

# THE UNIVERSITY OF AUCKLAND

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**SECOND SEMESTER, 2014**

**Campus: City**

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**COMPUTER SCIENCE**

**Modern Data Communications**

**(Time Allowed: TWO HOURS)**

Note:

- Read these instructions carefully.
- Compare the exam version number on the Teleform sheet supplied with the version number printed in the top left corner of this page. If they do not match, ask the examination supervisor for a new sheet.
- No books, calculators or other electronic aids are allowed.
- Enter your name and student ID on the Teleform sheet. Your name should be entered left aligned. If you have a middle initial, enter it under M. If your name is longer than the number of boxes provided, truncate it.
- Use a dark pencil to mark your answers in the multiple choice answer boxes on the Teleform sheet. Check that the question number on the sheet corresponds to the question number in this question book. If you spoil your sheet, ask the supervisor for a replacement. Writing on the sheet will NOT be marked.
- Each question should have exactly one correct answer and carries 1 mark.
- If you believe that a question erroneously may have no correct answer, choose the one you believe comes closest to a correct answer. If you believe that a question erroneously has more than one correct answer, choose whichever you believe may have been intended as the correct answer. In either case, please notify the course supervisor immediately after the exam.
- Take your question book home with you and keep it in a safe place. Writing on the question book will not be marked.
- This term test is marked out of 40 marks and is worth 70% of your final mark for this course.

CONTINUED

**Question 1**

A radio link between two points 100 km apart ...

- (a) is only possible if the two points are fixed and not mobile
- (b) has vastly more bandwidth than a fibre optic link
- (c) costs much more to implement than a fibre optic link
- (d) has two thirds or less latency than that of a fibre optic link
- (e) only makes sense if a geostationary satellite link is not an option

**Question 2**

Consider a sinusoidal carrier signal of 100 MHz and a square wave of 100 kHz fundamental frequency (i.e., 100,000 on-off cycles per second). Restrict the contributing frequency components of the square wave to the three components with the *lowest frequency* (not including any DC component). Then use this signal to amplitude modulate the carrier. What will be the lowest frequency in the resulting signal?

- (a) 99.5 MHz
- (b) 0 MHz
- (c) 100.1 MHz
- (d) The signal will have infinite bandwidth
- (e) 99.7 MHz

**Question 3**

Consider a QAM signal with a quadratic arrangement of the constellation points. Suppose that we have a signal-to-noise ratio of 24 dB at the receiver. How many constellation points can we roughly accommodate without getting an unduly large number of symbol errors?

- (a) 10 x 10
- (b) 32 x 32
- (c) 4 x 4
- (d) 16 x 16
- (e) 8 x 8

**Question 4**

The noise power per unit (Hertz) of bandwidth at a receiver depends only on the temperature. Assuming that the receiver bandwidth matches the (known) bandwidth of the signal we wish to receive, what else do we need to know to compute the theoretical maximum capacity of our transmission channel?

- (a) The bit error rate
- (b) The baud rate
- (c) The signal power at our receiver
- (d) The modulation scheme
- (e) The transmit power

**Question 5**

A power ratio of 34 dB corresponds to an absolute power ratio of approximately

- (a) 200:1
- (b) 2000:1
- (c) 68 dB
- (d) 2500:1
- (e) 17:1

**Question 6**

Consider a constellation diagram as it is "seen" by a receiver. If the received signal decreases and the noise increases, what would happen from the receiver's perspective?

- (a) The distance between actual constellation points would increase and the average distance between received and actual constellation points would decrease.
- (b) The actual constellation points would rotate around the origin and the received constellation points would all move further out.
- (c) The distance between actual constellation points would decrease and the average distance between received and actual constellation points would increase.
- (d) The distance between actual constellation points and the average distance between received and actual constellation points would decrease.
- (e) The distance between actual constellation points and the average distance between received and actual constellation points would increase.

**Question 7**

Consider a QPSK constellation diagram with four constellation points at 0, 90, 180, and 270 degrees. How many possible Gray codes exist for this constellation if the constellation point at 0 degrees has the bit value 00?

