



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Examination Answer Books

12 Pages

Instructions to Candidates

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can only read legible script or have it typed and the expense of typing is charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.

1	Student Number	1708232
2	Title of Examination Paper	ENTERING NETWORK TECHNOLOGY
3	Module Code	MTX01691
4	Date and Time of Examination	19/11/18 09:00
5	Examination Venue	TOWN HALL
6	Seat Number	G079.
7	Number of Answer Books handed in	2

Complete, fold and seal
(see note 2 below)

SURNAME:

PAUL

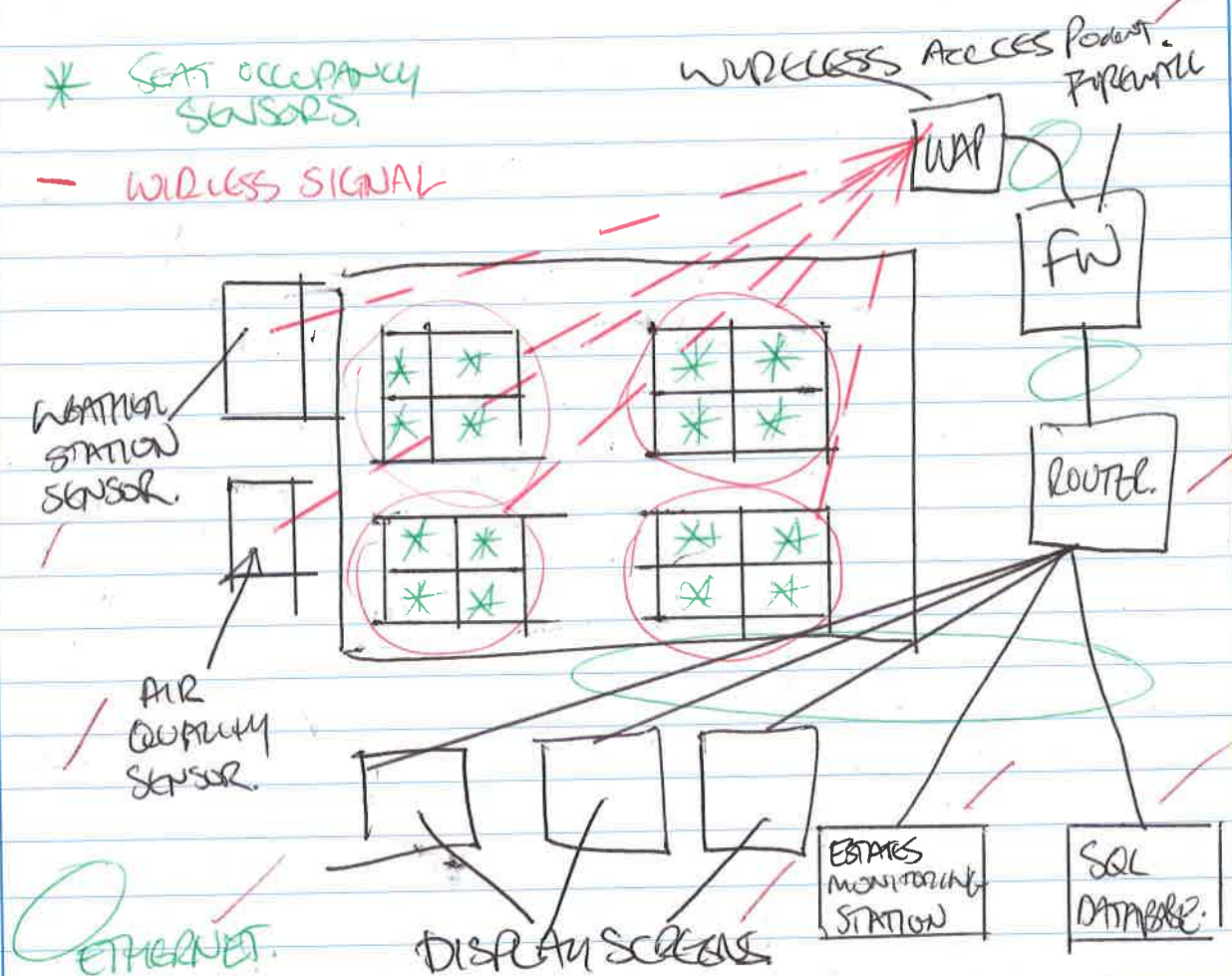
FORENAME(S):

