Semester One 2016
FIT 1047 Sample Exam Questions

Faculty of Information Technology

Note that this is a list of sample exam questions only. It is only made available for training purposes and does not contain questions from the actual exam.
The goal is to self-test and get an idea of the character of questions that can be expected in the actual exam.

In the actual exam it is not permitted to use any material, books, or calculators.

Part A: Multiple Choice Questions

Instructions: Each question has only one correct answer. Select the **single, best choice** for each question.

Question 1. Which base is usually used to display a binary file to a user?

a) Base 2
b) Base 8
c) Base 10
d) Base 16
e) None of the above

Question 2. Adding the two signed magnitude binary numbers 01000101 and 00011101 equals?

a) 10001101
b) 11101010
c) 11010101
d) 01100010
e) None of the above

Question 3. What are the decimal values for the two signed magnitude numbers 01001101 and 10011101?

a) 77 and 28
b) 72 and -22
c) 77 and -29
d) -80 and -16
e) None of the above

Question 4. Subtracting 01110011 from 00001011 using 2's complement notation equals?

a) 10011000
b) 11010101
c) 00101100
d) 11010100
e) None of the above

Question 5. How many different numbers can be represented with n bits?

a) n
b) 2^n
c) $\log_2(n)$
d) 16
e) 32

Question 6. Which of the following basic circuits is used in an ALU?

a) An S/R adder
b) A multiplexer
c) A D-Flipflop
d) A 2's complement
e) A decoder

Question 7. Assume a computer architecture where instructions are 64 bits long, which contain a 56 bit memory address, and enough bits to address 8 registers. How many different opcodes can this computer architecture support?

a) 3
b) 7
c) 5
d) 16
e) 32

Question 8. Which sequence of instructions in MARIE assembly code results in the value stored at address 123 to be negated?

a) Load 0, Subt 123, Store 123
b) Clear, SubtI 123, StoreI 123
c) Load 0, SubtI 123, Store 123
d) Clear, Subt 123, Store 123
e) Load 0, Subt 123, StoreI 123

Question 9. What is a context switch?

a) The operating system switching from one process to another
b) An I/O device that requests that the CPU deals with new input
c) A signal raised by the currently running process that causes the operating system to perform I/O.
d) A timer event that causes the operating system to perform process scheduling.

Question 10. Which of the following is **not** a typical function of operating systems?

a) Managing the CPU's fetch-decode-execute cycle
b) Handling hardware interrupts
c) Managing virtual memory
d) Providing a graphical user interface
e) Providing access to I/O devices

Question 11. Which of the following is a difference between preemptive timesharing and cooperative timesharing?

a) Preemptive t. is used in practice, cooperative t. is not.
b) Preemptive t. can interrupt malicious or buggy processes, cooperative t. cannot.
c) Preemptive t. does not require hardware support, cooperative t. does.
d) Preemptive t. does not require cooperation from the user, cooperative t. does.
e) Preemptive t. makes processes run more efficiently compared to cooperative t.

Question 12. HTTPS means that

a) A VPN is used for communication
b) A communication between client and server is encrypted using ASE 128
c) It is hypertext transfer protocol via TLS.
d) The authenticity of the server is always guaranteed.

Question 13. Which of the following problems is addressed by the CA part of CSMA/CA?

a) The "hidden node" problem in wireless LANs.
b) The "spam" problem in email networks.
c) The "Certification Authority" problem in public key cryptography.
d) The "Collision Avoidance" problem in wired Ethernet.

Question 14. How does TCP identify the application layer process that should handle a message?

a) Using the IP address.
b) Using the MAC address.
c) Using the port number.
d) Using the process ID.
e) Using the application ID.

Question 15. Which of the following is **not** part of the TCP protocol?

a) The four-way handshake.
b) The three-way handshake.
c) Acknowledgement numbers.
d) Sequence numbers.
e) HTTP status codes.

