Indian Institute of Information Technology-Allahabad

C1 Review Test

B.Tech. (IT & ECE) 4th Semester

Computer Networks (Code: ICNE532C)

Time: 2 Hour **MM:**

Note: Attempt all questions. All questions carry equal marks.

1. Multiple choice questions

i. Which of the following is/are **NOT** (a) layer(s) in TCP/IP protocol stack?

(a) Application **(b) Session** (c) Transport (d) Internet (e) Physical

Answer: b

ii. Which of the following modulation methods can have higher bit rates than the baud rate?

(a) Frequency Modulation (b) Amplitude Modulation (c) Phase Modulation – 2 Phase method (**d) Phase Modulation – 4 Phase method** (e) Pulse Code Modulation

Answer: d

iii. Which of the following indicates the increasing order of accuracy in error detection?

(a) CRC, Single Parity, Block Sum Check (b) Block Sum Check, CRC, Single Parity

(c) Single Parity, CRC, Block Sum Check **(d) Single Parity, Block Sum Check, CRC**

(e) CRC, Block Sum Check, Single Parity

Answer: d

iv. Identify the unequal pair(s).

(a) Physical Address – MAC Address (b) IP Address – Logical Address

(c) **Ethernet – IEEE 802.4** (d) Token Bus – IEEE 802.5

(e) Serial port – COM1

Answer: c

v. The following two bit strings show the transmitted and received bit patterns over a noisy serial data link.

Transmit: 0100101110100010110111 0011

Receive: 0101100110100110111111 0011

What is the length of the longest error burst?

(a) 4 (b) 6 **(c) 16** (d) 10 (e) 5

Answer: c

vi. The check bits C_1, C_2 and C_3 of a Hamming code are correctly positioned in

(a) $D_1C_1C_2D_2D_3C_3$. (b) $C_1C_2\ D_1D_2D_3C_3$. (c) $C_3D_3C_2D_2C_1D_1$.

(d) $C_1D_1C_2D_2C_3D_3$. **(e) $C_1C_2D_1C_3D_2D_3$.**

Answer: e

vii. The following two tables indicates the different types of transmission media and their respective characteristic features:

1	Coaxial cables
2	UTP cables
3	Fibre Optic cables
4	Micro wave cables
5	STP cables

A	Unbounded medium
B	Shield as a metal foil
C	Twisted pair wires
D	Good for very high speed
E	Use of BNC connectors

The correct order(s) of A to E which match(es) items 1 to 5 respectively is/are

(a) EDACB. **(b) BCDAE.** (c) ECDAB.

(d) CASED. (e) BADEC.

Answer: b

viii. Which of the following is a/are correct statement(s) with respect to the frequency components of a digital signal?

(a) As the frequency increases the amplitude decreases.

(b) As the frequency decreases the amplitude increases.

(c) As the amplitude decreases the frequency increases.

(d) There are an infinite number of frequency components.

(e) In many cases, the very high frequency components can be ignored.

Answer: d

ix. With respect to Circuit Switching and Packet Switching, which of the following statement(s) is/are incorrect?

(a) In circuit switching after data transfer begins, no busy conditions take place.

(b) In packet switching, each packet of the same message must follow the same route.

(c) In circuit switching, the packets of the same message are forwarded via different routes.

(d) In packet switching, each packet must contain the addressing information.

(e) In circuit switching, a circuit must be established on the network prior to the data transfer.

Answer: b, c

x. Flow Control is employed in data communications

(a) **because the transmitter and the receiver may not be able work at the same speed**.

(b) because the receiver buffer capacity is high in new computers.

(c) in a dynamic fashion using the sliding window protocol especially at higher protocol layers.

(d) because the communication channels are not always error free.

(e) to ensure that all transmitted frames are received in the order in which they have been sent.

Answer: a, e

2. We need to send 280 kbps over a noiseless channel with a bandwidth of 25 kHz. How many signal levels do we need?

Solution: Given Bandwidth B= 25 kHz

Bit rate = 280kbps

We know that, for noiseless channel

Bit rate = 2* B* Log2 L

280000= 2 * 25000* log L

5.6= log2L

L= 48.5 levels

3. The SNR is often given in decibels. Assume that SNR (dB) is 34 and the channel bandwidth is 5 MHz. Calculate the maximum theoretical channel capacity of the channel in bits/second.

