**BTC 1203 – Introduction to Computer Networks / ICS 2103 – Computer Networks**
**CAT2 ANSWERS**

**Date:** **Time: 1 Hour**

**Instructions**

1. *This Continuous Assessment Test consists of THREE questions.*
2. *Answer Question ONE (COMPULSORY) and any other ONE question.*
3. *Clear and precise answers are highly encouraged*

**COMPULSORY QUESTION (15 Marks)**

1. A host has the address IP 10.12.16.18 and a subnet mask of 255.255.255.128. What is the *broadcast address* of the network? **(2 marks)**

   Subnet Mask 11111111.11111111.11111111.10000000
   Inv. Subnet Mask 00000000.00000000.00000000.011111111

   IP Address 00001010.00001100.00010000.00010010
   Inv. Subnet Mask 00000000.00000000.00000000.011111111
   **Logical OR result** **00001010.00001100.00010000.011111111**

   The broadcast address of the network is **10.12.16.127**

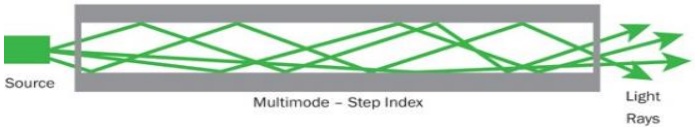
2. A network requires 50 hosts per subnet.
   a) How many bits will be borrowed? n=8-h, =8-6=2 bits **(1 mark)**
   b) How many bits will remain? $2^h$ -2 =>50, h=6 bits **(1 mark)**
   c) How many usable host addresses will there be per subnet? **(1 mark)**
   $2^h$ -2 = $2^6$ -2 = 62 hosts

3. Pamela, a network engineer is explaining to her team on the ground about the fibre optic cable they are about to install. She asks you to assist by drawing simple but concise diagrams of *single-mode step–index*, *multimode step–index* and *multimode graded–index* fibre optic signals. **(6 marks)**

   **single mode step-index fibre:** the light is guided down the center of an extremely narrow core

   
   Single-Mode – Step Index

   **multimode step-index fibre**: the reflective walls of the fibre move the light pulses to the receiver

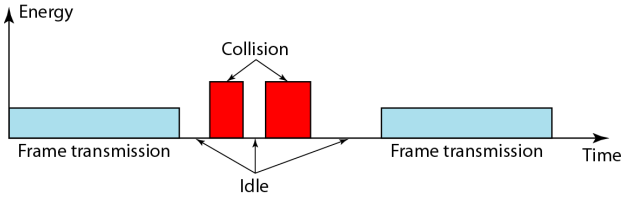
   
   

   **multimode graded-index fibre**: acts to refract the light toward the center of the fibre by variations in the density




Multimode – Graded Index

4. Describe the operation of *Carrier Sense Multiple Access with Collision Detection (CSMA/CD).* Include a diagram. **(4 marks)**
   *Each device senses whether the line is idle and therefore available to be used. If it is, the device begins to transmit its first frame.*
   *If no collision is detected, it continues to send the other bits of information while continuously checking whether a collision has been detected.*
   *If another device has tried to send at the same time, a collision is said to occur and the frames are discarded.*
   *Each device then waits a random amount of time, backoff and retries until successful in getting its transmission sent.*
   *If the maximal amount of attempts is reached, then no transmission is possible and it is aborted.*

5. State one advantage of *frequency modulation* over *amplitude modulation* **(1 mark)**
   In *frequency modulation* (and demodulation), the signal is not affected by channel noise. In *amplitude modulation* (and demodulation), the signal very susceptible to noise.

**QUESTION 2 (15 Marks)**

1. A host has the IP 192.168.8.26 and a subnet mask of 255.255.255.224. To what network does this host address belong to? **(1 mark)**

   IP Address 11000000.0101000.00001000.00011010
   Subnet Mask 11111111.11111111.11111111.11100000
   AND result 11000000.10101000.000001000.00000000
   192 . 168 . 8 . 0
   The address 192.168.64.3 belongs to the subnet 192.168.8.0

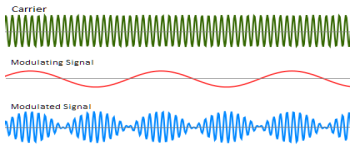
2. IPv6 is the most recent version of the Internet Protocol (IP)
   a. Explain two major differences between IPv4 and IPv6 **(2 marks)**
   Pv4 uses four 1 byte decimal numbers, separated by a dot (i.e. 192.168.1.1), while IPv6 uses hexadecimal numbers that are separated by colons (i.e. fe80::d4a8:6435:d2d8:d9f3b11).