Question 16. A "client-server" architecture approach

a) places all or almost all of the application logic on the client
b) places all or almost all of the application logic on the server
c) places all or almost all of the data storage logic on the client
d) places all or almost all of the presentation logic on the server
e) places all or almost all of the network logic on the client

Question 17. Which of the following parameters deteriorates with distance between sender and receiver?

a) Bandwidth
b) Burst rate
c) Frame rate
d) Committed Information Rate
e) Latency

Question 18. Which of the following is a malicious program hidden in what seems a legitimate program?

a) Virus
b) Worm
c) Trojan Horse
d) Backdoor
e) Botnet

Question 19. *Digital signatures* ensure that a message has not been

a) intercepted
b) delayed
c) forwarded
d) forged
e) read

Question 20. One main role of a packet-filter firewall is to drop packets that do not match the criteria defined in policy rules. What are typical parameters?

a) Content on application layer
b) MAC addresses
c) source and destination IP addresses and ports
d) route of the packet
e) digital signatures

Question 21. Which does IDS stand for in network security?

a) Information Decryption System
b) Intelligent Data Security
c) International Defense Society
d) Internet Decoding Specification
e) Intrusion Detection System

Question 22. Which property is required for storing passwords?

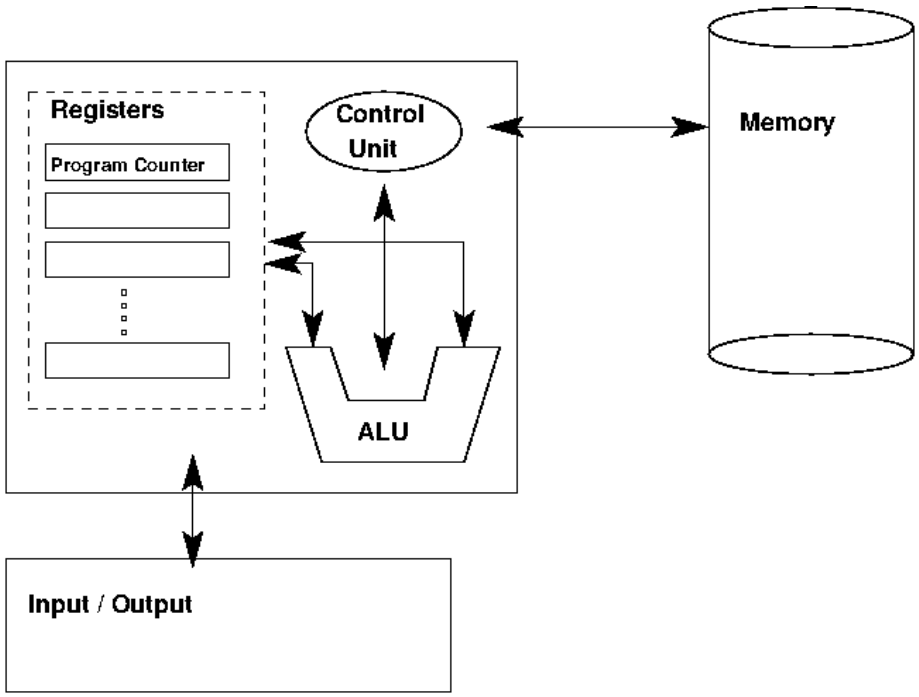
a) Confidentiality
b) Authenticity
c) Non-repudiation
d) Privacy
e) Integrity

Question 23. Which of the following mechanism can be instantiated as software on individual PCs or in hardware as a special device in the network ?

a) Firewalls
b) Virus scanners
c) Intrusion detection
d) Backup
e) All of the above

Part B: Short Answer Questions

Question 1.
Draw a sketch of the von Neumann Architecture and name the different components.