CHRISTOPHER

List the numbers of the questions you have attempted	Office Use
Q1A	23
Q3A	
Q3B	12 1/2
Q4A	
Q4C	
Q4D	6
Q1B	
Total	41 1/2

55%

1A)



AREAS AVAILABLE:

EACH SEAT IN THE SMART GARDEN WILL BE FITTED WITH A WIRELESS SEAT OCCUPANCY SENSOR, THIS SENSOR WILL BE CONNECTED TO THE LAN VIA WAP. INFORMATION FROM THIS SENSOR WILL BE SENT TO THE SQL DATABASE, WHICH THE SEAT OCCUPANCY SOFTWARE RESIDES.

AIR QUALITY / WEATHER / TEMPERATURE.

SITUATED IN THE MOST APPROPRIATE AREA OF THE SMART GARDEN WILL BE PLACED TWO SEPARATE SENSORS (AIR QUALITY SENSOR + WEATHER STATION SENSOR) THESE WILL BE CONNECTED TO THE LAN VIA THE WAP.

INFORMATION FROM THESE SENSORS WILL BE RELAYED TO THE SQL DATABASE SERVER WHICH THE WEATHER/TEMP/AIR SOFTWARE RESIDES.

DISPLAY SCREENS

THROUGHOUT THE CAMPUS DISPLAY SCREENS WILL BE INSTALLED IN THE MOST APPROPRIATE AREAS, TO DISPLAY THE INFORMATION GATHERED BY THE SENSORS. THESE WILL BE CONNECTED TO THE LAN VIA THE ROUTER.

ESTATES MONITORING STATION.

INFORMATION FROM THE SENSORS WILL BE COLLATED BY THE ESTATES DEPARTMENT, OBTAINED FROM THE DATA STORED WITHIN THE SQL DATABASE. THIS WILL ALSO BE CONNECTED TO THE LAN VIA THE ROUTER.

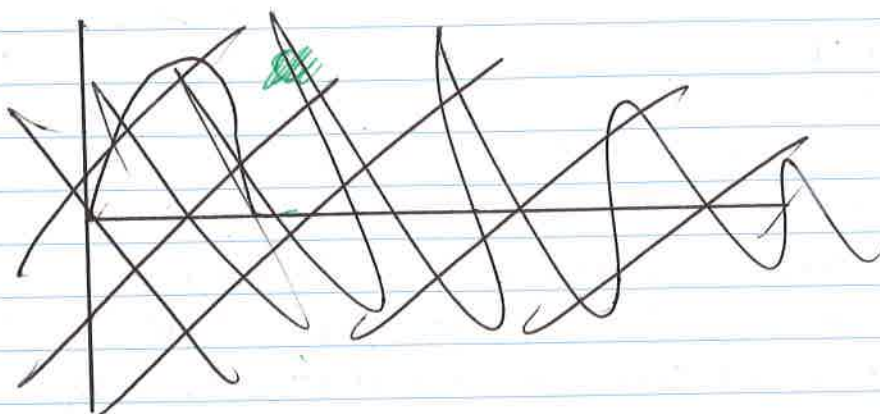
FIREWALL

A FIREWALL WILL BE PLACED BETWEEN THE ROUTER ~~AND THE~~ AND WAN. APPROPRIATE RULES WILL BE USED TO RESTRICT UNAUTHORISED ACCESS.

802.11 WILL BE USED FOR WIRELESS AREAS OF THE NETWORK

ETHERNET WILL BE USED FOR LAN.

