.
4. (7 pts.) Suppose that a code consists of the following valid codewords: {000000, 000111, 111000, 111111}.
- What is the Hamming distance of the code?
 - Can a single bit error be detected? Explain.
 - If 000100 is received with two bit errors, can it be corrected? Briefly explain how it would be corrected, or why it cannot be corrected.

Ans:

- The Hamming distance of the code is 3.
 - Yes, because $3 \geq 1 + 1$.
 - No, it could be 000000 or 000111. Besides, $3 < 2 \times 2 + 1$.
5. (7 pts.) An 8-bit byte with binary value 10101011 is to be encoded using an even-parity Hamming code.
- How many check bits are needed to ensure that the receiver can detect and correct a single bit errors?
 - What is the binary value after encoding?

Hint: Use the equation $m \leq 2^r - r - 1$. Ans:

- $m \leq 2^r - r - 1, m = 8 \Rightarrow r = 4$
- 1 _ 0 1 0 _ 1 0 1 1

Bit 1 = $(1 + 0 + 0 + 1 + 1) \bmod 2 = 1$

Bit 2 = $(1 + 1 + 0 + 0 + 1) \bmod 2 = 1$

Bit 3 = $(0 + 1 + 0 + 1) \bmod 2 = 0$

Bit 4 = $(1 + 0 + 1 + 1) \bmod 2 = 1$

The encoded value is 111001011011.

6. (7 pts.) Using the divisor polynomial $x^4 + x^3 + 1$ for CRC, what frame will be transmitted for the data $M = 101011001$?

Ans: $M(x) = 101011001$ $C(x) = 11001$, $r = 4$

```

      110000001
      -----
11001 ) 1010110010000
        11001
        ---
         11001
         11001
         ---
           10000
           11001
           ---
             1001
  
```

So the transmission frame $T(x)$ is 1010110011001.

7. (6 pts.) A video signal at a resolution of 320 x 240 pixels, 2 bytes/pixel color encoding, and 25 frames/second.

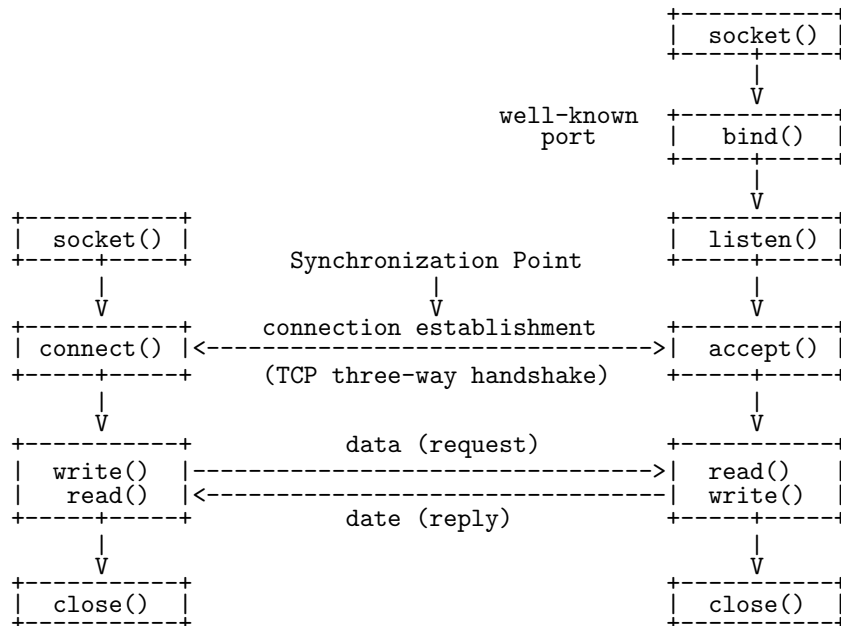
- Calculate the bandwidth necessary for transmitting in real time.
- Suppose your cable modem is up to 7.2 Mbps. Without loss of the resolution and color, how many frames per second can it transfer?

Ans:

- $320 \times 240 \times 2 \times 8 \times 25 = 30720000$ bps
- $7.2 \times 10^6 / (320 \times 240 \times 2 \times 8) = 5.86$ frames/s

8. (9 pts.) Draw a diagram to illustrate the general pattern followed by a client and server for connection-oriented communication using socket API in C. Briefly explain those functions used in the client and server.

Ans:



- `socket` - create an endpoint for communication.
- `bind` - bind a socket to an address. The address is a pair consisting of an IP-address and a port number.
- `listen` - specify the maximum number of outstanding connection requests that can be enqueued; that is, the connection request queue length.
- `accept` - wait to accept an incoming connection request. Use by a server to wait for an incoming request. When a request arrives, a new socket is created and the new socket is used for the connection.
- `write` - send data using a connection-oriented (TCP).
- `read` - read data using a connection-oriented (TCP).
- `close` - close a connection.