Question 2.

a) How many bits are needed to express 1024 numbers?
$1022=2^{10}$, thus 10 bits are needed.

b) How many bits are in 32 Gib? (Give answer in power of 2)
One Gib are 2^{30} bits. 32 times one Gib means 2^5 times 2^{30}.
Thus, the correct result is 2^{35}

Question 3.
Explain the subtraction of two positive integers using 2's complement arithmetic.
Subtracting B from A is the same as adding A and –B. To negate B in 2's complement arithmetic, we flip all bits and add 1. We can then add the result to A using normal binary addition.

Question 4.

A 16-bit word in memory contains two 7-bit ASCII characters and one additional even parity bit for each character. The parity bit is the right-most bit.
a) If you find 01101000 10001110. Would this be a valid representation of two characters?
No, because the first byte has an odd number of 1s.
b) Which two characters are encoded in 10001101 01101010?
F5

ASCII Hexadecimal	ASCII Binary (7-bit)	Character Value
030	0110000	0
031	0110001	1
032	0110010	2
033	0110011	3
034	0110100	4
035	0110101	5
036	0110110	6
037	0110111	7
038	0111000	8
039	0111001	9
041	1000001	A
042	1000010	B
043	1000011	C
044	1000100	D
045	1000101	E
046	1000110	F
047	1000111	G
048	1001000	H

Question 5.
Give one reason why signed integer arithmetic is not suitable for computation of 3D graphics.
Large number calculations in 3D modelling are much more efficient in floating point.

Question 6.
Convert the following numbers as specified. Show all workings.

1. From base 10 to base 16: 1286
   506

2. From base 10 to base 2: 2050
   100000000010

3. From base 16 to base 2: A F81C
   10101111100000011100

Question 7.
Convert the decimal integer **-65** to an 8-bit binary representation in 2´s complement notation. Show all workings.

First convert 65 to binary, fill with leading 0s and then convert to 2's complement :
65 in binary is 1000001, we need 8 bit: 01000001
Flip all bits: 10111110, add 1: 10111111
Thus, the answer is:
10111111

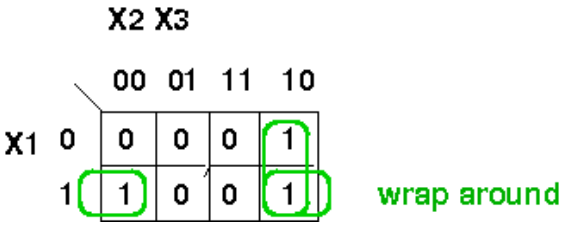
Question 8.
Using a truth table show that $X(\neg YY) = 0$ for all values of X and Y.

X	Y	$\neg Y$	$\neg YY$	$X(\neg YY)$
0	0	1	0	0
0	1	0	0	0
1	0	1	0	0
1	1	0	0	0

Question 9.

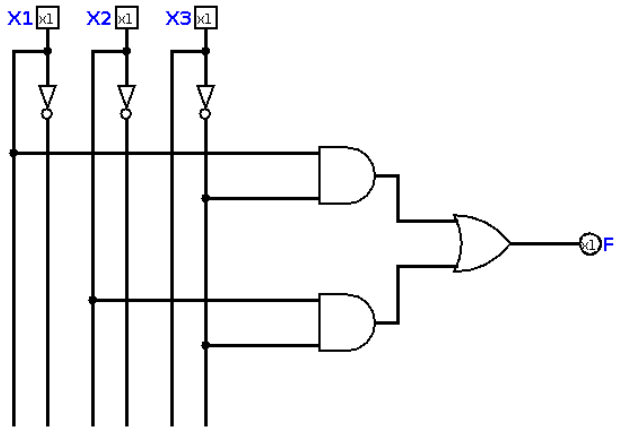
Draw an optimized combinational circuit for the following Boolean function using only NOT, OR, and AND gates. Draw a K-map for the optimization:

$F(X1, X2, X3) = X_1 \neg X_2 \neg X_3 + X_1 X_2 \neg X_3 + \neg X_1 X_2 \neg X_3$