- (a) 1
- (b) 3
- (c) 5
- (d) 4
- (e) 2

**Question 8**

Consider a simple parity code consisting of 8 data bits and one parity bit, with odd parity. Which of the following codewords contains an error?

- (a) 010110011
- (b) 110010111
- (c) 101000001
- (d) 110110010
- (e) 011110100

**Question 9**

In the following parity check matrix of a Hamming code, the rows indicate the parity bits p1 to p4 from top to bottom and the columns indicate the data bits m1 to m8 from left to right.

11011010  
10110110  
01110001  
00001111

If we have an error in data bit m6, which parity bits are affected?

- (a) p1, p2, and p4
- (b) p3 only
- (c) p2 and p4
- (d) p1, p2, and p3
- (e) p1 and p3

**Question 10**

A transmitter sends a bit sequence using NRZ. If the receiver clock is slower than the transmitter clock, what would you expect?

- (a) Bit deletion errors (receiver misses bits)
- (b) Bit inversion errors (receiver detects bit values that are the opposite of what was transmitted)
- (c) Bit insertion errors (receiver detects additional bits that were not transmitted)
- (d) Parity bits might occur.
- (e) Bit reordering errors (receiver detects bits in different order)

**Question 11**

Which of the following represents the actual CRC checksum value in cyclic redundancy checks?

- (a) The zero bits
- (b) The message polynomial
- (c) The remainder of the modulo-2 division
- (d) The result of the modulo-2 division
- (e) The generator polynomial

**Question 12**

Which information does the receiver feed back to the transmitter in network coding?

- (a) The number of bytes decoded
- (b) The latency between transmitter and receiver
- (c) The number of bytes received
- (d) The percentage of packets received
- (e) The degrees of freedom available at the receiver

**Question 13**

Which of the following flags may appear in more than two packets during a TCP connection?

- (a) FIN and ACK
- (b) ACK and PuSH
- (c) FIN and PuSH
- (d) SYN and FIN
- (e) SYN and ACK

**Question 14**

A TCP connection monitors its Round Trip Time (RTT) by measuring the time between sending TCP packets and receiving their ACKs. Which of the following best describes how TCP's retransmission timeout period (RTO) is determined?

- (a) TCP negotiates RTO during the connection's opening handshake
- (b) TCP's RTO is increased if packets are received out of sequence
- (c) TCP uses an arbitrarily high fixed value for RTO
- (d) A TCP sender's RTO is increased when the receiver's Window Size decreases
- (e) TCP maintains RTO as a small multiple of RTT

**Question 15**

The USB Interface Bus provides a way of connecting devices to a computer using a tree of USB hubs. Which of the following does the USB standard NOT specify?

- (a) Serial data transmission rate
- (b) Maximum number of USB hubs in a tree
- (c) Maximum current that a connected device may draw
- (d) Maximum number of connected devices
- (e) Number of insert/remove cycles for connectors

**Question 16**

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) 4 ms
- (b) 1.2 ms
- (c) 5.2 ms
- (d) 2 ms
- (e) 3.2 ms

**Question 17**

Consider a transport protocol that uses 5-bit sequence numbers. If you see an incoming frame with sequence number 29, what should the sequence number of the fourth incoming frame after that be?

- (a) 1
- (b) 2
- (c) 33
- (d) 31
- (e) 3

**Question 18**

The OSI Protocol Stack has seven layers (1:Physical, 2:Link, 3:Network, 4:Transport, etc). Which layers do Local Area Networks (LANs) provide?

- (a) 1, 2, 3 and 4
- (b) 1, 2 and 3
- (c) 2, 3 and 4
- (d) 2 and 3
- (e) 1 and 2

**Question 19**

Ethernet (802.3) has evolved over the years from 10 Mb/s on coaxial cable with repeaters to 1 Gb/s on unshielded twisted pair (UTP) cable using switches. Which of the following is the most important difference between these two kinds of hardware for Local Area Networks (LANs)?

