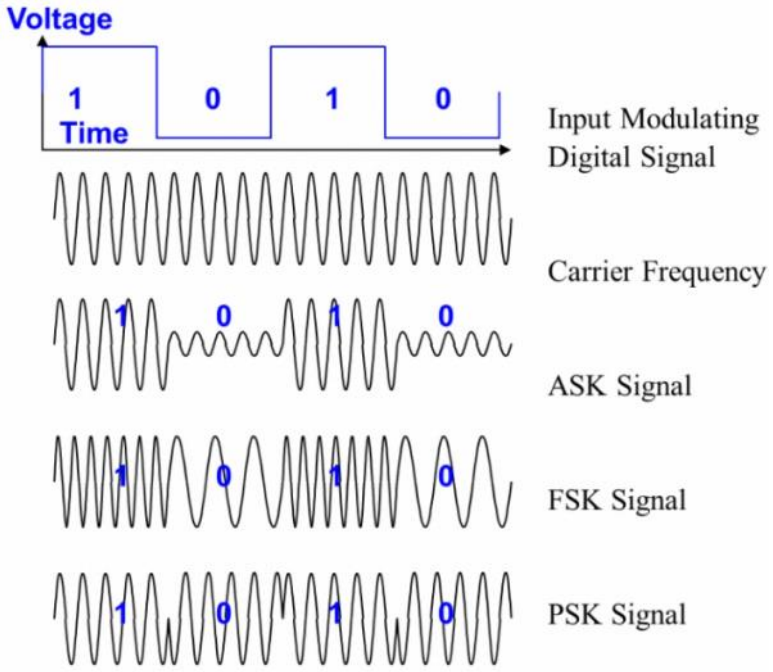
UE 2020

Tuesday, September 13, 2022 10:31 AM

QUESTION 1 - a



https://www.ni.com/en-za/innovations/white-papers/08/amplitude-shift-keying--frequency-shift-keying--and-phase-shift-.html

ASK
- Amplitude Shift Keying
- When the input modulation signal is high then the amplitude of the waveform is also high
- When the input modulation signal is low then the amplitude of the waveform is low
- Poor noise immunity
- Less bandwidth compared to PSK and FSK
- More power use

FSK
- Frequency Shift Keying
- When the input modulation signal is high then the frequency increases causing the waveform to be closely packed . The waveform travels fast but over a short distance
- When the input modulation signal is low then the frequency is low and the waveform is loosely packed
- Better noise immunity
- More bandwidth

PSK
- Phase Shift Keying
- When the input modulation signal changes from high to low then the waveform changes direction
- Better noise immunity
- The phase changes by 90 degrees
- Less to moderate bandwidth
- This is the best as it stands out but it has a complex implementation which is a drawback

ASK	FSK	PSK
1] Information is in amplitude variations.	Information is in frequency variations.	Information is in phase variations.
2] Less Bandwidth as compared.	More Bandwidth as compared.	Less to moderate Bandwidth.
3] Poor Noise immunity.	Better Noise immunity.	Better Noise immunity.
4] Synchronization is not required.	Synchronization is not required.	Synchronization is essential.
5] Effect of DC is more.	Effect of DC component is less.	Effect of DC component is less.
6] More power required.	Moderate power required.	Less-moderate power required.
7] Low bit rate application	Moderate bit rate application.	High bit rate application.
8] Simple Implementation.	Moderately complex Implementation.	Very complex Implementation.

QUESTION 1 - b

QAM (quadrature amplitude modulation) is a method of combining two amplitude modulation (AM) signals into a single channel.

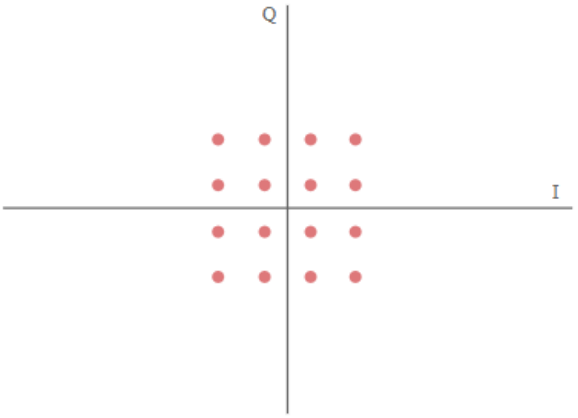
From <https://www.techtarget.com/searchnetworking/definition/QAM>

This approach helps double its effective bandwidth.

