THE UNIVERSITY OF AUCKLAND

SECOND SEMESTER, 2012
Campus: City

Computer Science

TEST

Modern Data Communications

(Time Allowed: 45 MINUTES)

Note:
- The use of calculators is NOT permitted.
- Compare the exam version number on the Teleform sheet supplied with the version number above. If they do not match, ask the supervisor for a new sheet.
- Enter your name and student ID on the Teleform sheet. Your name should be entered left aligned. If your name is longer than the number of boxes provided, truncate it.
- Answer all **Multiple-choice** questions on the Teleform answer sheet provided. Attempt all questions. There are no negative marks.
- Use a dark pencil to mark your answers in the multiple choice answer boxes on the Teleform sheet. If you spoil your sheet, ask the supervisor for a replacement.

Surname:	
First Name(s):	
Student ID:	
Login Name(UPI):	

Question 1
[1 mark] A prefix code is a code in which

(a) some codewords are not proper prefixes of all codewords.
(b) no codeword is a proper prefix of itself.
(c) no codeword is a proper prefix of another codeword.
(d) no codeword is a proper prefix of the smallest length codeword.
(e) some codewords are not proper prefixes of some codeword

Question 2
[1 mark] The code 1, 10, 110, 1110, 11110

(a) is not a prefix code because 11 is a prefix of 110.
(b) is a prefix code because 10 is not a prefix of any other codeword.
(c) is a prefix code because all codewords have different length.
(d) is not a prefix code because the codewords do not have the same length.
(e) is not a prefix code because 1 is a prefix of 10.

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Question 3
[2 marks] The code 11, 10, 110, 1110, 11110

(a) is not uniquely decodable.
(b) is a prefix code because it satisfies the Kraft's inequality.
(c) is uniquely decodable.
(d) is a prefix code because 10 is not a prefix of any other codeword.
(e) is not a code.

Question 4
[2 marks] The Baudot code is a 5-bit code which can encode 36 letters, 10 digits and special characters because it uses the extra information

(a) 11111 (shift down) and 11011 (shift up).
(b) 0 (shift down) and 1 (shift up).
(c) 11111 (shift down) and 00000 (shift up).
(d) 11111 (shift up) and 11011 (shift down).
(e) 11111 (shift up) and 00000 (shift down).

Question 5
[1 mark] All ASCII codewords have the same length, so ASCII

(a) is not a code.
(b) is an infinite code.
(c) is not a prefix code.
(d) is not uniquely decodable.
(e) is a prefix code.

Question 6
[1 mark] A higher-bandwidth channel

(a) has a lower bit rate.
(b) has a higher bit rate.
(c) has a negative bit rate.
(d) has the lowest bit rate.
(e) has zero bit rate.

Question 7
[1 mark] The process of extracting the data from a modulated signal is called

(a) encoding.
(b) modulation.
(c) discretization.
(d) decoding.
(e) demodulation.

Question 8
[1 mark] According to the Nyquist theorem, in a distortion-free transmission, the baud rate is at

(a) three times the maximum frequency of the medium.
(b) most twice the maximum frequency of the medium.
(c) the maximum frequency of the medium.
(d) half the maximum frequency of the medium.
(e) two and a half times the maximum frequency of the medium.

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Question 9
[1 mark] In a distortion-free telephone transmission (where the maximum frequency is 3300 Hz) in which each symbol carries 4 bits, the bit rate is at most

(a) 6400 b/s.
(b) 13200 b/s.
(c) 26000 b/s.
(d) 19200 b/s.
(e) 26400 b/s.

Question 10
[2 marks] The numbers 10, 2, 5:

(a) satisfy Kraft's inequality and the prefix code produced by Kraft's theorem is 00, 01000, 0100100000.
(b) satisfy Kraft's inequality and the prefix code produced by Kraft's theorem is 00, 01000, 0100000000.
(c) the numbers do not satisfy Kraft's inequality.
(d) satisfy Kraft's inequality and the prefix code produced by Kraft's theorem is 00, 0100, 10000000000.
(e) satisfy Kraft's inequality and the prefix code produced by Kraft's theorem is 10, 01000, 1000000000.