- (a) Less hardware (e.g. no switches) is required for a coaxial cable system
- (b) UTP and switches allow hosts to use full-duplex traffic
- (c) Coaxial cable provides a bus topology, UTP provides a star topology
- (d) A UTP-based system is easier to maintain and trouble-shoot
- (e) Coaxial cable hardware made it easy for users to add new hosts to the LAN

**Question 20**

Why do 802.11 wireless frames carry four MAC addresses, rather than two MAC addresses as in 802.3 Ethernet frames?

- (a) Because frames may be relayed through 802.11 Access Points
- (b) One of the four MAC addresses is used to carry the sender's network name (SSID)
- (c) The four addresses allow wireless hosts to specify an Internet route from sender to receiver
- (d) An 802.11 frame must always specify its Access Point's MAC address
- (e) One of the four MAC addresses is used to carry the address of the network's default router

**Question 21**

Which of the following does the Spanning Tree protocol for Ethernet bridges NOT do?

- (a) Eliminate loops within multi-LAN networks
- (b) Find the shortest path from each bridge to an elected 'root' bridge
- (c) Detect changes in network topology
- (d) Turn on bridges to maintain service in a multi-LAN network when bridges fail
- (e) Optimise paths between LANs

**Question 22**

Which of the following statements gives a reason NOT to use VLANs?

- (a) VLANs let sets of hosts interoperate together even if they are not connected to the same network switch
- (b) VLAN tagging can enable network administrators to prioritise network traffic within trunks (links that carry traffic for several VLANs)
- (c) VLANs may allow network administrators to make more effective use of their inter-building and inter-site cabling
- (d) 802.1q VLAN tags make Ethernet packets four bytes longer
- (e) Broadcast packets are only sent to hosts in their source host's VLAN

**Question 23**

Which of the following is a DISADVANTAGE of Link State routing?

- (a) A Link State router calculates a new routing table whenever a link state changes
- (b) Calculating a forwarding table using the Link State information is not a distributed algorithm
- (c) Link State routing relies on distributing network maps rather than routing tables
- (d) Since Link State routers know the state of all the network's links, their routing tables converge quickly
- (e) Routers need fast processors and large memory to handle the Link State calculation and storage

**Question 24**

BGP4, the Internet's global routing protocol, maintains routes between Autonomous Systems (ASes). What does BGP4 use as its link metric?

- (a) The AS path length
- (b) The sum of the transit times between ASes
- (c) The number of hops between routers
- (d) Internet Service Provider policy attributes, e.g. BGP Community
- (e) The minimum link capacity of hops between routers

**Question 25**

Which of the following statements about passive Internet measurement is FALSE?

- (a) Passive measurement can be done by targeting specific applications (e.g., Web or P2P traffic).
- (b) Passive measurement at an edge network of an organization is done by connecting a network monitor to the edge router.
- (c) Passive measurement generates additional network traffic and perturbs the flow of normal traffic.
- (d) An example of passive Internet measurement is logging data about requests made to a Web server.
- (e) Passive Internet measurement can be performed by listening to all traffic passing through routers or hosts.

**Question 26**

Which of the following statements about Internet traffic measurement is FALSE?

- (a) Measurements can be done at edge or core networks.
- (b) Measurements cannot be performed at individual end systems.
- (c) Measurements from multiple viewpoints enhance the representativeness of the results by reducing skews and anomalies in the data.
- (d) Measurements taken in core networks can provide representative results because core networks aggregate traffic from hundreds of thousands of users.
- (e) Off-the-shelf network analyzers come with measurement devices and software for real-time analysis and visualization of Internet traffic.

**Question 27**

Suppose a client requests an html page from a Web server. The Web server transfers this html file to the client. Based on data transfer reliability and timing requirements of the Web application, this transfer would be

- (a) Loss intolerant and time sensitive
- (b) No set requirements
- (c) Loss intolerant and time insensitive
- (d) Loss tolerant and time sensitive
- (e) Loss tolerant and time insensitive

**Question 28**

Consider the following lines from a Web server log (in common access log format):

```
corvas.cts.com - - [24/Oct/2014:13:46:45 -0600] "GET 2.gif HTTP/1.1" 200 1024
corvas.cts.com - - [24/Oct/2014:13:46:47 -0600] "GET 3.gif HTTP/1.1" 200 1024
corvas.cts.com - - [24/Oct/2014:13:46:50 -0600] "GET 4.gif HTTP/1.1" 200 2048
```

Which of the following statements is FALSE?

