THE UNIVERSITY OF AUCKLAND

SECOND SEMESTER, 2017
Campus: City

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.
- Use of calculators is NOT permitted.
- Good luck!

Multiple choice questions

Fill in the correct answer on the Teleform sheet.

1. A communication transmitter's output power is approximately 3 mW (milliWatts) with an output voltage of around 0.4 V. If you increase the output power until you achieve an output voltage of about 1.2 V, you would expect the output power to be close to:

   A. 6 mW
   B. 1.5 mW
   C. 30 mW
   D. 10 mW
   E. 5 mW

2. A computer at the ground station of geostationary satellite 'pings' the satellite once every few seconds by sending a small packet to the control computer aboard the satellite. The ground station computer then measures the time it takes until the return packet from the satellite's computer arrives (the round-trip-time or RTT). The log files of the ground station computer show that RTT suddenly increased by over half a second, from one 'ping' to the next. What is the most likely reason?

   A. The satellite's cable has snapped.
   B. The satellite has drifted out of its orbit.
   C. The satellite transmitter's output power has dropped.
   D. The computer on the satellite is too busy to process its receive and/or transmit queue.
   E. The satellite's frequency has changed.

3. Which of the following is a disadvantage of optical fibre compared to direct line-of-sight wireless communication?

   A. Optical fibre communication suffers from interference from nearby fibres.
   B. Wireless communication permits much higher data rates.
   C. Over the same distance, fibre has higher latency.
   D. Optical transmission can use much higher power.
   E. Optical transmitters are much more expensive than radio transmitters.

4. You have five signal amplifiers, A1, A2, A3, B1, and B2. For a sinusoidal signal, you measure the input and output power at A1, A2, and B1, and the input and output voltage levels at A3 and B2. From your measurements, you compute the output-to-input power ratio of A1 as 12 dB, that of A2 as 10 dB, and that of B1 as 15 dB. The output-to-input voltage ratios of A3 and B2 are 8 dB and 6 dB, respectively. Presuming that you feed the output of one amplifier into the input of the next, which of the following combinations of amplifiers gives the highest total gain?

   A. B1 followed by A3
   B. A1 followed by B1
   C. A2 followed by A3
   D. B1 followed by B2
   E. A3 followed by B2

5. A transmitter X in a 100 Mb/s (Megabits per second) half-duplex channel sends packets with a total data volume (headers and payload data) of 5 MB (MegaBytes) per second. What is the maximum goodput that receiver Y can theoretically receive on this channel from another transmitter Z?. You may assume that the signal power that Y from X is similar to that received from Z.

   A. 7.5 MB/s
   B. 5 MB/s
   C. 12.5 Mb/s
   D. 95 Mb/s
   E. 5 Mb/s

6. Compared to a GEO satellite system, a MEO satellite system

   A. requires no moving parts on its ground antennas.
   B. orbits faster and requires larger rockets and more fuel.
   C. has higher latency.
   D. generally requires larger antennas for the same level of service.
   E. requires more satellites for continuous service provision to a ground station.

7. Which of the following is not possible in a bandwidth-limited channel?

   A. Forward error correction.
   B. Near error-free communication.
   C. Bit stuffing.
   D. Communication at bit rates higher than the bandwidth.
   E. Instantaneous transitions between constellation points.

8. You are amplitude modulating a 1,200 MHz carrier with a baseband speech signal consisting of frequencies between 1 kHz and 5 kHz. The lower sideband of the resulting spectrum would be found

   A. between 1,200 MHz and 1,205 MHz.
   B. between 1,199,999,995 Hz and 1,199,999,999 Hz.
   C. between 1 kHz and 1,199,995 kHz.
   D. between 1 kHz and 1,199,999,999 Hz.
   E. between 1,199,995,000 Hz and 1,199,999,000 Hz.

9. A QAM scheme uses a Gray code that assigns 6 bits to each constellation point. To be able to assign all possible bit combinations, this scheme must use

   A. a 6-by-6 array of constellation points.
   B. 256-QAM.
   C. four phases and two amplitude levels.
   D. an 8-by-8 array of constellation points.
   E. 16384-QAM.

10. A given input signal into a channel consists of 10 sinusoidal signals of different amplitudes, frequencies and phases. Two of these frequencies are outside the channel's bandwidth. This means that the received signal will be

    A. distorted.
    B. channeled.
    C. attenuated.
    D. amplified.
    E. corrupted.

11. If the channel adds significant noise to a QAM signal, this may result in

    A. a higher bit rate.
    B. higher latency.
    C. a lower number of constellation points.
    D. a lower signal bandwidth.
    E. reception of the wrong constellation point.