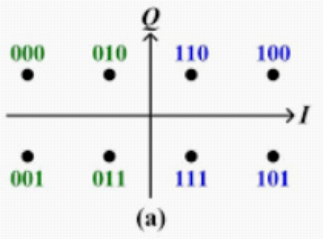
QAM is also used with pulse AM (PAM) in digital systems, like wireless applications. A QAM modulator works like a translator, helping to translate digital packets into an analog signal to transfer data seamlessly. QAM is used to achieve high levels of spectrum usage efficiency.

16 QAM and 64 QAM are currently used for digital terrestrial television using DVB - Digital Video Broadcasting

From <https://www.electronics-notes.com/articles/radio/modulation/quadrature-amplitude-modulation-types-8qam-16qam-32qam-64qam-128qam-256qam.php>



16QAM constellation



MODULATION	BITS PER SYMBOL	SYMBOL RATE
BPSK	1	1 x bit rate
QPSK	2	1/2 bit rate
8PSK	3	1/3 bit rate
16QAM	4	1/4 bit rate
32QAM	5	1/5 bit rate
64QAM	6	1/6 bit rate

Apart from ASK, PSK, FSK IN QAM it modulates more than one bit
QAM modulates 2 bits at a time
Keep in mind the 2^n where this is the max number of users

QUESTION 1 - c

FDMA	TDMA	CDMA
FDMA stands for Frequency Division Multiple Access.	TDMA stands for Time Division Multiple Access.	CDMA stands for Code Division Multiple Access.
In this, sharing of bandwidth among different stations takes place.	In this, only the sharing of time of satellite transponder takes place.	In this, there is sharing of both i.e. bandwidth and time among different stations takes place.
There is no need of any codeword.	There is no need of any codeword.	Codeword is necessary.
In this, there is only need of guard bands between the adjacent channels are necessary.	In this, guard time of the adjacent slots are necessary.	In this, both guard bands and guard time are necessary.
Synchronization is not required.	Synchronization is required.	Synchronization is not required.
The rate of data is low.	The rate of data is medium.	The rate of data is high.
Mode of data transfer is continuous signal.	Mode of data transfer is signal in burts.	Mode of data transfer is digital signal.
It is little flexible.	It is moderate flexible.	It is highly flexible.

QUESTION 1 - d

FDD

- Uses large guard bands hence uses a lot of frequency spectrum to minimize interference
- Provides two distinct bands of frequencies for every user, one for downlink and one for uplink.

TDD

- Example : WIFI, WiMAX, Bluetooth, Zigbee
- Same channel, difference timeslot

Parameter	FDD	TDD
Spectrum requirements	Requires paired spectrum	Only one channel required
Traffic asymmetry	Depends on available spectrum	Dynamically adjustable
Duplex separation	Guard band in frequency domain required	Guard Period in time domain required
Intra-system Interference	Unlikely to occur	Time synchronization between eNodeBs is required
Cell size	Suit for small and large cells	Suits for smaller distances because of Guard Period
Hardware costs	Higher costs caused by complicate diplexer	No major cost affects

QUESTION 1 - e

https://www.electronics-notes.com/articles/connectivity/3g-umts/td-cdma-umts-tdd.php

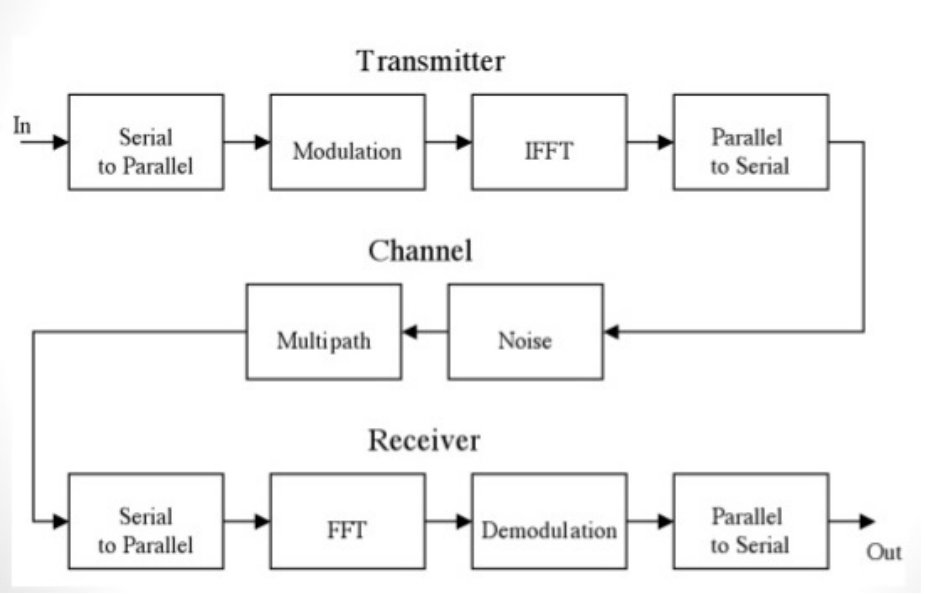
https://www.everythingrf.com/community/tdd-vs-ldd#:~:text=Time%2Ddivision%20duplexing%20(TDD),for%20transmit%20and%20receive%20operations