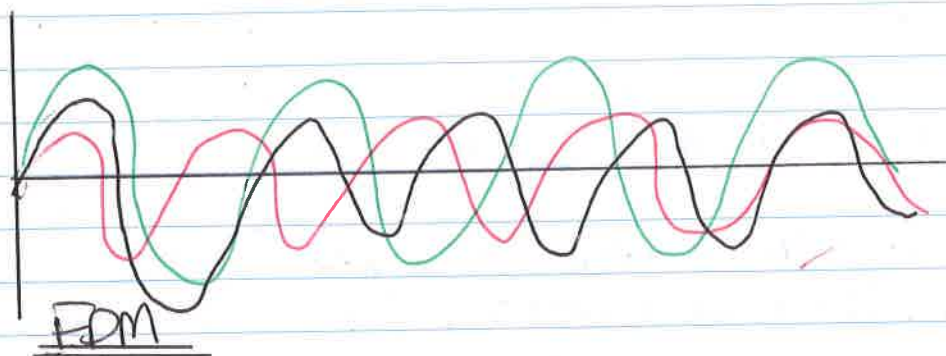
16) ASK



- 23A) 1) FREQUENCY DIVISION MULTIPLEXING (FDM)
 2) TIME DIVISION MULTIPLEXING (TDM)
 3) CODE DIVISION MULTIPLEXING (CDM)

FREQUENCY DIVISION MULTIPLEXING.

THIS IS WHEN A SIGNAL IS SENT ON A SPECIFIC FREQUENCY SPREAD OUT OVER THE SPECTRUM.



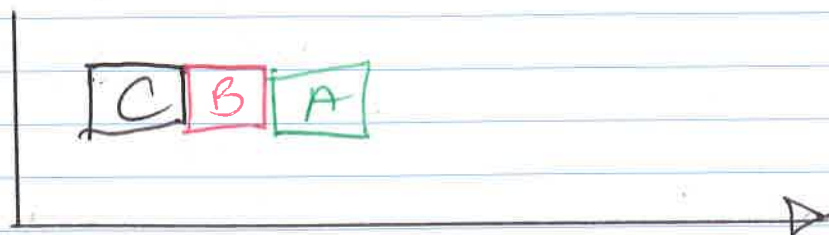
ADVANTAGES

NO ORGANISATION IS REQUIRED FOR THE SIGNAL

DISADVANTAGES

WASTE OF BANDWIDTH

(Q3A) TIME DIVISION MULTIPLEXING



THIS IS WHEN A SIGNAL IS GIVEN A SPECIFIED AMOUNT OF TIME TO SEND ITS SIGNAL. AS CAN BE SEEN ABOVE SIGNAL A IS SENT FIRST FOLLOWED BY SIGNAL B AND SO ON

ADVANTAGES

THE SIGNAL HAS FULL USE OF THE BANDWIDTH DURING TRANSMISSION

DIS ADVANTAGES

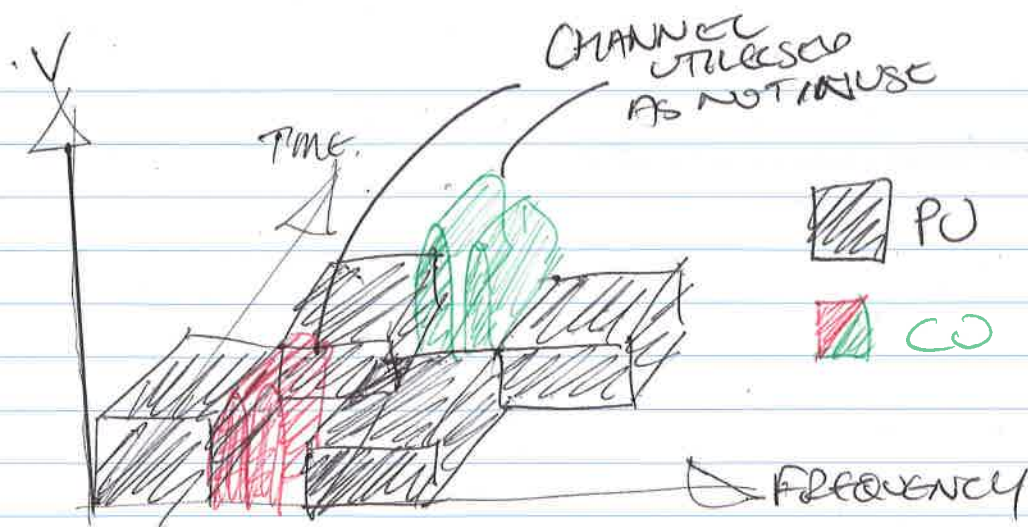
SOME ORGANISATION IS REQUIRED TO DECIDE WHICH SIGNAL IS SENT AND FOR HOW LONG.