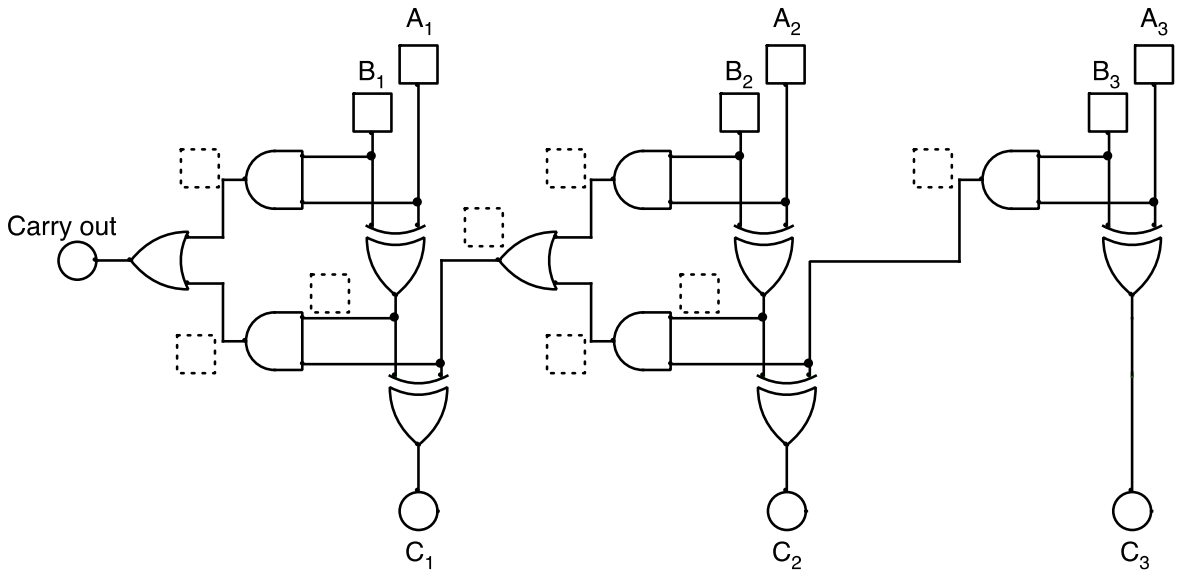
Thus, the resulting optimized function is:

$\boldsymbol{(X1, X2, X3) = X_1 \neg X_3 + X_2 \neg X_3}$



Question 10.

Identify the function of the circuit below. Give an example of inputs A and B (by writing into the squares) and fill in all intermediate and final outputs (dotted squares and circles).



This circuit adds two 3-bit numbers A1A2A3 and B1B2B3 and also outputs a carry bit.

Question 11.
Identify and briefly explain the roles of the three main components of a Central Processing Unit

ALU (Arithmetic Logic Unit): Performs arithmetic computations
CU (Control Unit): Performs the fetch, decode, execute cycle
Registers: Temporary storage for data and instructions

Question 12.
Describe the difference between a *direct jump* and an *indirect jump* instruction, using the MARIE system as an example.

A direct jump causes the CPU to continue execution at the given address (e.g. address X for the instruction Jump X). An indirect jump continues execution at the address pointed to by the given address. E.g. JumpI X jumps to the address stored in memory location X.

Question 13.
Identify which MARIE instruction corresponds to the following RTL code:

MAR <- X
MBR <- PC+1
M[MAR] <- MBR
AC <- X+1
PC <- AC

JnS X

Explanation (not necessary in exam question): *The first three lines of this RTL code store the address of the next instruction (PC+1) into the memory location X. This is the return address. The fourth line then computes the address X+1 (which is where the subroutine starts) and the fifth line then jumps to that address.*

Question 14.
Briefly explain the concept of a *flipflop* circuit. Name a computer component where a flipflop is used.

A flipflop is a sequential circuit that can store one bit of information, and the stored information can be read and changed at a later point in time. It can be used to implement registers.

