Data Communication & Networks

Spring 2008 Semester

Roll Number _____

Name _____

Section _____ Signature: _____

MID I

Friday, 15th February 2008

Solution

Total Time: 60 Minutes
Total Marks: 40

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Signature of Invigilator

Course Instructors:
Engr. Shahid Qurashi, Engr. Waleed Ejaz

Q	1	2	3	4	5	6	7	Total
Marks	Zero	8	6	9	7	10	Zero	40
Obtained Marks	Zero	8	6	9	7	10	Zero	40

You are advised to READ these notes:

1. **Attempt the paper on the question paper. NO EXTRA SHEETS will be provided. Use the back of the page if more space is required. However, no extra sheet will be checked.**
2. After asked to commence the exam, please verify that you have **nine (9) different printed pages** including this title page.
3. There are **7 questions**. Attempt all of them. It is advisable to go through the paper once before starting with the first question.
4. All questions don't carry **equal marks**. Marks for subparts are indicated.
5. **Suggested time** for each question is also indicated but this is not hard and fats, its just for your convenience,
6. If part of a problem depends on a previous part that you are unable to solve, explain the method for doing the current part, and, if possible, give the answer in terms of the quantities of the previous part that you are unable to obtain.
7. Exam is closed books, closed notes. Please see that the area in your threshold is clean. You will be charged for any material which can be classified as 'helping in the paper' found near you.
8. Calculator sharing is strictly prohibited.
9. Students who attempt the paper with **lead pencils** loose the right to get them rechecked.
10. The invigilator present is not supposed to answer any questions. No one may come to your room for corrections and you are not supposed to request to call anyone. Make assumptions wherever required and clearly mark them.

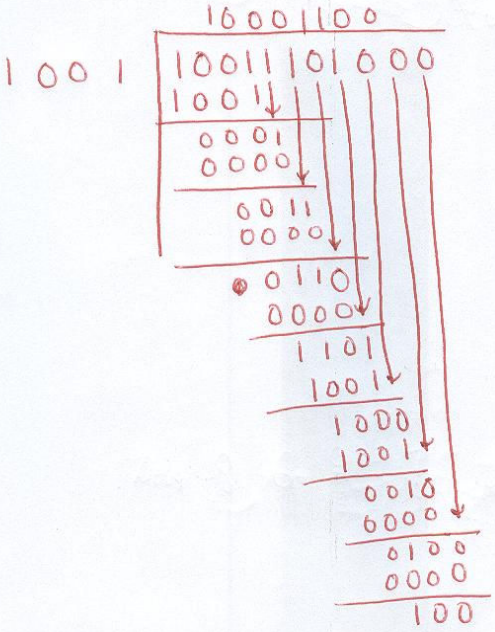
Question 1 **[0]** **[Suggested Time: 4.5 min]**

Take a look at whole paper.

Question 2 **[3+1+1+1+2]** **[Suggested Time: 12 min]**

A bit stream 10011101 is transmitted using the standard CRC method. The generator polynomial is $x^3 + 1$ (i.e. x-cube + 1).

a. Show the actual bit string transmitted.



Transmitted Bit String: 10011101100

b. Will this generator polynomial detects all single bit errors? If yes then why? If no then why?

Yes, Because coefficient of x^0 is 1.

c. Up to what length all burst errors will be detected using this generator polynomial? Give reason also?