CODE DIVISION MULTIPLEXING

THIS IS WHEN A SIGNAL IS GIVEN A SPECIFIC CODE FOR TRANSMISSION, THIS IS USED PRIOR TO TRANSMISSION TO IDENTIFY THE SIGNAL, THIS CODE IS USED ON THE RECEIVING END TO IDENTIFY THE TRANSMISSION.

ADVANTAGES

NO CO-ORDINATION OF SIGNALS IS REQUIRED
DIS-ADVANTAGES - COMPLEX GENERATION/REGISTRATION OF SIGNALS.



COGNITIVE RADIO.

THIS IS WHEN A CHANNEL IS USED THAT IS NOT ~~NOT~~ CURRENTLY IN USE. CERTAIN CHANNELS HAVE BEEN GIVEN TO SPECIFIC USERS AND ARE NOT PERMITTED FOR USE. EXAMPLES OF THESE CAN INCLUDE FIRE, POLICE, TV ETC....

CHALLENGES AND ISSUES

INTERFERENCE BY THE PU INTO THE CU CHANNEL WILL SHUT DOWN THE CHANNEL.

INTERFERENCE BY THE CU INTO THE PU CHANNEL WILL CAUSE THE PU SIGNAL TO BE DISRUPTED/INTERFERENCE.

QBC) CONTENTION FREE

THIS IS WHEN IT IS ASSUMED THAT IT IS NOT FREE.

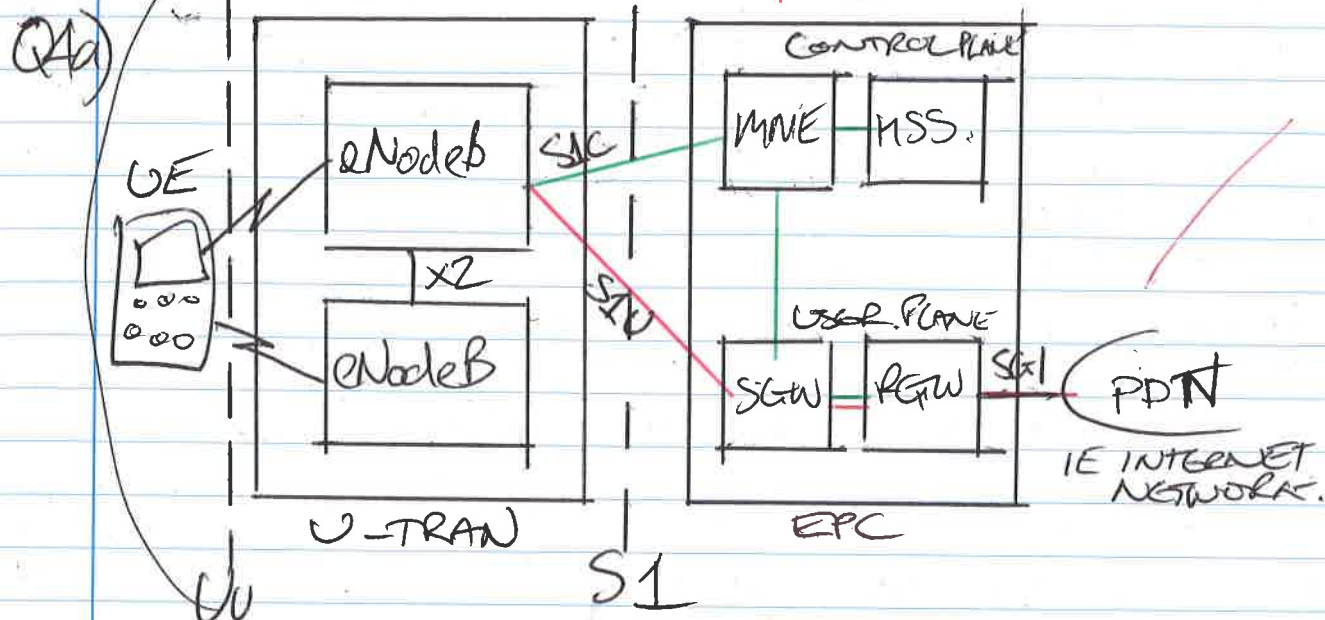
- 1) FDM (FREQUENCY DIVISION MULTIPLEXING)
- 2) TDM (TIME DIVISION MULTIPLEXING)
- 3) CDM (CODE DIVISION MULTIPLEXING)