- (a) The average transfer size of the requests was approximately 13 kilobyte.
- (b) The host corvas.cts.com made three successful requests to the Web server.
- (c) The Web server transferred 4 kilobytes of data to the host corvas.cts.com.
- (d) The Web server is located in a time zone that is 6 hours behind GMT.
- (e) The objects transferred by the server were probably image files.

**Question 29**

Given the following request made by a browser to a Web server:

```
GET /pslv-c25/Imagegallery/satellitesimages/mars1.jpg HTTP/1.1
Host: isro.org
User-Agent: Mozilla/5.0 (Windows NT 6.1; WOW64; rv:32.0) Gecko/20100101
Firefox/32.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Referer: http://isro.org/pslv-c25/Imagegallery/mom-images.aspx
Connection: keep-alive
```

Which of the following statement is FALSE?

- (a) The browser is running on a Windows operating system.
- (b) The browser is running HTTP 1.1.
- (c) The URL of the object requested by the browser is `http://isro.org/pslv-c25/Imagegallery/satellitesimages/mars1.jpg`
- (d) The browser requested a non-persistent connection.
- (e) The type of browser making the request is Firefox.

**Question 30**

The following is the reply sent by the server in response to the HTTP GET message in the previous question:

```
HTTP/1.1 200 OK
Content-Type: image/jpeg
Last-Modified: Fri, 26 Sep 2014 07:44:03 GMT
Accept-Ranges: bytes
ETag: "90c1bfa45dd9cf1:33b7"
Server: Microsoft-IIS/6.0
X-Powered-By: ASP.NET
Date: Sat, 27 Sep 2014 10:24:26 GMT
Content-Length: 437383
Connection: Keep-Alive
Age: 0
<object not shown here>
```

Which of the following statements is FALSE?

- (a) The object transferred by the server is less than 400 kilobytes in size.
- (b) The server accepts range requests for the object.
- (c) The server was able to successfully find the requested object and send it to the browser.
- (d) The server replied to the request on Sat, 27 Sep 2014 10:24:26 GMT according to its own clock.
- (e) The object transferred by the server is probably an image file.



**Question 31**

Suppose a browser requested and received an image file from a Web server on 28 Sep 2014 10:24:26 GMT. The image is now stored in the browser cache. After 30 minutes, the browser makes a conditional GET request for the same image file stored on the same Web server. This image file has not changed since 27 Sep 2014 09:00:00 GMT. What is the status code of the server response received by the browser following this conditional GET request?

- (a) 200
- (b) 304
- (c) 500
- (d) 206
- (e) 305

**Question 32**

Consider a client-server architecture. Let the size of the file to be distributed be 3600 Megabits. The server transmits one copy of the file to each of its 100 clients. Let the upload rate of the server be 100 Megabits per second. The download rate of the client with the lowest download rate is 2 Megabits per second. What is the distribution time to get a copy of the file to all 100 clients?

- (a) 60 minutes
- (b) 30 minutes
- (c) 10 minutes
- (d) 20 minutes
- (e) 1 minute

**Question 33**

The DNS resource records contain four fields: Name, Value, Type, and TTL. If the Type=MX, then which of the following statements is TRUE?

- (a) Value is the IP address of the mail server that has the alias hostname Name.
- (b) Value is the IP address of the Web server that has the alias hostname Name.
- (c) Value is the canonical name of the Web server that has an alias hostname Name.
- (d) Value is the canonical name of the mail server that has an alias hostname Name.
- (e) Value is the hostname of the DNS server that is authoritative for Name.

**Question 34**

Which of the following statements about a Local DNS server is TRUE?

