Name.....

THE UNIVERSITY OF AUCKLAND

Department of Computer Science
COMPSCI 314 S1 C 2004 : Test
Monday May 3 2004, 6.30 – 7.30 pm.

- Attempt all questions
- Time allowed 1 hour : total marks = 50 (say 1 minute per mark)
- Answer questions in the spaces provided on the question paper
- Approximate calculations only are needed – no calculators allowed
- Space for extra answers is at the end of this question/answer paper
- You must show working – no working may mean no marks.

1. An LZW compressor has its dictionary initialised as in the diagram. (Yes it is DNA.) Show the decompressed output starts with `TGCCAGCCCGAGCAC` .

	Received code	~~Dictionary entry~~	Decompressed output	generate
1	4		T	
2	3		G	TG
3	2		C	GC
4	2		C	CC
5	1		A	CA
6	6		GC	AG
7	7		CC	GCC
8	3		G	CG
9	9		AG	GA
10	8		CA	AGC
11	7		CC	CAC
12				
13				
14				

Dictionary

Index	Contents
0	end-of-file
1	A
2	C
3	G
4	T
5	TG
6	GC
7	CC
8	CA
9	AG
10	GCC
11	CG
12	GA
13	AGC

Question = 10 marks

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TOTAL	

2. In "classic" 10BASE5 Ethernet, a single cable has a maximum length of 500 metres, and cables may be linked by repeaters to form a segment with a maximum distance between stations of 3 000 metres. Assuming that signals on the cable travel at 200 metres/μs, what is the latest part of an Ethernet frame where a collision may occur on –

   i. a single cable [4 marks]

   ii. a segment (ignore repeater delays) [2 marks]

   iii. Comment on the relevance of these calculations to Fast Ethernet (100 Mbit/s), in a network without hubs or repeaters. [2 marks]

Question = 8 marks

The worst-case situation occurs when a station at one end sends and stations at its end and the other end are both waiting. Both stations must wait for the interframe gap before starting. The near one can start immediately, but the remote must wait for one cable latency and its signal arrives back at the near end after a further latency. The near-end station then detects a collision after one round-trip delay.
Signals take 500/200 = 2.5µs to travel from one end to the other of the cable, or 5µs round-trip latency.
At 10 Mbps this corresponds to 50 bits (after the start of line activity), which is in the middle of the preamble.

The question here asks "where in the Ethernet frame". A lot of students correctly worked out the 2.5µs and went no further. The question does not ask "after what time does a collision occur". So please complete the question and answer what is asked.

Signals take 3000/200 = 15µs to travel from one end to the other of the segment, with a round-trip delay of 30µs.
At 10 Mbps this corresponds to 300 bits, or in the 37th octet.
The preamble/Stt delim are equivalent to 8 octets, the dest adr goes to 14 octets and the source adr to 20 octets.
The collision is therefore in the middle of the 17th data octet (hence the minimum frame length)

These calculations apply only to a contention bus, with propagation times and delays before collisions are detected. Fast Ethernet, being switch based rather than a bus system does not have these delays.

The calculations do not apply.

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3 (i) A bit string `0100 1101` is encoded with a (12,8) Hamming code (odd Parity). What is the resulting binary codeword? [6 marks]

(ii) Show that a received codeword `1001 1100 1101`, can be decoded to yield the original value, after correcting a single error. [4 marks]

(Assume that the bits are shown in the same order as they used in the Hamming code, bit 1 on the left)

[Total = 10 marks]

	1	2	3	4	5	6	7	8	9	10	11	12	1-bits	p-bit
	P	P	0	P	1	0	0	P	1	1	0	1		
Parity 1	X		X		X		X		X		X		2	1
Parity 2		X	X			X	X			X	X		1	0
Parity 4				X	X	X	X					X	2	1
Parity 8								X	X	X	X	X	3	0
Codeword	1	0	0	1	1	0	0	0	1	1	0	1		
Receive	1	0	0	1	1	**1**	0	0	1	1	0	1		syndrome
Parity 1	X		X		X		X		X		X		3	0
Parity 2		X	X			X	X			X	X		2	1
Parity 4				X	X	X	X					X	4	1
Parity 8								X	X	X	X	X	3	0

The syndrome=0110 indicates an error in Bit 6, which is the correct place

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4. Many communications protocols involve sending a message and waiting for a reply before sending anything more. What features should the protocol include to protect against the following situations (1 mark for each answer in right hand column)

Question = 6 marks

i	One or more bits being corrupted in a message	Checksum, Block Check (BCC), Cyclic Redundancy Check CRC), Frame Check Sequence (FCS), etc
ii	Receiving no reply or acknowledgment to a message.	Timeout
iii	What two situations might result from not receiving a reply and then not recovering properly? Explain how each situation arises.	Situation 1 A message is completely lost
		Reason 1 The next message in sequence is sent, instead of repeating the one that is lost
		Situation 2 A message is duplicated
		Reason 2 A message is received correctly, but the reply is lost and the sender repeats the message.