Solution: SNR (dB) = 10 * log10(SNR)

SNR = 10(SNR(dB)/10)

SNR = 10^(34/10)

= 2511.88

We know that for noisy channel-

Capacity = bandwidth * log2(1 + SNR) bits/sec

= 5*10^6* log2(1 + 2511.88)

=5* 10^6* 11.29

= 56.45 Mbps

4. Explain clearly the responsibilities and the list protocols for each layer of ISO-OSI reference model. How OSI reference model is different from TCP/IP reference model?

Solution:

The seven Open Systems Interconnection layers are:

Layer 7: The application layer: This is the layer at which communication partners are identified (Is there someone to talk to?), network capacity is assessed (Will the network let me talk to them right now?), and that creates a thing to send or opens the thing received. (This layer is *not* the application itself, it is the set of services an application should be able to make use of directly, although some applications may perform application layer functions.)

Layer 6: The presentation layer: This layer is usually part of an operating system (OS) and converts incoming and outgoing data from one presentation format to another (for example, from clear text to encrypted text at one end and back to clear text at the other).

Layer 5: The session layer: This layer sets up, coordinates and terminates conversations. Services include authentication and reconnection after an interruption. On the Internet, Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) provide these services for most applications.

Layer 4: The transport layer: This layer manages packetization of data, then the delivery of the packets, including checking for errors in the data once it arrives. On the Internet, TCP and UDP provide these services for most applications as well.

Layer 3: The network layer: This layer handles the addressing and routing of the data (sending it in the right direction to the right destination on outgoing transmissions and receiving incoming transmissions at the packet level). IP is the network layer for the Internet.

Layer 2: The data-link layer: This layer sets up links across the physical network, putting packets into network frames. This layer has two sub-layers, the Logical Link Control Layer and the Media Access Control Layer. Ethernet is the main data link layer in use.

Layer 1: The physical layer: This layer conveys the bit stream through the network at the electrical, optical or radio level. It provides the hardware means of sending and receiving data on a carrier network.

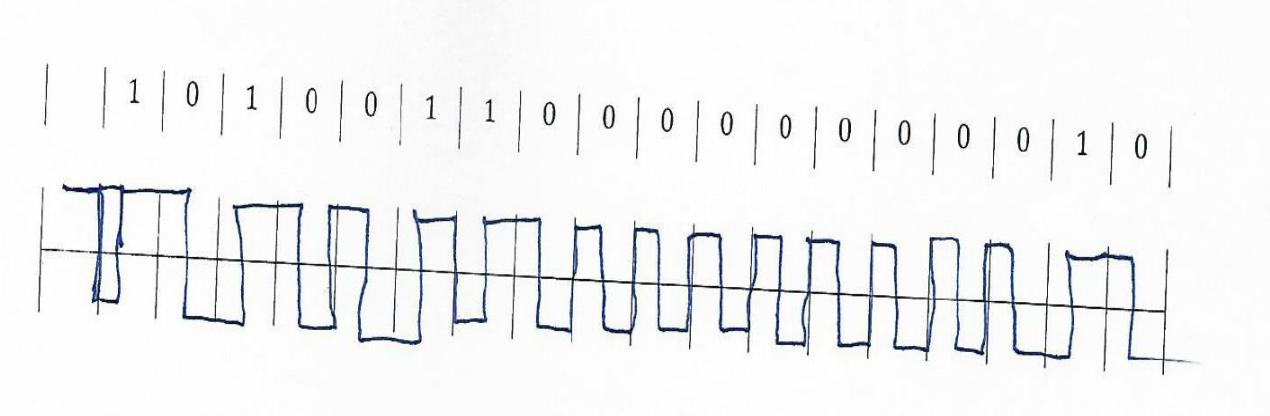
OSI Reference Model	TCP/IP Reference Model
Application Layer	Application Layer
Presentation Layer	Transport Layer
Session Layer	
Transport Layer	
Network Layer	Network Layer
Data Link Layer	Data Link Layer
Physical Layer	Physical Layer

5. Assume that the voltage level at time t = 0 is high, show Manchester and HDB3 encoding for the following bit stream 101001100000000010. Why net DC component is undesirable in the encoding techniques? **[10 Marks]**

