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

THE UNIVERSITY OF AUCKLAND

Computer Science COMPSCI 314FC

Test 23 April 2001, 6.30 – 7.30pm

- Attempt all questions
- Time allowed **1 hour**
- Answer questions in the spaces provided on the question paper
- Approximate calculations only are needed – no calculators are allowed
- Assume that signals travel at 3×10^8 m/s in air or vacuum (300m/µs)
  and at 2×10^8 m/s in cables (200m/µs)

1. **Communication media**: The main communication link between New Zealand and North America is now a fibre-optic cable. Give two reasons why the fibre-optic cable is a better solution than an electrical cable, and give one reason why it is a better solution than a satellite link. **(6 marks)**

2. **Propagation**: An Internet user in New Zealand connects to an Internet Site in Europe. The two sites are connected via various fibre-optic cables with a total length of 20000 kilometres. How long does it take for a packet from New Zealand to reach the server in Europe, provided that there are no other delays except the propagation delay? **(2 marks)**

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3. The orbital period of a geostationary satellite is one sidereal day. This is less than 24 hours. Explain why. **(5 marks)**

4. If the ratio of output over input voltage of an amplifier is 13 dB, what is
   a. the power ratio in dB and
   b. the output power divided by input power? **(8 marks)**

a	
b	

5. In a wireless office network in an open office, a laptop with an 802.11 card is placed on the desk of your boss, 5 m away from a base station. The communications software on the laptop shows that the laptop receives a strong signal from the base station – about 40 dB more than the minimum required for communication. Your boss wants to shift to a desk that is 20 m away from the base station. Should the wireless link still work, and if so, how many dB above the minimum would you expect the signal to be? You may assume that there are no obstacles in the way and that there are no other effects such as reflection or interference from microwave ovens. **(10 marks)**

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6. In an NRZI encoding scheme, zeros are coded as a change in level, whereas ones are coded as "no change". NRZI on its own does not guarantee that the transmitter clock can be recovered at the receiver. If we add bit stuffing to the scheme, the clock can be recovered. Given the above implementation of NRZI,

   a. which bits (zeros or ones?) facilitate the clock recovery? **(2 marks)**

   b. assuming that we bit stuff after five consecutive bits of the type that does not facilitate clock recovery, bit stuff the following sequence **(3 marks)**

   `0111100000111110`

   c. assuming that we bit stuff after five consecutive bits of the type that does not facilitate clock recovery, remove the bit stuffing from the following sequence. **(3 marks)**

   `1111010000011111011`

a	
b	
c	

7. What is an advantage of using Manchester coding over using NRZ? **(2 marks)**

8. What is a disadvantage of using Manchester coding over using NRZ? **(2 marks)**

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9. What is the advantage of using differential Manchester coding over using plain Manchester coding? **(1 mark)**

10. Why does the ASCII character set contain control characters that you cannot print on a screen? Give an example of one such character. **(2 marks)**

11. If you modulate the amplitude of a 1000 Hz sinusoidal tone with a 50 Hz sinusoidal signal, you get two sidebands. At which frequencies are these sidebands? **(2 marks)**

12. Name two components that you might find in an Analog-to-Digital Converter (ADC). **(2 marks)**

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13. An IEEE802.3 network is simulating an 802.4 Token Bus network, sending messages which mimic those of the Token Bus protocol, in an effort to guarantee response times. Although the network usually works satisfactorily, it is found that there is sometimes trouble, especially when adding stations or during other ring maintenance operations.
Explain why —
    a. an 802.3 network might be unable to give guaranteed response times? **(2 marks)**
    b. simulating an 802.4 network might permit guaranteed response times? **(3 marks)**
    c. there might be problems with some 802.4 network maintenance operations? **(4 marks)**

a	
b	
c	

14. A token ring operates at 4 Mbit/s and has 50 stations over a physical cable length of 500 metres. Each station contributes a delay of 1 bit time.
    a. What is the overall delay around the ring, in µs. **(2 marks)**
    b. What is the overall delay around the ring, if each station has a delay of 8 bits (1 octet). **(2 marks)**

a	
b	

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15. Two IEEE 802.3 10BASE5 stations are separated by 500 metres of cable and start transmitting at the same instant.