- (a) Local DNS servers cache resource records, however, these records are discarded after a period of time.
- (b) Local DNS servers obtain resource records from Web caches.
- (c) Local DNS servers cannot cache the IP addresses of TLD servers.
- (d) Local DNS server cache resource records and these records are kept permanently.
- (e) Local DNS server cannot bypass the root DNS servers in a query chain.

**Question 35**

Which of the following statements about DNS is FALSE?

- (a) DNS is used to perform load distribution among replicated Web servers.
- (b) DNS query and reply messages have the same format.
- (c) When the 1-bit query/reply flag in the DNS message is set to 0, it indicates a reply.
- (d) DNS lookups often involve a combination of recursive and iterative queries.
- (e) DNS is an application-layer protocol that allows hosts to query the distributed database that translates hostnames to IP addresses.

**Question 36**

Which of the following server classes is at the top of DNS server hierarchy?

- (a) Local DNS servers
- (b) TLD servers
- (c) User DNS servers
- (d) Authoritative DNS servers
- (e) Root DNS servers

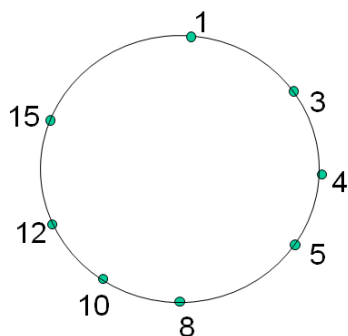
**Question 37**

Which of the following statements about P2P architecture is FALSE?

- (a) P2P file distribution generates significant upstream traffic putting stress on ISPs dimensioned for asymmetrical bandwidth usage.
- (b) Peers are not owned by content or service providers.
- (c) P2P architecture is highly scalable.
- (d) Peers communicate with each other via a dedicated server.
- (e) Peers form an overlay network.

**Question 38**

Given the following circular DHT, where each peer keeps tracks of its first and second successor:



Consider the situation of peer churn where peer 5 exits the overlay network. Which peer becomes the second successor for peer 4 now?

- (a) 12
- (b) 10
- (c) 3
- (d) 8
- (e) 4

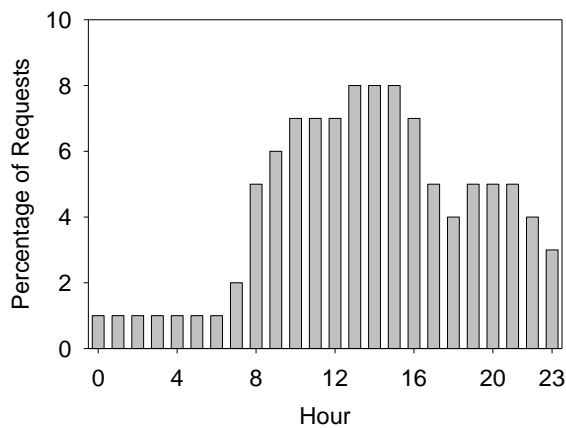
**Question 39**

Which of the following statements about BitTorrent file distribution is FALSE?

- (a) Trackers keep track of peers participating in a torrent.
- (b) The peer determines from, among the chunks it does not have, the chunks that are the rarest among its neighbours, and then request those chunks.
- (c) To determine which requests to respond to, a peer gives priority to its closest geographically located neighbours.
- (d) The incentive mechanism for trading chunks among peers is commonly referred to as tit-for-tat.
- (e) Peers in a torrent download equal-sized chunks of a file from one another.

**Question 40**

After analyzing the Web server access logs of an e-commerce site, the network administrator generated the following graph:



The graph shows the percentage of total requests made to the site on an hourly basis in a day. Note the x-axis has 23 tics. Each tic represents a 1 hour time window. For example, the Hour 0 tic represents the time period between 12 midnight and 1 a.m. Using this graph, when is the network administrator most likely to take the site offline for maintenance?

- (a) Between 0 and 6 hours
- (b) Between 8 and 18 hours
- (c) Between 13 and 14 hours
- (d) Between 7 and 12 hours
- (e) Between 19 and 23 hours

**Rough Working – This page will not be marked**  
(You may detach this page from the question booklet and use it for rough working)

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