12. Consider the Shannon-Hartley capacity theorem in its simplified form:

$$C = B \log_2 \frac{S}{N}.$$

What would happen to the channel capacity if you were to double the transmit power and double the bandwidth to $B' = 2B$?

A. The capacity increases to $2C + 2B^2$.
B. The capacity increases to $2C^2$.
C. The capacity increases to $2C$.
D. The capacity remains constant.
E. The capacity increases to $2(C + B')$.

13. A transmitter T transmits an optical signal that encodes a 1 as 'light on' and a 0 as 'light off.' Each bit takes the same amount of time *t* microseconds to transmit, which the transmitter measures using its own clock. The receiver R checks every t microseconds (according to its own clock) whether the state of the channel is'light on' or 'light off' and outputs the corresponding bit. If the clock of T runs faster than the clock of R, which of the following effects would you expect?

A. R will occasionally receive a parity bit.
B. R will occasionally receive a flipped (inverted) bit.
C. R will occasionally receive the same bit twice.
D. R will occasionally miss a transmitted bit.
E. R has sidebands at +/- t Hz.

14. Which of the following statements is *FALSE?*

A. Synchronous transmission uses much the same number of overhead bits as Asynchronous transmission, even when sending large data frames.
B. Synchronous transmission uses a continuously-running clock. If there are no frames to send, SYN chacters are sent instead.
C. Asynchronous communication was designed for devices that send single characters, such as keyboards.
D. Synchronous transmission sends large groups of characters as data 'frames'.
E. In asynchronous mode, a character is preceded by a start bit, and ends with a stop bit.

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

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

16. Time-Division Multiplexing (TDM) and Statistical Multiplexing (SM) are two methods to carry several bit streams through a channel. Which of the following statements is *FALSE*?

A. TDM uses fixed time slots, so each bit stream gets a well-defined share of the channel.
B. SM is harder to implement, which could make Statistical Multiplexers more expensive.
C. SM data frames may carry a stream identifier.
D. TDM doesn't require data frames to carry a stream identifier.
E. SM makes better use of the channel if traffic in the bit streams is bursty.

17. Consider a link that is using the Selective Repeat protocol, with a window size of 6 and a sequence number range of 20. A receiver has acknowledged (and delivered to the user), packets with sequence numbers up to 7. It then receives packets with sequence umbers 8, 10, 12, 13.
Which of the following actions should it take?

A. Send an ACK for packet 8, and a NACK for packet 9.
B. Send ACKs for packets 8, 10, 12 and 13.
C. Send an ACK for packet 8, and deliver packet 8 to the user.
D. Send an ACK for packet 8, 10, 12 and 13, and NACKs for packets 9 and 11.
E. Send ACKs for packets 8, 10, 12 and 13, and deliver packet 8 to the user.

18. The following list contains four statements about UDP:

    W: UDP applications can implement their own recovery from packet losses.
    X: UDP headers have only 8 bytes, but TCP headers have at least 20 bytes.
    Y: UDP does not guarantee that any packet will be received only once.
    Z: UDP is connectionless, allowing it to handle incoming packets quickly

    Which of the above statments are good reasons why UDP is most suitable for Domain Name System (DNS) transactions?

    A. X and Z.
    B. Y and Z.
    C. W and Y.
    D. X and Y.
    E. W and Z.

19. Consider the following TCP session, which starts with an opening (3-way) handshake and ends with a closing (4-way) handshake:

Packet	Direction	Flags	Seq Number	Ack Number
1:	A → B	SYN	120	–
2:	A ← B	SYN+ACK	310	121
3:	A → B	ACK	121	311
4:	A → B	ACK	121	311
5:	A ← B	ACK	311	132
6:	A ← B	FIN+ACK	324	132
7:	A → B	ACK	132	325
8:	A → B	FIN+ACK	132	325
9:	A ← B	ACK	325	133

    How many *data* bytes were sent by A to B, and by B to A?

    A. 12 from A to B, 15 from B to A
    B. 12 from A to B, 13 from B to A
    C. 11 from A to B, 14 from B to A
    D. 11 from A to B, 13 from B to A
    E. 13 from A to B, 13 from B to A

20. How does a CSMA/CD sender behave when it detects a collision on the medium?

A. It sends a long 'Jam' signal, so as to make all stations aware of the collision, then resends.
B. It sends a short 'Jam' signal, so as to minimise the time the medium is occupied, then resends.
C. It stops sending, waits for a random time, then resends.
D. It stops sending, waits for the medium to be quiet, then resends.
E. It discards the frame it was trying to send, and reports the collision to its network layer.

SPARE PAGE FOR ROUGH WORKING

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