Question 15.
Briefly explain the difference between *sequential* and *combinational* circuits.

The output of a sequential circuit depends on previous inputs (e.g. a flipflop). The output of a combinatorial circuit only depends on its current inputs, i.e., it simply computes a Boolean function of the inputs.

Question 16.
Assume a memory that can store 2^{16} bytes. What are the lowest and highest addresses, and how many bits are needed to store those addresses, if the memory is

1. Byte addressable

Each byte needs to be addressed, thus we have 2^{16} addresses. This needs 16 bits. Thus, the lowest address would be 0000000000000000 and the highest would be 1111111111111111

2. Word addressable with a word size of 16 bits

Each word consists of 2 bytes. Thus, we only need $2^{16}/2 = 2^{15}$ addresses. This needs 15 bits and the lowest address is 000000000000000, while the highest is 111111111111111

Question 17.
Briefly explain the difference between Reverse Polish Notation and "ordinary" arithmetic notation, using the expression $(4 \times 12 + 3) - 10 \div 2$ as an example.

Ordinary: Multiplication/division before addition/subtraction and computing inside bracket before computing the rest …
RPN: 4 12 * 3 + 10 2 ÷ -
Operators are written after the operands. We can evaluate RPN from left to right, each operator "pops" two values from a stack and "pushes" the result onto the stack. By doing this, no brackets are necessary. The stepwise computation is
4 12 * 3 + 10 2 ÷ - = 48 3 + 10 2 ÷ - = 51 10 2 ÷ - = 51 5 - = 46

Question 18.
Explain two restrictions for a PC during firmware (BIOS/UEFI) configurations, when compared to a PC running a full operating system.

There are a number of restrictions that could be mentioned. Examples: The size of the BIOS is restricted to the size of the ROM or Flash chip. Therefore, functionality is restricted. Some components, such as printers, attached to the computer are not available before the OS starts. Only basic drivers for graphic cards are available. Thus, there is no fancy graphical user interface.

Question 19.
Briefly explain the concept of a *process*, including the states it can be in.

A process is a program that is currently being executed. A process can be in the *ready*, *running* or *blocked* states. Running means that it is currently running on the CPU. Blocked means it is waiting for I/O to finish. Ready means it could be running, but the OS has not scheduled it yet.

Question 20.
Briefly explain how the hardware and operating system work together to control how programs access I/O devices.

The hardware (the CPU) has a kernel mode and a user mode, and in user mode it restricts processes so that they cannot access I/O devices directly. The operating system provides a set of system calls, which are basically subroutines that implement I/O functionality and that user mode processes can call. That way, the OS can control what kind of I/O each process is allowed to perform.

Question 21.
Name and briefly explain the mechanism that operating systems use to provide each process with its own address space.

Virtual memory: when processes access a location in memory, the hardware maps that virtual location to a physical memory location, e.g. using a base register storing the physical address for the current process. The OS sets up the base register when it switches between processes.

Question 22.
Name the layers of the TCP/IP architecture (also called the *Internet Model)*, and briefly explain the function of layer 2.

Application, Transport, Network, Data Link, Physical
Layer 2 is the Data Link layer:
This layer is the interface to the hardware; it encodes digital data into signals to be sent over the physical medium and it controls access to the physical medium.

Question 23.
Briefly explain how a switch works.

A switch connects different devices in a Local Area Network. When it receives a packet, it looks into its *forwarding table* to find out to which port the device with the destination MAC address is connected to. If the destination is not in the forwarding table, it sends the message to all ports. When a packet comes in e.g. from MAC address A on port 3, it adds that information to the forwarding table.

Question 24.
Briefly explain how a router works.

A router provides the connection between different IP networks. When a packet comes in, it looks up the destination IP address in its routing table. It then sends the packet either directly to the destination (if the destination is directly connected to the router), or to another router. Routing tables can be configured statically or using dynamic routing protocols.

