Name ..... **Student ID** .....

THE UNIVERSITY OF AUCKLAND

Computer Science COMPSCI 314 FC 2002 Answers

Test 6 May 2002, 7.00 – 8.00 pm

- Attempt all questions — **total = 50 marks**
- No calculators allowed
- Put your name and ID number *legibly* at the head of every page
- A table of the ASCII character codes is included at the end of the paper.

1. (i) What is one *advantage* of using Manchester coding rather than NRZ?

It gives the timing for each bit

[2 marks]

(ii) What is one *disadvantage* of using Manchester coding rather than NRZ?

It requires more transitions per bit. For a given bandwidth the data rate is lower

[2 marks]

(iii) What is one *advantage* of using differential Manchester coding rather than plain Manchester coding?

It is insensitive to reversal of the signal wires

[2 marks]

[Total = 6 marks]

2. (i) Why does the ASCII character set contain control characters that cannot print or directly affect the display?

To surround messages, for signalling between devices, controlling transmission.

[2 marks]

(ii) Give two examples of such characters and explain their purpose.

Characters may NOT include CR, LF, VT, HT
Communications, such as SOH, STX, ETX, ACK, NAK, SYN

[4 marks]

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[Total = 6 marks]

3. (i) If you modulate a 2 kHz carrier with a 300 Hz single frequency, what frequencies are the sidebands?

1700 Hz, 2300 Hz, (but NOT 2000 Hz – it is the carrier, not a sideband)

[2 marks]

(ii) If you modulate a 1 MHz carrier with a 2 kHz square wave, what frequencies (not more than 8) are present in the final spectrum, with approximate amplitudes?

1000 kHz (or 1 MHz, unspecified amplitude), 998 & 1002 Hz (ampl 1), 994 & 1006 kHz (amp 1/3) 990&1010 kHz (amp 1/5)

[2 marks]

[Total = 4 marks]

4. (i) A hexadecimal value 0x4B is encoded with a (12,8) Hamming code (odd parity). What is the resulting binary codeword?(Least-significant bit on the left.)
This is the answer I wanted, but see the end of these answers for more ……

The bits in "computer order" are 01001011 and in "communications order" 11010010. The Hamming code has parity in bits 1,2,4,8 - pq1r101s0010

```
              p q 1 r 1 0 1 s 0 0 1 0
Bit 1 checks  |   |   |   |   |   |      p=1 for odd
Bit 2 checks    | |     | |     | |      q=0 for odd
Bit 4 checks        | | | |         |    r=1 for odd
Bit 8 checks              | | | | |    s=0 for odd
```

The codeword is **1 0 1 1 1 0 1 0 0 0 1 0**

[6 marks]

(ii) Show that a received codeword 0xBA0 (LSB leading, from the coding of part(i)), can be decoded to yield the original value, after correcting a single error.

```
Rcvd codeword  1 0 1 1 1 0 1 0 0 0 0 0
Bit 1 checks   |   |   |   |   |   |      even (FAIL)
Bit 2 checks     | |     | |     | |      even (FAIL)
Bit 4 checks         | | | |         |    odd (OK)
Bit 8 checks               | | | | |    even (FAIL)

Errors are in groups for bits 1, 2 & 8; bad bit is 1+2+8 = 11
                                     V
Received codeword   1 0 1 1 1 0 1 0 0 0 0 0
Corrected codeword  1 0 1 1 1 0 1 0 0 0 1 0 Parity underlined
Corrected information 1 1 0 1 0 0 1 0    (=0x4B after bit reversal)
```

[4 marks]