| IPv4 | IPv6 |
|---|---|
| 32 bit length. | 128 bit length. |
| binary numbers represented in decimals. | binary numbers represented in hexadecimals. |
| four 1 byte decimal numbers, separated by a dot | hexadecimal numbers that are separated by colons |
| IPSec support is only optional. | Inbuilt IPSec support. |
| Fragmentation is done by sender and forwarding routers. | Fragmentation is done only by sender. |
| No packet flow identification. | Packet flow identification is available within the IPv6 header using the Flow Label field. |
| Checksum field is available in IPv4 header | No checksum field in IPv6 header. |
| Options fields are available in IPv4 header. | No option fields, but IPv6 Extension headers are available. |
| Address Resolution Protocol (ARP) is available to map IPv4 addresses to MAC addresses. | Address Resolution Protocol (ARP) is replaced with a function of Neighbor Discovery Protocol (NDP). |
| Internet Group Management Protocol (IGMP) is used to manage multicast group membership. | IGMP is replaced with Multicast Listener Discovery (MLD) messages. |
| Broadcast messages are available. | Broadcast messages are not available. Instead a link-local scope "All nodes" multicast IPv6 address(FF02::1) is used for broadcast similar functionality. |
| Manual configuration (Static) of IPv4 addresses or DHCP (Dynamic configuration) is required to configure IPv4 addresses. | Auto-configuration of addresses is available. |

b. Show the abbreviated representation of the following IPv6 address
1234:2346:0000:0001:0000:0000:0000:1111 **(1 mark)**
1234:2346:0:1::1111

c. Decompress the following IPv6 address and show its complete unabbreviated representation: 0:1:: **(1 mark)**
000:0001:0000:0000:0000:0000:0000:0000

3. Which type of *Ethernet* cables are used to connect the following devices? **(3 marks)**
   a. Switch to Switch –Crossover cable
   b. PC to Switch – Straight-through cable
   c. Router to switch – Straight-through cable
4. Using drawings, explain how the amplitude of the carrier signal is varied with the modulating signal of an analogue modulating (AM) signal. **(2 marks)**



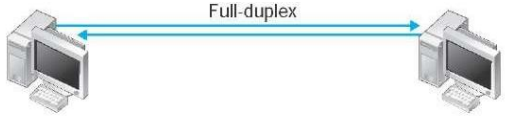

The information contents of the *modulating signal* superimposes on the *carrier signal* (which has constant amplitude and frequency) by varying the characteristic (either amplitude or frequency) of the carrier signal according to the modulating signal.

5. Differentiate between half duplex and full duplex communication. (2 marks)
**A half-duplex connection** (*alternating connection* or *semi-duplex*) is a connection in which the data flows in one direction or the other, but not both at the same time. With

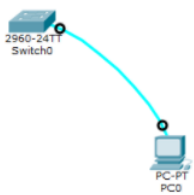


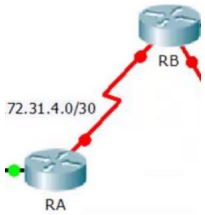
this type of connection, each end of the connection transmits in turn. This type of connection makes it possible to have bidirectional communications using the full capacity of the line.


**A full-duplex connection** is a connection in which the data flow in both directions simultaneously. Each end of the line can thus transmit and receive at the same time, which means that the bandwidth is divided in two for each direction of data transmission if the same transmission medium is used for both directions of transmission.



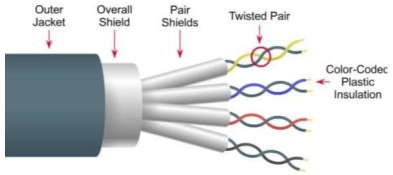

6. The following cables are used in networks between PC and router (or switch) for configuration purposes and between router and router. Identify the cables. **(2 marks)**
Cable A - Console cable Cable B - Serial cable




**QUESTION 3 (15 Marks)**

1. DRAW and LABEL the parts of the following types of media: State TWO benefits and TWO disadvantages of each.
   a. Shielded twisted pair cable (STP) **(3 marks)**

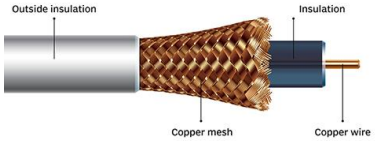



*Conductor*- the conductor that carries the signal
*Twisted pair* – twisted at varied angles to minimize crosstalk from one pair to the other.
*Pair shields* – They separate the twisted pairs from each other and aid in reducing electromagnetic interference and noise
*Overall shield/ foil* –braided jacket prevents infiltration of electromagnetic noise and eliminate crosstalk.