QUESTION 2 -a
Refer to the paper Japhet sent

OFDM - a multiple carrier transmission technique where a single set of data is transmitted over a number of sub-carriers
Uses multipath - propagation and reduces the fading effect

Ofdm makes transmission faster by dividing a single carrier into many (multipath) - normally the transmission over a long path will reach with a weak signal

This will help in using lower bandwidth and lower power is used and reduces inter-symbol inteference



In OFDM we have transmitter, channel and receiver
For a signal to be modulated or demodulated and transmitted it has to be in parallel form
Multipath - same frequency but different path, info is multi reflected and sent several times through different paths
The channel assist in noise elimination and multipath

QUESTION 2 - B
In OFDM the signal itself is first split into independent channels,
modulated by data and
then re-multiplexed to create the OFDM carrier.

QUESTION 2 - C
Telephony encoding - 4G
Wireless networks
DSL (Digital subscriber line) internet access
Digital television - digital video broadcasting
Digital radio - digital audio broadcasting
Video conferencing

In all of the above it has an advantage of higher data rates, low bandwidth

QUESTION 2 - D
Uplink is sending data
Downlink is getting data

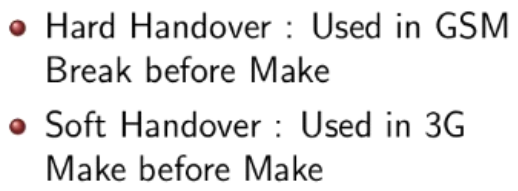
- To overcome effect of multipath fading
- it presents a high Peak-to-average Power Ratio it is not possible to use it on the uplink
- Has a good ability to resist inter symbol interference

Uplink uses more power consumption so OFDM is not used in uplink

So LTE uses SC-FDMA for uplink

QUESTION 3 - A

QUESTION 3 - B



Hard because of circuit switching
FDMA and TDMA is supporting hard handover
UMTS supports soft handover - more seamless

For 2G you break the old connection before you make the new connection
For 3G you make a new connection before you break the old connection

Hard Handover
Old Connection is broken before new connection is activated.
Fdma & Tdma is supporting hard handover.
Minimize Interference and Different frequency ranges.
One Mobile station and one Base Station.
Break Before Make.

Soft Handover
New Connection is activated before old is broken.
UMTS is supporting it.
More Seamless handover.
Up-link and down-link more costly.
One Mobile Station and two Base Station.
Make Before Break.

QUESTION 3 - C
Seamless connectivity - you can't feel the disconnectivity
Higher bandwidth and higher data rates
Lower latency 1ms
100 times more efficient than 4G
Faster because it uses millimeter waves

Different frequencies for uplink and downlink
Can be used in various frequency bands include higher and lower frequencies
Suitable for real time services
Enabled by new radio technology
It is data only - voice over IP
It is the latest technology
Lower cost per bit
5G is meant to connect massive number of embedded sensors - low cost, higher data rate