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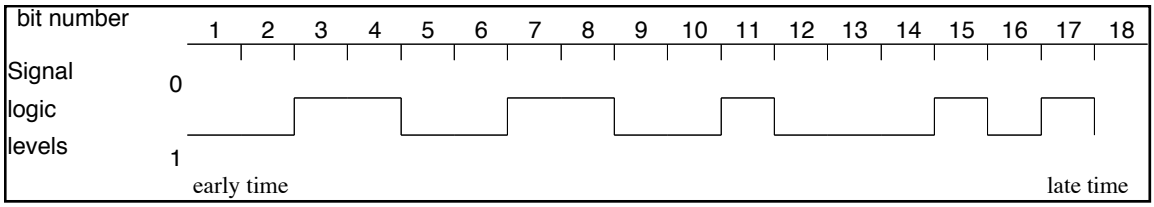
[Total = 10 marks]

5. This waveform represents an 8-bit character encoded for asynchronous transmission, and includes the start of the next character. Logic "1" is low, and logic "0" is high.



At the top is a scale giving numbers of successive bits.
Use this scale to give the bit numbers of —

(i) the first and last data bits of the first character — First 4, last 11 — [2 marks]

(ii) the stop bit of the first character — bit 12 — (1 mark]

(iii) the start bit of the following character — bit 15 — [1 mark]

(iv) the character parity is (tick one or more options)

odd	even	force to 1	force to 0
	X		X

[2 marks]

[Total = 6 marks]

6. A modem delivers a synchronous bit stream to a DTE (Data Terminating Equipment, say a computer). The DTE specifications state that any sequence of two or more SYN characters will establish character boundaries and that any later SYN characters will be stripped from the data stream.

Examine the following bit stream and identify SYN and other characters as far as possible Mark the character boundaries in the bit stream, and name any non-SYN characters which you find.

…10111011010000110100010000000011011001O1…
<--SYN-><--SYN-><-SOH--><--6--->
SYN is 0x16, = 01101000 in transmission order
The next two characters are SOH (0x01) and "6" (0x36)

[6 marks]

[Total = 6 marks]

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7. An IEEE 802.3 message includes the following components.

(i) Briefly explain the purpose of each of the components —

Destination Address	The address (or addresses) which are meant to receive this message
Frame Check Sequence	To detect transmission errors in the message. (It is ALWAYS a CRC, and NEVER any other form of parity.)
length	To give the length of the message, in octets NOT bits. (It may be less than the apparent length of the message if there are fewer than 46 data bytes.)
Preamble	introduce the message, establish bit timing and clock synchronisation

[4 marks]

(ii) What changes would you expect to see in a corresponding Ethernet message?

• The length field becomes a type field,
• the LLC/SNAP header is no longer needed at the start of the Frame information field

[2 marks]

(iii)

Explain why the Destination address might sometimes be all 1s..

The address all 1s if it is to be received by all astations on the network (a "broadcast" address).

[2 marks]

[Total = 8 marks]

8. Stations and networks may be interconnected by Repeaters, Bridges, or Routers.

List *two* features of each which make it different from the other two devices.

(i) Repeater	A repeater works at the bit level (Physical layer)
	A repeater does not examine the fields within a message
(ii) Bridge	A Bridge works at the DataLink Layer
	It may examine the addresses, and selectively forward messages based on addresses
(iii) Router	A Router works at the Network Layer.
	It may examine payload types and use them to control message processing and forwarding.

The devices should be different in <u>different</u> ways! If you say that A differs from B in the same way that A differs from C, then is B the same as C? So it best to give different differences.

[Total = 6 marks]

4. Alternate

If we leave the bits "as is" and assume the bit order 01001011 is already LSB to left

The Hamming code has parity in bits 1,2,4,8 - pq0r100s1011

```
              p q 0 r 1 0 0 s 1 0 1 1
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```

The codeword is **0 0 0 1 1 0 0 0 1 0 1 1**

[6 marks]

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But the information after removing parity is 11010010, which is NOT the original data!

[4 marks]

But the information after removing parity is 11010010, which is NOT the original data!

People who have made this error should see me (not Jihong) and can expect to get some marks, if their working is correct apart from the non-reversed bits. However, as part (ii) does not yield the answer as stated, they cannot expect many marks for that.