*Outside jacket*– Protects cable from mechanical damage. cuts, corrosion etc.

| Benefits | Disadvantages |
|---|---|
| 1. Cheap compared to fiber<br>2. Easy to work and install | 1. More susceptible to electromagnetic interference and noise<br>2. Signal attenuates after 100m (best for short distances)<br>3. Has the lowest security (easiest to intercept data) |

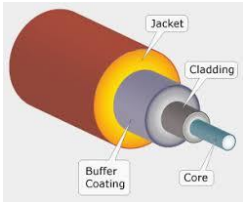
b. Coaxial cable **(3 marks)**




*Copper wire/core* – the conductor that carries the signal
*Insulation* – separates the core (copper conductor) from the shield and also provides the core with a consistent effective resistance between core and shield.
*Copper mesh/shield*- prevents the signal from escaping from the core conductor and also prevents unwanted external noise or signals from interfering with the signal carried by the core conductor
*Outside insulation*– Protects cable from mechanical damage

| Benefits | Disadvantages |
|---|---|
| i. Good resistance to electromagnetic interference and noise<br>ii. Offers higher security than twisted pair (fairly hard to intercept data)<br>iii. Covers relatively longer distances (1000-2500m) | i. Expensive to manufacture<br>ii. More difficult to install |

c. Fiber optic **(3 marks)**




*Core* – used to transmit signal in form of a light pulse

*Cladding* –keeps the light wave in the core
*Buffer coating*- made of hard plastic; protects the cladding
*Jacket* – Protects cable from mechanical damage

| Benefits | Disadvantages |
|---|---|
| 1. Very high resistance to electrical interference<br>2. Highest security (very hard to intercept data)<br>3. Covers relatively longer distances (1000-2500m) | i. Expensive to manufacture<br>i. More difficult to install |

2. Name the THREE forms of unguided media. **(3 marks)**

Microwave
- Microwaves are a subset of the radio frequency range



- Covers frequencies between 300 MHz to 3 GHz
- Uses highly directional beams
- Suitable for point to point transmission
- Used for satellite communications

Radio
- Covers frequencies between 3 Hz to 300 GHz
- Suitable for omnidirectional applications
- Are not strongly absorbed by the atmosphere so can be used to carry information for radio and TV programs, thus includes AM and FM radio bands

Infrared
- Covers frequencies between 300 GHz to 400 THz
- Invisible light waves whose frequencies is below that of red light
- Requires line of sight
- Is affected by heavy rain
- Cannot penetrate walls
- Uses transceivers (transmitters/receivers) that modulate non-coherent infrared light
- Used for short-range communication e.g. local point-to-point and multipoint applications within confined areas
- Used with remote control devices, but can also be used for device-to-device transfers, such as PDA to computer

3. The figures below show two types of antennas. One sends out a focused electromagnetic beam while the other spreads out the signal in all directions. Identify the two forms of transmission and match each to the correct antenna. **(2 marks)**

antennae A

Omnidirectional transmission

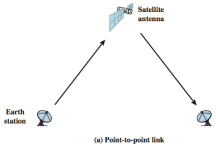
antennae B

Directional transmission

4. State one main difference in the application of *terrestrial microwaves and satellite microwaves.* **(1 mark)**

Terrestrial microwaves are used for long-haul telecommunications via antennas located at substantial heights **above ground level** to extend the range between antennas and to be able to transmit over intervening obstacles. Used as an alternative to coaxial cable or optical fiber

Satellites microwaves are transmitted between satellite microwave relay station and two or more ground stations (also called earth stations)



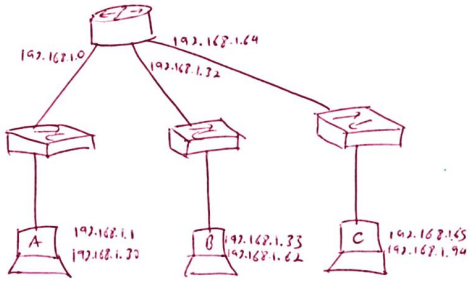

**QUESTION 4 (15 Marks)**

1. A network has the following requirements:

| Department | No of hosts per subnet |
|---|---|
| A | 29 |
| B | 13 |
| C | 22 |