Question 11
[2 marks] On input C, the Sardinas-Patterson algorithm computes the sets C_i in increasing order of i. The algorithm terminates and answers that the given code is not uniquely decodable as soon as

(a) there exist two numbers $j < i$ such that $C_i = C_j$.
(b) there exist two numbers $j < i$ such that C_i contains as many elements as C_j.
(c) a set C_i contains a word of odd length.
(d) a set C_i contains a word from C or the empty word.
(e) a set C_i contains a word of even length.

Question 12
[2 marks] Which of the following codewords is a correct Huffman set of codewords for the letters A, B, C, D, E having frequencies 15%, 15%, 10%, 10%, 50%?

(a) A= 101, B=100, C=111, D=0, E=0.
(b) A= 0, B=100, C=111, D=110, E=101.
(c) A= 101, B=100, C=111, D=110, E=0.
(d) A= 101, B=100, C=111, D=110, E=10.
(e) A= 101, B=100, C=111, D=110, E=000.

Question 13
[1 mark] The human eye

(a) cannot see small differences in brightness over a relatively large area.
(b) is insensitive to brightness variation at high frequency.
(c) can see small differences in brightness over a relatively large area and is sensitive to brightness variation at high frequency.
(d) is sensitive to brightness variation at high frequency but cannot see small differences in brightness over a relatively large area.
(e) is sensitive to brightness variation at high frequency.

Question 14
[1 mark] Which of the following statements is TRUE?

(a) Error-correcting codes include redundant information based on which the receiver is able to deduce only the number of incorrect bits.
(b) Error-correcting codes include redundant information so that the receiver is able to deduce, with high likelihood, which bits are incorrect.
(c) Error-correcting codes cannot include redundant information.
(d) Error-correcting codes do not include redundant information.
(e) Error-correcting codes include redundant information so that the receiver is able to deduce exactly which bits are incorrect.

Question 15
[1 mark] The minimum number of redundancy bits r required to correct n bits of data has to satisfy the inequality:

(a) $2^r \leq n+r$.
(b) $2^r \geq n+r+1$.
(c) $2^r = n+r$.
(d) $2^r > n+r+1$.
(e) $2^r < n+r+1$.

Question 16
[1 mark] Which one among the following statements is NOT true in general?

(a) Some uniquely decodable codes are prefix codes.
(b) Some finite codes are uniquely decodable.
(c) Every uniquely decodable code is a prefix code.
(d) Every fixed-length code is a prefix code.
(e) Every prefix code is uniquely decodable.

Question 17
[1 mark] Which of the following statements is TRUE?

(a) There are only two ways to adjust a sine wave: changing the frequency and the phase.
(b) There are three ways to adjust a sine wave: changing the frequency, the amplitude, and the phase.
(c) There are no ways to adjust a sine wave.
(d) There is only a way to adjust a sine wave: changing the amplitude.
(e) There are only two ways to adjust a sine wave: changing the amplitude and the phase.

Question 18
[1 mark] Which of the following statements is TRUE?

(a) Every periodic function can be expressed as a finite sum of sine and cosine functions of varying frequencies and phase shifts.
(b) Every periodic function can be expressed as an infinite sum of sine and cosine functions of varying amplitudes, frequencies and phase shifts.
(c) Every periodic function can be expressed as a finite sum of sine and cosine functions of varying amplitudes, frequencies and phase shifts.
(d) Every periodic function can be expressed as a finite sum of sine and cosine functions of varying amplitudes and frequencies.
(e) Every periodic function can be expressed as an infinite sum of sine and cosine functions of varying amplitudes and phase shifts.

Question 19
[2 marks] Which of the following statements is TRUE?

(a) By compression the size of a file of *8n* characters has decreased by *5n* characters thus resulting in a 33.5% reduction.
(b) By compression the size of a file of *8n* characters has decreased by *5n* characters thus resulting in a 37.5% reduction.
(c) By compression the size of a file of *8n* characters has decreased by *5n* characters thus resulting in a 33% reduction.
(d) By compression the size of a file of *8n* characters has decreased by *5n* characters thus resulting in a 35% reduction.
(e) By compression the size of a file of *8n* characters has decreased by *5n* characters thus resulting in a 35.5% reduction.

Question 20
[1 mark] Which of the following statements is TRUE?