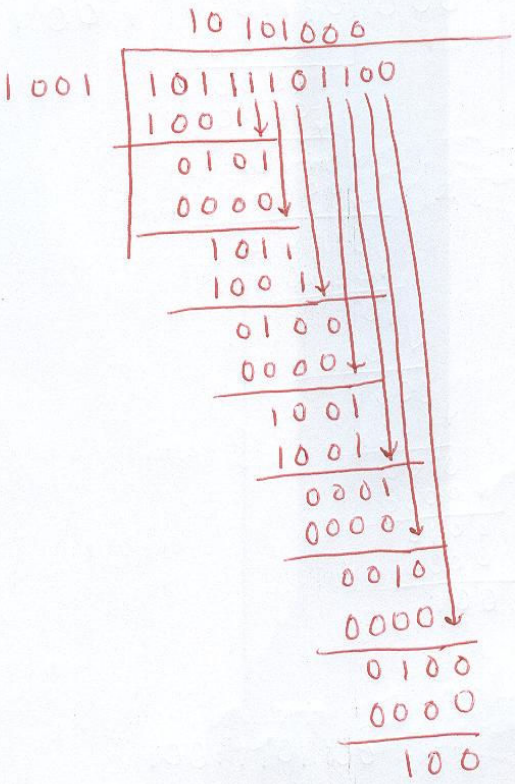
Burst length 3. Because highest power of generator polynomial is 3.

d. Will generator polynomial detects all odd numbers of errors? If yes then why? If no then why?

Yes. As generator polynomial contains a factor of $x+1$, So it can detect all odd-numbered errors.

$$(x^2-x+1)(x+1) = x^3+1$$

e. Suppose the third bit from the left is inverted during transmission. Show that this error is detected at the receiver's end.



As remainder is different from zero. Thus, the receiver detects the error and can ask for retransmission.

Question 3 **[2+2+2]** **[Suggested Time: 8 min]**

Consider sending a packet of **90** Bytes (1 Byte = 8 bits) over a path of **10** links. Each link transmits at **80** bps. The network is lightly loaded so that there are no queuing delays. Propagation delay is negligible.

a. Suppose the network is a packet-switched network. Suppose each packet has **20** Bytes of header. How long does it take to send the packet from source to destination?

$$\text{Total Delay} = \left[\frac{(90 \times 8) + (20 \times 8)}{80}\right] \times 10$$

$$= 110 \text{ sec}$$

b. Suppose the network is a circuit-switched network. Further, suppose that the transmission rate of the circuit between source and destination is **80** bps. Assuming **10** second setup time and **10** Bytes of header appended to the packet, how long does it take to send the packet?

$$\text{Total Delay} = \text{Setup Time} + d_{Tx}$$

$$= 10\text{sec} + \frac{(90 \times 8) + (10 \times 8)}{80}$$

$$= 20\text{sec}$$

c. Now let's suppose that the propagation delay is also considered. What would be the time to transmit the **100** Byte packet, with **10** bytes of header over the above mentioned **circuit switched network** transmitting at **100** bps? Assume that the length of each of the **10** links is **20,000** km. (propagation speed in the medium = $\mathbf{2 \times 10^8}$ m/s)

$$\text{Total Delay} = \text{Setup Time} + d_{Tx} + d_{prop}$$

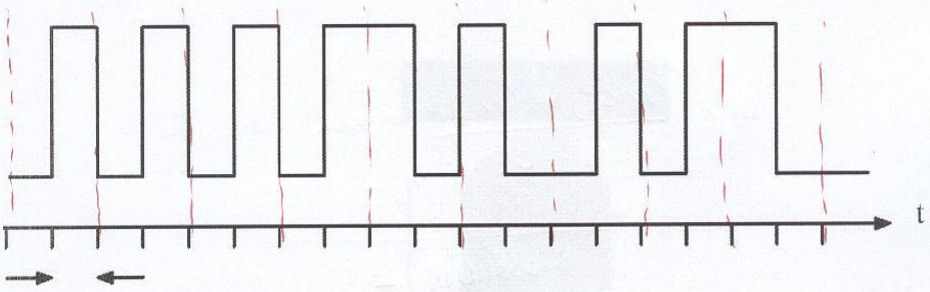
$$= 10\text{sec} + \left[\frac{(100 \times 8) + (10 \times 8)}{100}\right] + \frac{20{,}000 \times 10^3}{2 \times 10^8} \times 10$$