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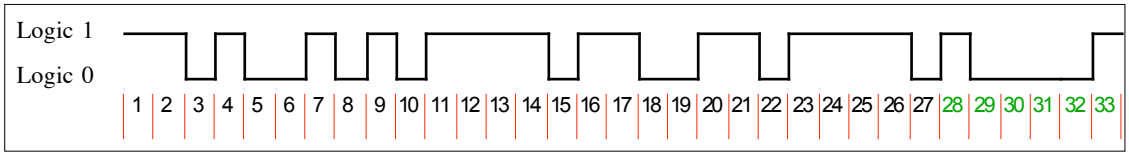
5. The diagram shows the waveforms of some characters encoded for asynchronous transmission. The characters are known to be 7-bit ASCII, plus one parity bit. Assume that the signal has been steady for some time before the waveform shown.



Give the requested information about these characters and their coding. A table of the ASCII character set is at the end of the question. Each bit-time is identified by a number, which should be used to specify the bit.

i	The start bit number of the *first* character	1 mark	3
ii	The stop bit number of the *first* character	1 mark	12
iii	The start bit number of the *second* character	1 mark	15
iv	The Parity bit number of the *third* character (yes, the 3rd)	1 mark	35
v	The *first* character (its symbol, such as 'A')	1 mark	)
vi	The *second* character (its symbol, such as 'Z')	1 mark	3
vii	The Parity rule used for *both* characters	2 marks	force to 1

Question = 8 marks

row (suffix bits)		Column (prefix bits)							
binary	**hex**	**000**	**001**	**010**	**011**	**100**	**101**	**110**	**111**
0000	**0**	NUL	DLE	SP	0	@	P	`	p
0001	**1**	SOH	DC1	!	1	A	Q	a	q
0010	**2**	STX	DC2	"	2	B	R	b	r
0011	**3**	ETX	DC3	#	3	C	S	c	s
0100	**4**	EOT	DC4	$	4	D	T	d	t
0101	**5**	ENQ	NAK	%	5	E	U	e	u
0110	**6**	ACK	SYN	&	6	F	V	f	v
0111	**7**	BEL	ETB	'	7	G	W	g	w
1000	**8**	BS	CAN	(	8	H	X	h	x
1001	**9**	HT	EM	)	9	I	Y	i	y
1010	**A**	LF	SUB	*	:	J	Z	j	z
1011	**B**	VT	ESC	+	;	K	[	k	{
1100	**C**	FF	FS	,	<	L	\	l	|
1101	**D**	CR	GS	-	=	M	]	m	}
1110	**E**	SO	RS	.	>	N	^	n	~
1111	**F**	SI	US	/	?	O	_	o	DEL

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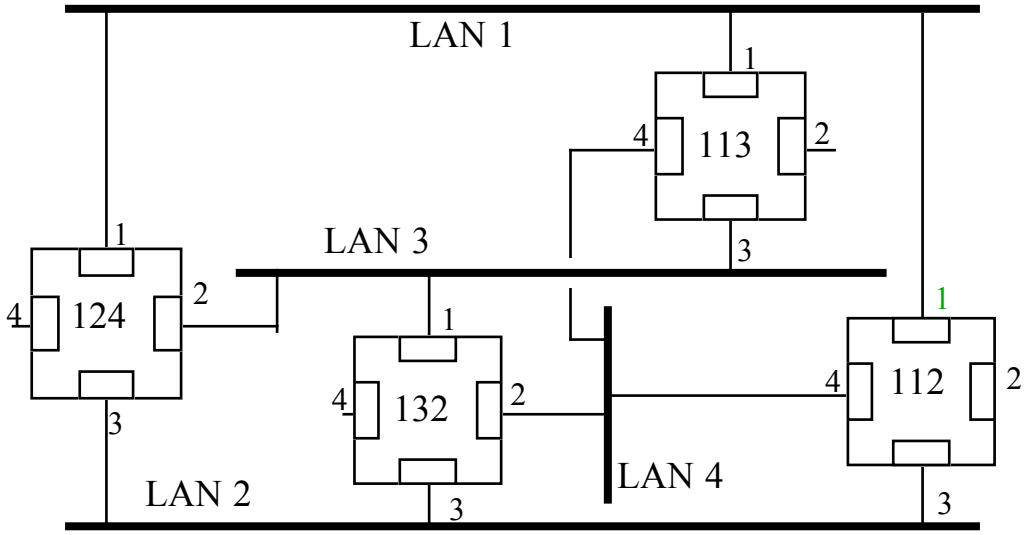
6. The diagram shows four LANs interconnected by bridges. Each bridge is identified by the numbers shown within it (such as 113) and all bridges have the same priority. (Bridge 113, Port 4 is connected to LAN 4.) Ports are numbered as shown and all ports have the same cost (which may be taken as 1).



i. Which is the root bridge, and why? [2 marks]

ii. Determine the spanning tree for this network. [6 marks]

This answer may continue onto the following page

Question = 8 marks

1. Bridge 112 becomes the root bridge because it has the lowest bridge number.

2. LANs 1, 2 and 4 all connect directly to the Root bridge, and only LAN 3 must be considered.
3. Bridge 124 parallels the root bridge connections between LAN 1 and LAN 2 and disables itself because of its higher number (and therefore lower priority).
4. LAN 3 connects to the root bridge through both bridge 113 and bridge 132; bridge 113 takes precedence because of its lower number.

2 marks for each point

END OF QUESTIONS – work space follows