Application - IOT, virtual reality, self-driving cars, Realtime services

QUESTION 3 - D
Eg Amazon Go

By capturing the difference in the picture background

b-frame - this is the first
i-frame -
p-frame

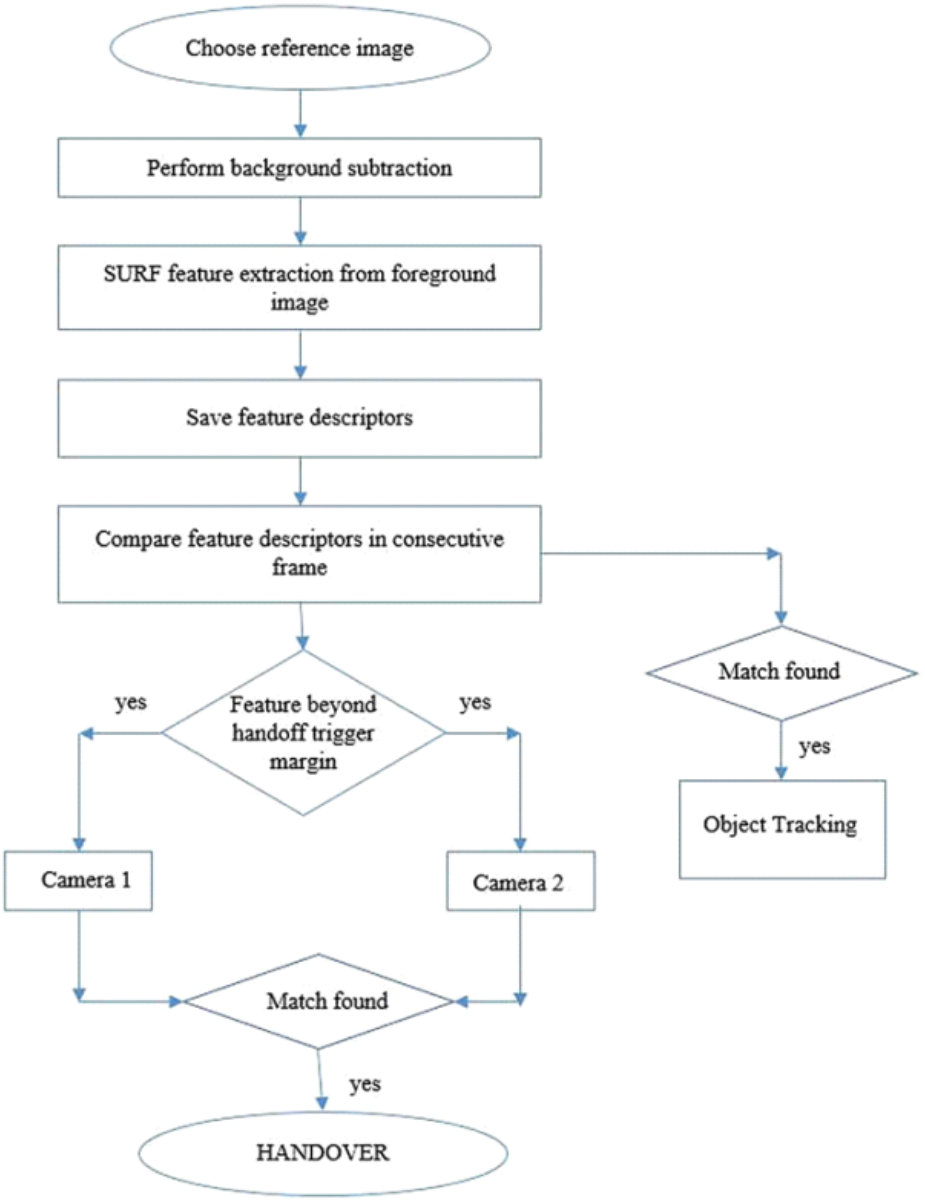


Fig. 2 Algorithm for Camera Handoff and Object Tracking

QUESTION 4 - A
Channel coding - Is the addition of information to remove corruption
It is important to reduce corruption level in data
Disadvantage is that the redundancy of information increases, complexity of coding operation

Source coding - compression - removal of some part of information when sending file eg in file compression

It's best to use in wireless communication systems since signal loss is greater in wireless than wired for improved error performance

Add parity bits to get the output t

QUESTION 4 - B
Block codes - the bits are taken in block after block at a time for encoding independent of all other blocks

There is linear and nonlinear - Hamming code
They are memory less / no memory
Information bits are followed by parity bits

Convolution codes - one bit at a time, they encode much longer inputs at once
There is linear and non linear
They have memory
Information bits are spread along the sequence
Uses small code weights but achieve same quality as block codes

QUESTION 4- C