THE ABOVE 3 TECHNIQUES ARE USED TO UTILISE THE CHANNEL.

CONTENTION BASED

THIS IS WHEN CARRIER SENSE MULTIPLE ACCESS IS USED.

CSMA WILL CHECK IF A SIGNAL CAN BE SENT BY CHECKING IF ANYTHING IS CURRENTLY TRANSMITTING. IF IT IS FOUND NO ONE IS TRANSMITTING A BACKOFF TIMER IS INITIATED. ONCE THIS BACKOFF TIMER HAS CEASED THE SIGNAL IS TRANSMITTED.



UE - USER EQUIPMENT.

EPC - ENHANCED PACKET CORE

MME - MOBILE MANAGEMENT ENTITY.

HSS - HOME SUBSCRIBER SERVER

S-GW - SERVING GATEWAY

P-GW - PDN GATEWAY

eNodeB - BASE STATION

USER EQUIPMENT IS CONNECTED TO THE eNodeB WITHIN THE CELL WHICH IT CURRENTLY RESIDES. VIA THE APPROPRIATE RADIO TECHNOLOGY OF THE HANDSET AND ANTENNA.

THE eNodeB CONNECTS TO THE MME VIA THE S1-M INTERFACE. IT CAN ALSO CONNECT TO OTHER eNodeB'S VIA ITS X2 INTERFACE.

THE MME IS RESPONSIBLE FOR ORGANISING THE SIGNALS RECEIVED ~~VIA~~ VIA THE eNodeB AND THE HOME SUBSCRIBER SERVER. THE HSS IS WHERE INFORMATION IS STORED RELATIVE TO THE USER EQUIPMENT.