$$= 10 + 8.8 + 1$$

$$= 19.8 \text{ sec}$$

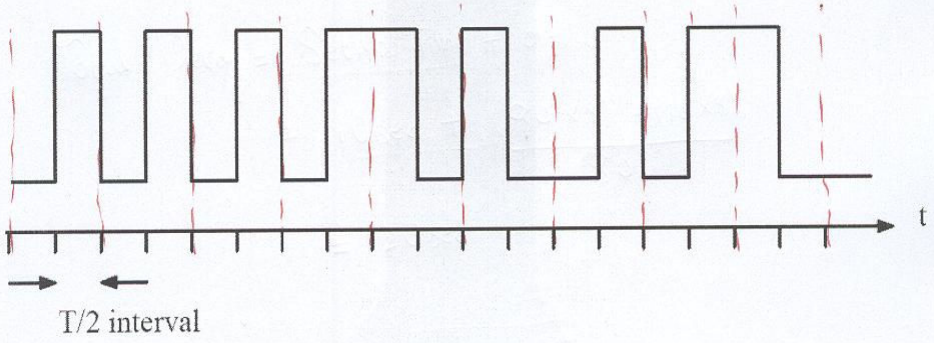
Question 4 **[3+4+2] [Suggested Time: 10 min]**

a. Suppose the waveform below comes from a Manchester encoded binary data stream for which the rate is 1/T bps. Determine the beginning and end of bit periods (i.e, extract timing information), and give the binary data sequence.

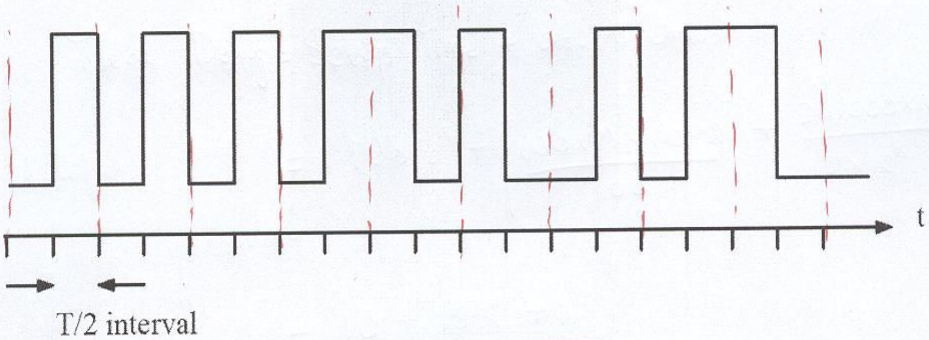


Binary Data Sequence: 11100110 or 00001100

b. Now assume that the waveform represents differential Manchester coding, and find the two possible bit streams.

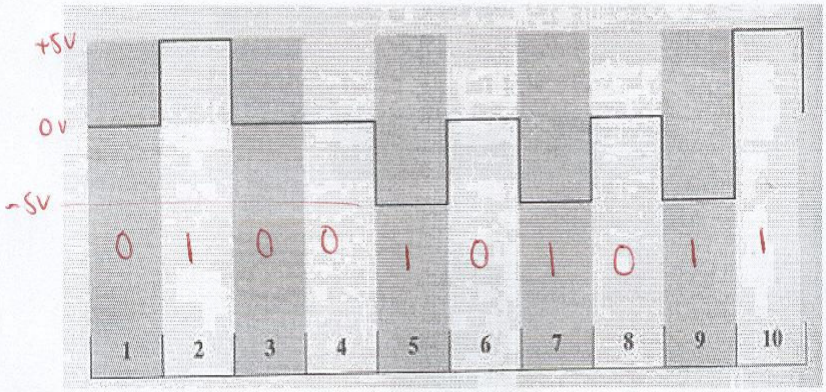


First Possible Binary Data Sequence: 000010101



Second Possible Binary Data Sequence: 1060 1010 1

c. The bipolar-AMI waveform representing the binary sequence 0100101011 is transmitted over a noisy channel. The received waveform is shown in Figure below, it contains a single error. Locate the position of this error.