Manchester Encoding Rule

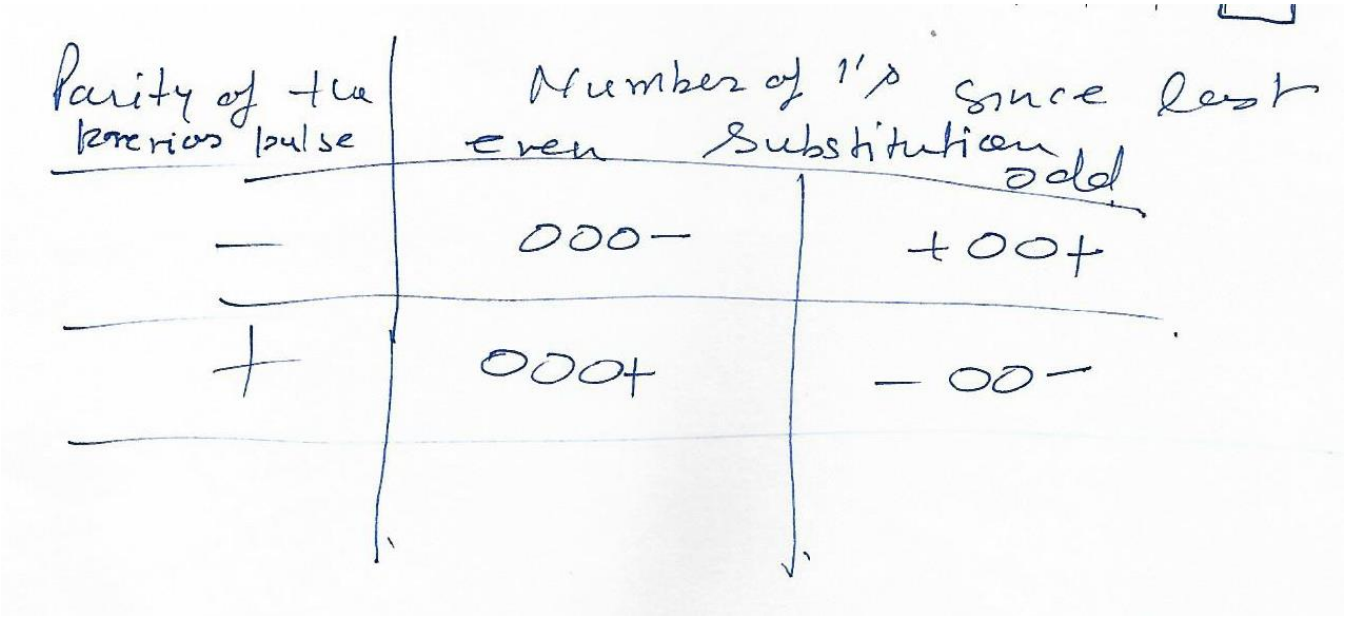
- has transition in middle of each bit period
- transition serves as clock and data
- 1: Low to high transition at the middle of the bit interval
- 0: High to low transition at the middle of the bit interval

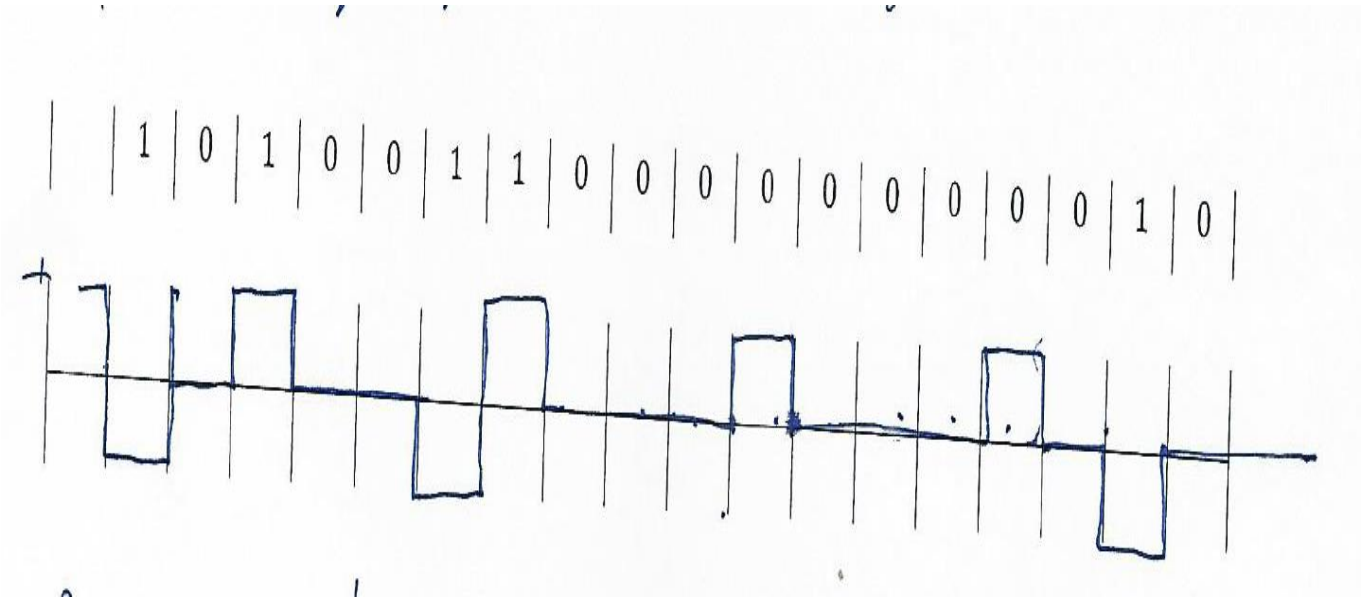
Initially the signal is at high level.