a. How long does it take each station to detect a collision? **(2 marks)**

b. Approximately how much of each frame will have been sent before the collision is detected? (FCS, Source address, or where?) **(2 marks)**

a	
b	

16. Two users are communicating using a protocol which uses XON/XOFF flow control. What is the visible effect if

a. One user, at a terminal, receives an XOFF character? **(2 marks)**

b. Each user, almost simultaneously, sends an XOFF character to the other? **(2 marks)**

a	
b	

17. A station using an XON/XOFF protocol will often send an XOFF when its buffers are nearly full and then an XON when the buffers are nearly empty.

a. What are the likely effects if the station waits until the buffers are completely full or completely empty? **(4 marks)**

b. How might you estimate a suitable "fullness" or "emptiness" to trigger sending the XON or XOFF. **(3 marks)**

a	
b	

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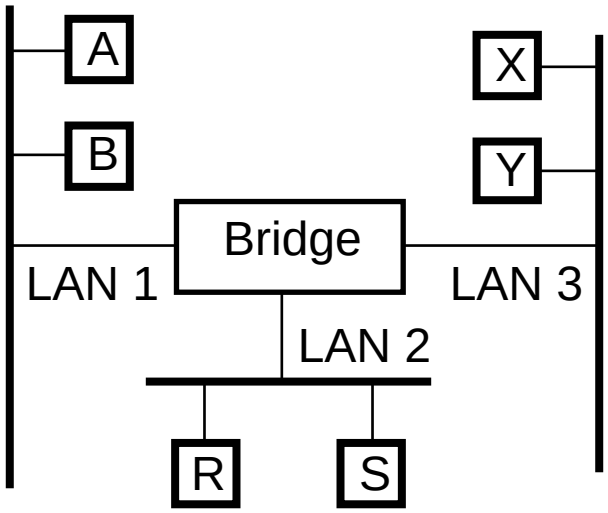
18. A network contains 3 LANs and 6 stations connected by a learning bridge. As the network operates the bridge learns the location of stations and eventually forwards messages only as needed.



The network starts from a completely idle state, with no entries in the bridge's routing tables.

a. Explain what the bridge learns from each of the following messages, and on which LANs each message appears. **(12 marks)**

b. Suggest any more messages that might be needed for the bridge to complete its knowledge of the network. **(4 marks)**

Source		Destination	Message on LANs	bridge learns
R	→	Y		
X	→	B		
S	→	R		
A	→	X		
S	→	X		
X	→	B		
	→			
	→			

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19. When a token ring station wants to send a message of higher priority, it will usually claim a token of lower priority and then stack the old priority.

a. When will the old priority be restored? **(3 marks)**

b. What would be the effect of not restoring the priority? **(3 marks)**

a	
b	

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Sample solutions comments by Ulrich:

Question 1: - I will mark this myself

- Greater bandwidth than copper cable (you can argue about the satellite side of things)
- I would not consider less noise and interference to be an expected benefit of an optical cable over an electrical cable. However, I would consider it a benefit over a satellite link.
- One benefit of fibre optical cables over copper cables is that they are cheaper, so this is an extra benefit. Cost is not an advantage over satellites.

Question 2: to be marked by someone else

1 mark for correct result, 1 mark if there is some reasoning/deduction

Question 3: to be marked by me

Question 4: to be marked by someone else

3 marks for part (a) and 5 marks (2 for result, 3 for deduction) for part (b).

Question 5: to be marked by someone else

5 marks for correct application of distance formula, 5 marks for correct interpretation of results.

Question 6: to be marked by someone else

In (a), just stating "zeros" or "0", etc. should yield full marks.

Question 7 + 8 + 9: to be marked be me

Question 10: to be marked by someone else.

A valid example is sufficient for full marks

Question 11: to be marked by someone else

Full marks for the final solution (no working required here).

Question 12: to be marked by me

Peter Q 15 — 19
Jihong Q 13, 14
Ulrich Q 1, 3, 7 — 9, 12
Andrew Q 2, 4, 10, 11
Clark Q 5, 6