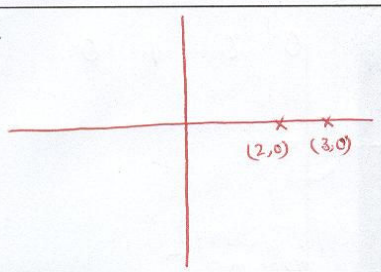
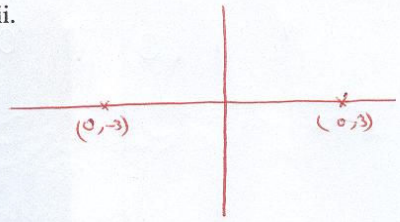
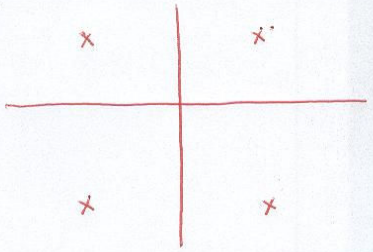
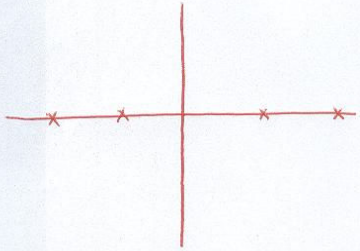


Position of Error: 7 position

Question 5 **[4+1.5+1.5] [Suggested Time: 10 min]**

a. Draw the constellation diagram for the following cases. Find the peak amplitude value for each case and define the type of modulation (ASK, FSK, PSK or QAM). The number in the parenthesis define the values of I and Q (x-axis and y-axis) respectively.

i. Two points at (3, 0) and (2, 0)
ii. Two points at (0, 3) and (0,-3)
iii. Four points at (3, 3), (-3, 3), (-3,-3) and (3,-3)
iv. Four points at (2,0), (4,0), (-2,0), (-4,0)

<table>
<tr><td>i.
 
</td><td>ii.
 
</td></tr>
<tr><td>Type of Modulation: ASK</td><td>Type of Modulation: BPSK</td></tr>
<tr><td>iii.
  </td><td>iv.
  </td></tr>
<tr><td>Type of Modulation: 4-PSK or 4QAM with 4 phases & 1 Amplitude</td><td>Type of Modulation: QAM with 2 phases and 2 amplitudes.</td></tr>
</table>

b. What is significance of twists in twisted pair cables?

Twisting ensures that both wires are equally, but inversely, affected by external influences such as noise.

c. How cladding is different from core of optical fiber cable? And what is the purpose of cladding in optical fiber?

The inner core of an optical fiber is surrounded by cladding. The core is denser than the cladding, so a light beam traveling through the core is reflected at the boundry between the core and the cladding if the incident angle is more than the critical angle.

Question 6 **[4+2+2+2]** **[Suggested Time: 11 min]**

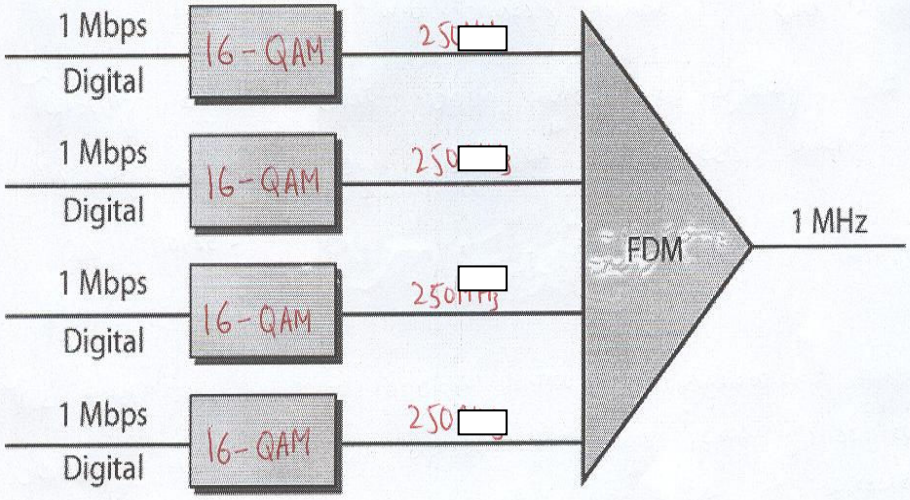
a. For n devices in the network, what is the number of cable links required for a mesh, ring, bus and star topology?