HDB3 Encoding Rule:

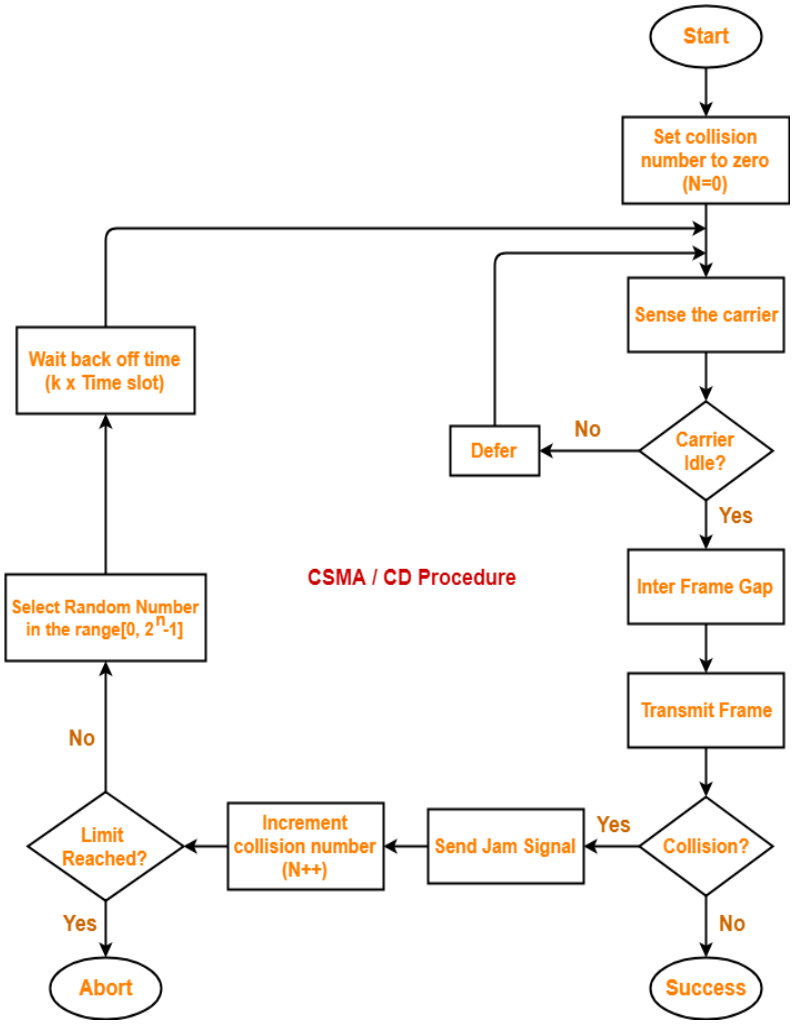
- Encoding takes place as per Bipolar –AMI but every sequence of 4 zeros will be replaced by the following rules:





6. What MAC algorithm used in IEEE 802.3 networks? Explain using a flowchart? Distinguish between 1-persistent and p-persistent and non-persistent CSMA. Why is Ethernet's binary exponential back-off scheme superior to a p-persistent scheme for any fixed p? Why the maximum and minimum frame size is defined for Ethernet frame? **[10 Marks]**

Part 1



Part 2

Basis	1-persistent CSMA	p-persistent CSMA
Carrier Sense	When channel is idle it will send with probability 1.	When channel is idle it will send with probability p.
Waiting	It will continuously sense channel for transmission of frames.	It will wait for next time slot for transmission of frames.
Chance of Collision	In this method, there is highest number of collisions observed.	In this method, there are less chances of collision than in 1-persistent.
Utilization	It's utilization is above ALOHA because frames are sent only when channel is found in idle state.	It's utilization is dependent on probability p.
Delay low load	It is small because frames are sent only in idle state.	It is large when probability p is small because station will not send always in idle state of

		channel.
Delay high load	It is high due to collision.	It is large when probability p of sending is small when channel is found in idle state.