Question 25.
Briefly describe the two-tier email architecture (using a diagram).

Show in a diagram: sender-client sends to sender's mail-server, mail-server sends to receiver's mail server. Finally, receiver's client retrieves mail from receiver's mail server.

Question 26.
Name two different methods for transmitting digital data through cables.

Unipolar or bipolar encoding
(Alternatively, NRZ and Manchester encoding would also be acceptable, also other notions, e.g. baseband and passband or parallel vs. serial are acceptable)

Question 27.
Explain the advantage of *roaming* in wireless networks.

Roaming enables devices to automatically move from one access point to another, without losing the network connection. This enables us to build large wireless networks by combining access points that each have a limited range.

Question 28.
Name the acronym of the application layer protocol used for accessing the World Wide Web.

This question is too easy.... (and this answer would not be acceptable in a real exam)…if you still don't know, it is HTTP

Question 29.
Are wireless LANs more or less secure than wired Ethernet? Explain your answer.

In a wired Ethernet an attacker needs to get access to the cable or the switch to read or manipulate communication or to access devices. In a wireless LAN, interfaces are accessible over the air. Physical access control (walls, locked doors, etc.) does not provide protection. Also, interfaces are accessible without physical access and could be used to attack a device. Thus, in general wireless LANs can be considered less secure.

Question 30.
Explain the high-level structure of the Internet.

The Internet is a network of networks. Each of these large-scale network is called an *Autonomous System (AS)*, and is typically run by a single organisation (e.g. an ISP, or a university). Autonomous Systems are inter-connected using routers that use the BGP protocol for exchanging routing information.

Question 31.
What is the difference between *interior* and *exterior routing protocols?*

Interior routing: Routing within autonomous systems
Exterior routing: Routing packets between different autonomous systems

Question 32.
What are the end-points of the encrypted channel in a VPN connection? Explain why a VPN does not provide end-to-end security between a home-office PC and a PC in the enterprise network.

The end-points are a VPN client, often a PC, laptop or other personal device and a VPN gateway to the internal network. As the encrypted channel ends at the gateway, traffic from the gateway to the PC within the internal network is not encrypted and there is no end-to-end security between the two PCs.

Question 33.
Certificates are used to identify servers when using TLS. Give one reason, why certificates can be problematic.

A certificate needs to be related to a particular server, be valid and signed by a trusted certification authority. Some possible problems are:
- A certificate check in the browser fails, but the user needs to accept the certificate in order to use a service.
- There is a long list of certification authorities installed in a browser. It is unclear if all of them are trustworthy. There have been cases of malicious certificates.
- Everybody can buy a certificate for their website. Thus, the certificate does not say anything about how trustworthy the site is.

Question 34.
Explain the term demilitarised *zone* and provide 2 examples of firewall placements for such a zone..

A demilitarised zone lies between an internal network and the Internet. It usually contains those servers and gateways that need to be accessible from outside the network. A DMZ can be realized with one firewall (three-legged), one leg is the Internet, the second the DMZ and the third is the internal network. Better is a DMZ with two firewalls, one towards the Internet and a second one towards the internal network and the DMZ between the two.
(You could also draw a diagram to explain).

Question 35.
Compare public Message Authentication Codes and Hash Functions showing one similarity and two differences.

Explanation: The term *public* means that both functions are publicly known and can be easily computed by anybody.
One similarity: Both map longer messages to shorter values of a fixed length. Thus, they can both can be used to check if a message was changed.
One difference: The MAC uses a key (secret) in addition to the actual message as input. Thus, in a message exchange, an attacker is not able to create a valid MAC for a manipulated message, while the attacker could easily compute a valid Hash value for any message.

Question 36.
What is a currently recommended hash function for use in digital signatures and which hash function is still used, but no longer recommended.

Currently recommended: SHA256, SHA512, SHA2
Still in use, but no longer recommended: SHA1