(a) A single video image contains no repetition, and there is no repetition over several images.
(b) A single video image may contain lot of repetition, but there is little repetition over several images.
(c) A single video image contains lot of repetition, but there is little of repetition over several images.
(d) A single video image may contain little repetition, as well as little repetition over several images.
(e) A single video image may contain little repetition, but there is a lot of repetition over several images.

Question 21
[1 mark] Consider two links:
(i) an asynchronous link that adds one start bit and one stop bit to each 8-bit byte.
(ii) a synchronous link sending frames of 8-bit bytes, using two SYNC bytes and one END byte within each frame.
How many bits are needed to send 100 bytes of data on each link?

(a) asynchronous 1000, synchronous 824.
(b) asynchronous 1000, synchronous 800.
(c) asynchronous 1000, synchronous 830.
(d) asynchronous 800, synchronous 824.
(e) asynchronous 800, synchronous 803.

Question 22

[1 mark] Which of the following best describes a *null modem?*

(a) A device that enables a computer to communicate over power lines.
(b) A device for interconnecting two computers.
(c) A device used for testing a single computer serial interface.
(d) A device used for testing a network link.
(e) A device for connecting a computer to a telephone line.

Question 23

[1 mark] Which of the following flow control techniques does NOT use in-band signalling?

(a) Stop-and-wait protocol.
(b) Selective Repeat protocol.
(c) DTE-DCE.
(d) Go-back-n protocol.
(e) XON/XOFF.

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Question 24
[2 marks] Assume that a fibre from Auckland to Wellington is 600 km long, and provides a 10 Mb/s link. Approximately how long does it take for a 1500-byte frame to be sent out and acknowledged? *(Hints: light travels at 2×10^8 m/s in optical fibre; you may ignore the time needed to send the short ACK frame)*

(a) 1.2 ms
(b) 4.2 ms
(c) 6 ms
(d) 3 ms
(e) 7.2 ms

Question 25
[1 mark] Assume you have designed a transmission protocol that uses an 8-bit unsigned integer for frame sequence numbers. What limits does that impose on a sliding-window protocol?

(a) The protocol will only work properly if the round-trip time is less than 256 ms.
(b) Files smaller than 256 frames may not be transmitted reliably.
(c) Files bigger than 256 frames cannot be transmitted.
(d) Each frame cannot contain more than 256 bytes.
(e) The window cannot hold more than 256 frames.

Question 26
[1 mark] Which of the following statements about the Selective Repeat protocol (SR) is FALSE?

(a) SR resends frames that receive a NAK response.
(b) SR resends timed-out ACK or NAK frames.
(c) SR resends frames received out of sequence.
(d) An SR sender knows that all ACKed frames have been safely received.
(e) SR sends an ACK frame for each correctly-received frame.

Question 27
[1 mark] Why does Ethernet transmission have an inter-frame gap?

(a) We need such a gap to allow reliable collision detection.
(b) It provides time for interfaces to switch between transmit and receive mode.
(c) We need to allow time for sender to read frames from memory.
(d) We need to stop a host from monopolising the medium.
(e) We need to allow time for a receiver to write frames to memory.

Question 28
[1 mark] Consider Ethernet hubs and switches. Which of the following statements is FALSE?

(a) A switch allows full-duplex Ethernet working.
(b) A hub can be used to extend an Ethernet segment.
(c) A switch can have more ports than a hub.
(d) A hub always repeats a signal to all its ports.
(e) A switch may receive a packet then re-send it.

Question 29
[1 mark] Gigabit Ethernet allows collisions in half-duplex links; what feature of 10 Mb/s Ethernet had to be changed to allow this?

(a) Increase minimum segment size to 512 B.
(b) Only allow collisions on fibre links.
(c) Increase inter-frame gap to 192 bits.
(d) Require switches to detect collisions.
(e) Decrease max segment length to 10 m.

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Question 30
[1 mark] Why is 10 Gb/s Ethernet not available for copper-wire links?

(a) 10 Gb/s Ethernet is only suitable for links longer than 10 km.
(b) Fibre links are more secure than copper.
(c) Copper interfaces would be too expensive.
(d) A suitable encoding scheme for this hasn't been found yet.
(e) Only fibre can handle its high data rate.