Back off Algorithm:

Waiting time = back–off time

Let n = collision number or re-transmission serial number.

Then,

Waiting time = K * Tslot

where K = [0, 2n – 1]

Although the p-persistent CSMA/CD algorithm has less chances of collision but back off algorithm reduces the chances of subsequent collisions in case of retransmissions because after every collision, the spread of choosing a random slot is increasing exponentially for both the stations involved in the collision and possibility of collision therefore decrease exponentially.

Part 3

The minimum packet size is defined so that all nodes present in the network can detect every collision and the maximum size is defined so that one node shall not capture the medium for infinite amount of time to ensure fairness.

7. Consider an error-free 1024-kbps channel used to send 512B data frames in one direction, with very short acknowledgements coming back the other way. Assume a propagation delay of 50msec.

[10 Marks]

(a) What should be the size of Sender's Window and number of bits required for the sequence number to attain maximum utilization of channel capacity

(b) What is the maximum throughput for a window size of 1, 7, 15, 127, and 255?

(c) At what minimum window size can the protocol run at the full rate of the channel?

(a) And (c)

$$SWS = \left\lfloor \frac{Link\ Capicity\ * RTT}{Frame\ Size} \right\rfloor$$

$$SWS = \left\lfloor \frac{1024 * 1000 * 2 * 50}{512 * 8 * 1000} \right\rfloor$$

$SWS = 25$

$MaxSeqNum + 1 \geq 2 * SWS$

$MaxSeqNum + 1 \geq 2 * 25$

$MaxSeqNum \geq 49$

No. of bits required for the sequence number $\geq \log_2(MaxSeqNum + 1)$

≥ 5.64

Therefore, no. of bits required for the sequence number = 6.

(B)

$$Link\ Utilization = \frac{No.of\ outstanding\ frames\ allowed\ to\ send * frame\ size}{Link\ Capicity * RTT} * 100\ \%$$

For SWS = 1; $Link\ Utilization = 4\%$

For SWS = 7; $Link\ Utilization = 28\%$

For SWS = 15; $Link\ Utilization = 60\%$

For SWS = 127; $Link\ Utilization = 100\%$

For SWS = 255; $Link\ Utilization = 100\%$

8. Given a sender-receiver pair using Hamming Codes for single bit error correction and the binary message 1100010001 at the sender, what is the actual message transmitted including the parity bits (show your calculation)? Demonstrate error correction mechanism for the given message?

Solution:

Number of redundant bits can be found by satisfying the following equality

$$m + r + 1 \leq 2^r$$

Here m = 10

Therefore minimum value of r = 4

Now, if we are enforcing the odd parity on the subset of bits then the computation is as follows:

Bit Position

1	2	3	4	5	6	7	8	9	10	11	12	13	14
R1	R2	M1	R3	M2	M3	M4	R4	M5	M6	M7	M8	M9	M10

Value

Where R is the redundant bits and M is the message bits. After filling the message bits we get the following table:

Bit Position

1	2	3	4	5	6	7	8	9	10	11	12	13	14
R1	R2	1	R3	1	0	0	R4	0	1	0	0	0	1

Value

For R1 the subset of bits will be: 1, 3, 5, 7, 9, 11, 13.

For R2 the subset of bits will be: 2, 3, 6, 7, 10, 11, 14.

For R3 the subset of bits will be: 4, 5, 6, 7, 12, 13, 14.

For R4 the subset of bits will be: 8, 9, 10, 11, 12, 13, 14.

Now to decide the value of redundant bit, we shall enforce odd parity on the above subsets one by one by using the redundant bit value.

R1, 1, 1, 0, 0, 0, 0 -> R1==1;

R2, 1, 0, 0, 1, 0, 1 -> R2==0

R3, 1, 0, 0, 0, 0, 1 -> R3==1

R4, 0, 1, 0, 0, 0, 1-> R4==1

After adding the redundant bit the message will be:

1	0	1	1	1	0	0	1	0	1	0	0	0	1

For error detection, reviver check the parity enforced on the subset of bits again as explained above and determine the position of error bit and flip that bit to correct the message.

**********End of Paper**********