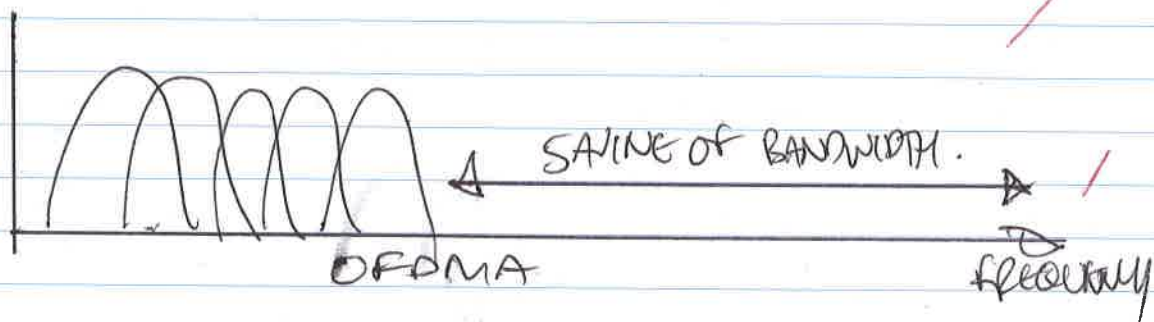
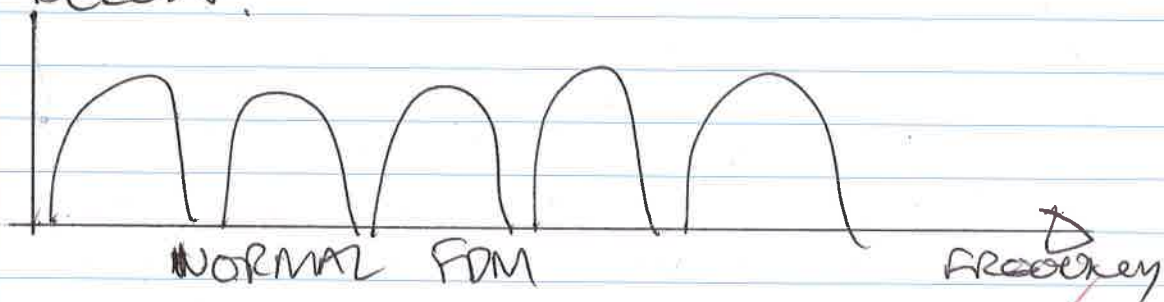
QAA)

THE S-GW IS RESPONSIBLE FOR PASSING THE ~~THE~~ SIGNALING INFORMATION RECEIVED FROM THE MME AND THE TRAFFIC RECEIVED FROM THE ENDS ONTO TO P-GW.

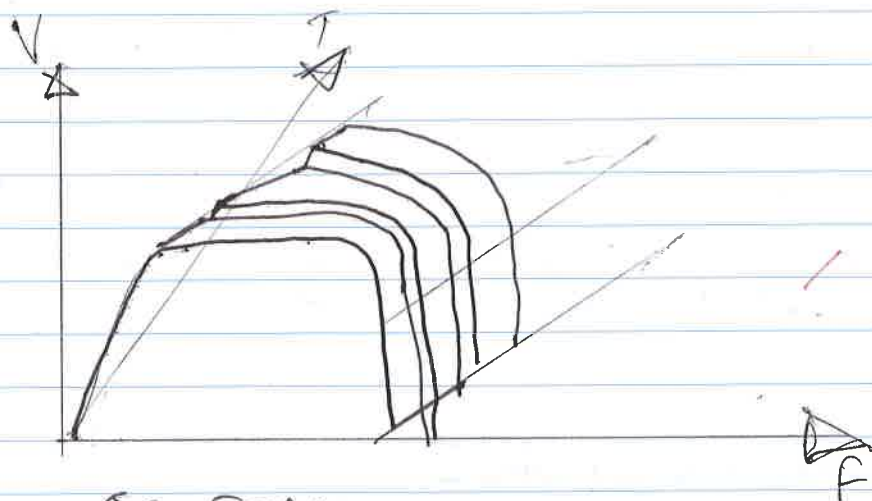
ONCE THE P-GW RECEIVES THE DATA/SIGNALS FROM THE S-GW, IT IS PASSED ON AND OUT ARE THE EXTERNAL NETWORK OR PDN.

LTE USES THE MIMO (MULTI IN/MULTI OUT) TECHNIQUE. THIS IS WHEN MULTIPLE CONNECTION ARE CREATED TO THE ANTENNAS TO INCREASE THE DATA RATE.

OFDMA IS USED IN THE DOWNLOAD OF DATA. THIS CAN BE SEEN IN THE DIAGRAM BELOW.



Q4A) SC-FDM IS USED IN THE UPLOAD OF DATA. THIS CAN BE SEEN IN THE DIAGRAM BELOW.



SC FDM.

LTE ADVANCED USES THE 4×4 MIMO FOR UPLOAD AND 8×8 MIMO FOR DOWNLOAD COMPARED TO THE 2×2 MIMO OF NORMAL LTE. THUS ALLOWING FOR MUCH LARGER DATA RATES.

