

# THE UNIVERSITY OF AUCKLAND

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**SECOND SEMESTER, 2015**  
**Campus: City**

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## COMPUTER SCIENCE

### Modern Data Communications

**(Time allowed: 40 minutes)**

**NOTE:**

- Enter your name and student ID into the Teleform sheet **FIRST**.
- **THEN:** Attempt *all* questions!
- All questions have **ONE** correct answer.
- **DO NOT** tick two answers as correct for the same question.
- If you believe that there is an error in a question (multiple correct answers or no correct answer), select the answer you believe was intended as the correct one and contact the test room supervisor after the test.
- Hand in your Teleform sheet, but *keep your question sheets*.
- Use of calculators is **NOT** permitted.
- Good luck!

1. The difference between QPSK and 16QAM is that

- A. in 16QAM, one also does phase shift keying.  
 B. 16QAM has fewer phase angles for its constellation points.  
 C. 16QAM is more robust against noise.  
 D. in 16QAM, one also does amplitude shift keying.  
 E. 16QAM occupies more bandwidth.

2. You receive a Hamming-encoded codeword with 8 data bits  $m_1$  to  $m_8$  and 4 parity bits  $p_1$  to  $p_4$ . The parity check matrix is:

	$m_1$	$m_2$	$m_3$	$m_4$	$m_5$	$m_6$	$m_7$	$m_8$
$p_1$	1	1	0	1	1	0	1	0
$p_2$	1	0	1	1	0	1	1	0
$p_3$	0	1	1	1	0	0	0	1
$p_4$	0	0	0	0	1	1	1	1

After computing your own parity checks on the received codeword, you find that your values for  $p_2$  and  $p_4$  differ from those in the codeword you received. Which bit is in error with the highest probability?

- A.  $m_6$   
 B. There is more than one bit error in the codeword, and it is not possible to tell which bits are affected.  
 C.  $p_4$   
 D.  $p_2$   
 E.  $m_5$

3. 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. Files bigger than 256 frames cannot be transmitted.  
 B. Each frame cannot contain more than 256 bytes.  
 C. Files smaller than 256 frames may not be transmitted reliably.  
 D. The protocol will only work properly if the round-trip time is less than 256 ms.  
 E. The window cannot hold more than 256 frames.

4. Which of the following does the UDP protocol allow an application to send?

- A. A reliable sequence of bytes.
- B. A reliable sequence of data segments.
- C. A reliable sequence of datagrams.
- D. An unreliable sequence of bytes.
- E. An unreliable sequence of datagrams.

5. 54 dB correspond to a voltage ratio of approximately

- A.  $54^2 : 1$
- B. 54:1
- C. none at all, dB correspond only to power ratios
- D. 500:1
- E. 250,000:1

6. Point A and point B are 20 m apart. The power received at point B from a wireless transmitter at point A is -68 dBm. What is the power at point C 80 m away from the transmitter? You may assume that A, B, and C are on the same straight line.

- A. -80 dBm
- B. -62 dBm
- C. -88 dBm
- D. -144 dBm
- E. -65 dBm

7. To construct a ground station for a medium earth orbit satellite system that can provide 24/7 service (except in cases of equipment failure), you need:

- A. a larger antenna than for a geostationary satellite
- B. to be on the equator
- C. a clear view to the sky above the South Pole
- D. 20
- E. a more powerful transmitter than for a geostationary satellite

8. Suppose we have a received signal power 256 times that of the noise power, giving us a theoretical channel capacity of  $C$  bits/second in a bandwidth of  $B$  Hz. Doubling the bandwidth of the system from  $B$  to  $B'$  results in a theoretical channel capacity of

- A.  $2C$
- B.  $3B$
- C.  $2B'$
- D.  $7B'$
- E.  $8B'$

9. Category-5 twisted-pair Ethernet wiring has four separate copper wire pairs in an insulating outer covering. How does 1000BaseT (Gigabit Ethernet) use the pairs to achieve its 1 Gb/s data rate?

- A. Each pair carries 250 Mb/s of data, using 5-level signaling and error-correcting codes.
- B. Each pair carries 250 Mb/s of data, using Manchester encoding and error-correcting codes.
- C. Two pairs carry 500 Mb/s, using 8-level signaling; the other two are unused.
- D. Each pair carries 250 Mb/s of data, using 5-level signaling; error-correction is not needed.
- E. Each pair carries 250 Mb/s of data, using Manchester encoding; error correction is not needed.

10. Which of the following is NOT one of the reasons why TCP connections are considered to be “good neighbours”?

- A. TCP recovers well if it receives packets that are out of sequence because they have followed different Internet paths.
- B. A TCP sender will retransmit a segment after seeing three duplicate ACKs with values less than its next segment's sequence number.
- C. TCP starts sending data slowly, but increasing gently.
- D. TCP works well over a wide range of link speeds.
- E. TCP will attempt to use as much of a link's capacity as it can.

11. The speed of light in an optical communications fibre

- A. is lowest in the mantle of the fibre.
- B. is lowest in the core of the fibre.
- C. can be increased with optical amplifiers.
- D. is 1.5 times the speed of light in vacuum.
- E. depends on the length of the fibre.

12. A 32-bit CRC checksum has

- A. a 31 bit generator polynomial.
- B. an even generator polynomial.
- C. a 32 bit generator polynomial.
- D. a 16 bit generator polynomial.
- E. a 33 bit generator polynomial.

13. Assume that a fibre from Auckland to Palmerston North is 400 km long, and is used to provide 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  $2 \times 10^8$  m/s in optical fibre; you may ignore the time needed to transmit the short ACK frame.)

- A. 1.2 ms
- B. 5.2 ms
- C. 2 ms
- D. 4 ms
- E. 3.2 ms

14. Assume a receiver clock that runs at about 1.000002 the speed of the clock of a transmitter. The transmitter sends (going by its own clock) at signal with a symbol rate of 100 MBaud (100 Megabaud). At the receiver, you would expect:

- A. bitstuffing
- B. 200 symbol deletion errors per second
- C. 500,000 symbol deletion errors per second
- D. 100 symbol insertion errors per second
- E. 200 symbol insertion errors per second

15. We can delimit messages on a binary channel that only knows the symbols 0 and 1 with the byte 01111110 at each end, and by bit stuffing the bits within the message itself. How can we “prove” to the receiver that the bits between the 01111110’s are a message rather than just bits from random noise?

- A. By NRZI-encoding.
- B. By sending the symbol 11111111 at the end of the message.
- C. By sending the symbol 11111111 at the beginning of the message.
- D. By including a CRC checksum at the end of the message.
- E. By sending the symbol 11111111 in the middle of the message.

16. Which of the following features of USB makes it safe to use a USB interface to charge the battery in a small, portable device?

- A. USB supports several common types and sizes of connector.
- B. A computer's USB port can support a tree of connected devices.
- C. A computer's USB port can power to USB-connected devices.
- D. USB devices are hot-swappable.
- E. USB supports serial data transmission at speeds of 400 Mb/s or more.

17. In Gray-coded 16QAM, which of the following cannot be a closest neighbour of the constellation point labelled 1101?

- A. 1100
- B. 1010
- C. 0101
- D. 1001
- E. 1111

18. How many dB does a power ratio of 1200:1 approximately correspond to

- A. 31 dB
- B. 12 dB
- C. 60 dB
- D. 61 dB
- E. 36 dB

**Working page 1**

**Working page 2**