Assume that you are the administrator, and you have chosen the 192.168.1.0 for network addressing: *(**NB:** use subnet zero and all-ones subnet i.e. use $2^n$, instead of $2^n$-2 for no of useable subnets).*

a. Sketch a basic topology showing how your departments would appear: (Equipment: One router, three switches, three PCs, ethernet cables). **(2 marks)**




b. Write an addressing table to depict the above scenario. **(3 marks)**

**Option 1: Without VLSM**

No. of useable hosts per subnet, $2^h$-2>=29, where h is the number of host bits.
Therefore, h=5, hence $2^5$-2=30

n = 8-h = 8-5 = 3, where n is the number of borrowed bits.
The step value of least significant subnet bit (i.e.x.x.x.11**1**00000) is 32, hence our subnets should increment by 32.

| Departme nt | Subnet Address | First Host IP Address | Last Host IP Address | Broadcast Address |
|---|---|---|---|---|
| A | 192.168.1.0 | 192.168.1.1 | 192.168.1.30 | 192.168.1.31 |
| B | 192.168.1.32 | 192.168.1.33 | 192.168.1.62 | 192.168.1.63 |
| C | 192.168.1.64 | 192.168.1.65 | 192.168.1.94 | 192.168.1.95 |

**Option 2: With VLSM**

| Department | Hosts | Useable hosts | borrowed bits n=8-h | Prefix |
|---|---|---|---|---|
| A | $2^h$-2>=29 | h=5, $2^5$-2=30 | 3 | /27 |
| B | $2^h$-2>=13 | h=4, $2^4$-2=14 | 4 | /28 |
| C | $2^h$-2>=22 | h=5, $2^5$-2=30 | 3 | /27 |

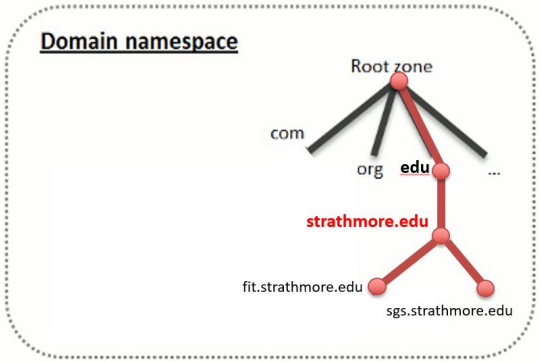


| Department | Hosts | First Host IP Address | Last Host IP Address | Broadcast Address |
|---|---|---|---|---|
| A | 192.168.1.0 | 192.168.1.1 | 192.168.1.30 | 192.168.1.31 |
| B | 192.168.1.32 | 192.168.1.33 | 192.168.1.46 | 192.168.1.47 |
| C | 192.168.1.48 | 192.168.1.49 | 192.168.1.78 | 192.168.1.79 |

2. Jazajaza Inc. has been contracted by Strathmore University to design a network for 4 labs and a reserve for 2 future labs. You have been provided with an address 192.168.1.1 /24.
   a. How many bits will be borrowed? $2^n$ =>6, **n=3** **(1 mark)**
   b. How many bits will remain? 8 – 3 = **5** **(1 mark)**
   c. How many useable host addresses will there be per subnet? h=5, $2^5$ - 2 = **30** **(1 mark)**
3. Peter, an IT administrator is setting up a network and needs to decide between using a bridge and a *switch* which both work at the data link layer. Using a table compare the basic operations of the two devices for him to decide. **(4 marks)**

| **Bridge** | **Switch** |
|---|---|
| Are software based | Are hardware based |
| Have lesser number of ports thus connects fewer LAN nodes | Have higher number of ports thus connect more LAN nodes |
| Generally used for connecting two different topologies | Generally used for connecting a single topology |
| Do not have buffers. | Has a buffer for each connected link |
| Are half-duplex | Are half and full duplex |
| Do not perform error checking. | Perform error checking. |

4. Draw the domain space for strathmore.edu clearly showing all nodes from the root zone to subdomains and hosts. **(2 marks)**




5. State one advantage of *frequency modulation* over *analogue modulation*. **(1 mark)**
In *frequency modulation* (& demodulation), the signal is not affected by channel noise.
In *amplitude modulation* (& demodulation), the signal very susceptible to noise.