Mesh	Ring
$\frac{n(n-1)}{2}$	$(n$ [illegible]
Bus	**Star**
one backbone and n drop lines.	n

b. A cable company uses one of the cable TV channels (with a bandwidth of 6MHz) to provide digital communication for each resident. What is the available data rate for each resident if company uses a 128-QAM technique?

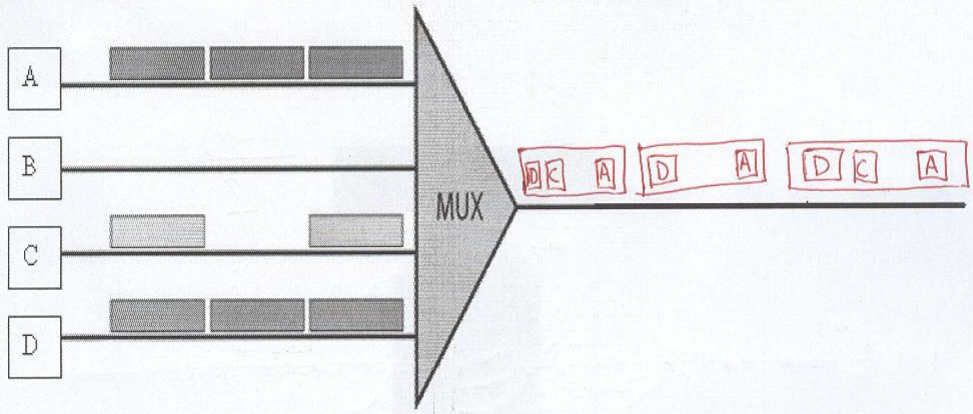
$$\text{Bit Rate} = 2 \times B \times \log_2 L$$
$$= 2 \times 6 \times 10^6 \times \log_2 128$$
$$= 84 \times 10^6 \text{ bps}$$

c. Four data channels (digital), each transmitting at 1 Mbps, use a satellite channel of 1 MHz. Design an appropriate configuration, using FDM.

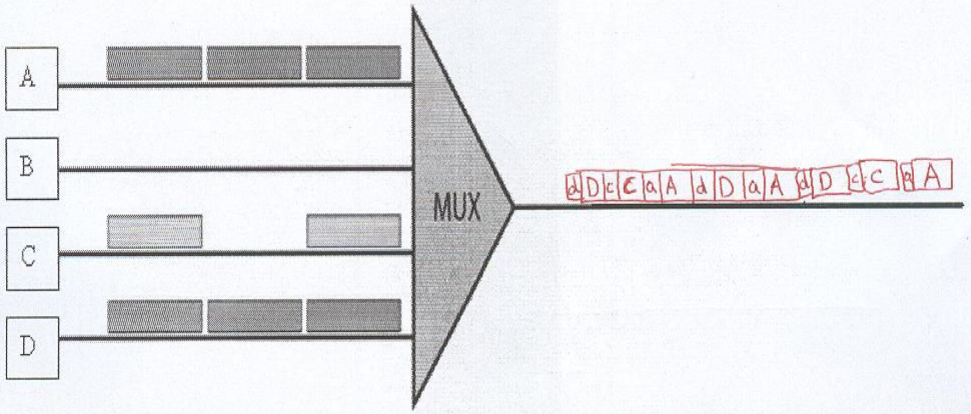


d. Figure below shows a multiplexer. Show output stream for synchronous and statistical TDM Systems?

Synchronous TDM



Statistical TDM



Question 7 **[0]** **[Suggested Time: 4.5 min]**

Just recheck your answers.