THIS ESSENTIALLY MEANS THAT THE END DEVICES CONNECT TO AN ANTENNA ~~MORE~~ CREATING A CONNECTION PIPE MULTIPLE TIMES. ~~OR EVEN TO DIFFERENT~~ ANTENNAS, CREATING THE ADDITIONAL BANDWIDTH. MORE USERS CAN BE ON AT ANYTIME IN LTE ADVANCED.

Q4C) SECURITY CONCERNS IN LTE ARE DDoS ATTACKS WHICH ESSENTIALLY OVERLOAD THE SYSTEM, CUTTING OFF ALL USERS OFF.

STEALING OF AUTHENTICATION KEYS.

Q4D) TOTAL BANDWIDTH = 25 MHz (25000 kHz)
 USER BANDWIDTH = 40 kHz

i)

$$\frac{\text{TOTAL BANDWIDTH}}{\text{USER BANDWIDTH}} = \text{TOTAL USERS}$$

$$\frac{25000 \text{ kHz}}{40 \text{ kHz}} = 625 \text{ USERS}$$

ii)

~~25000 kHz ÷ 8 = 3125 kHz~~
~~3125 kHz ÷ 7 = 446 kHz per cell~~

i) ~~$25000 \text{ kHz} \div 7 \text{ cells per cluster} = 3571 \text{ kHz per cell}$~~

ii) ~~$3571 \text{ kHz} \div 40 \text{ kHz} = 89 \text{ users}$~~ 78.

iii) ~~$89 \times 20 \text{ users} = 1780 \text{ users}$~~

~~$25000 \div 8 = 3125 \text{ kHz}$
 $3125 \div 7 = 446 \text{ kHz per cell}$~~

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$$ii) 2) n = k \left(\frac{S}{W} \right)$$

$$N = \text{number of users} \quad 7 \checkmark$$

$$K = 8 \checkmark$$

$$S = 25000 \text{ KHz} \checkmark$$

$$W = 40 \text{ KHz} \checkmark$$

~~$$n = 8 \left(\frac{25000}{40} \right)$$~~

~~$$n = \frac{28571}{40}$$~~

$$n = \frac{28571}{40}$$

$$n = 714 \text{ users.}$$

~~$$1) n = 8 \left(\frac{25000}{40} \right)$$~~

~~$$n =$$~~

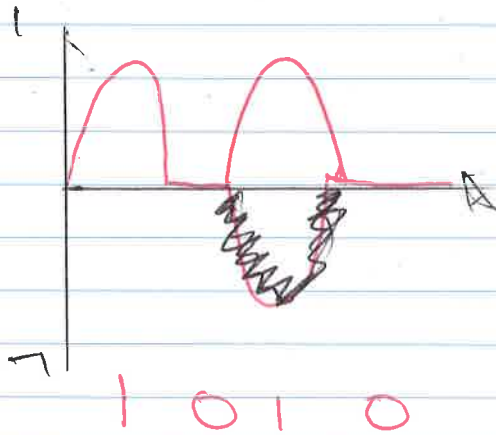
$$25000 \text{ KHz} \div 8 \text{ users}$$

$$= 3125 \text{ KHz} \div 7 = 446 \text{ KHz}$$

Q/B)

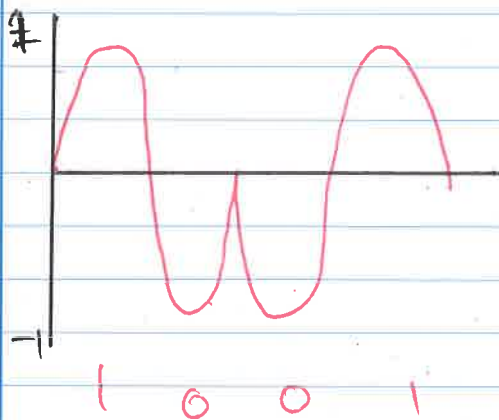
ASK.

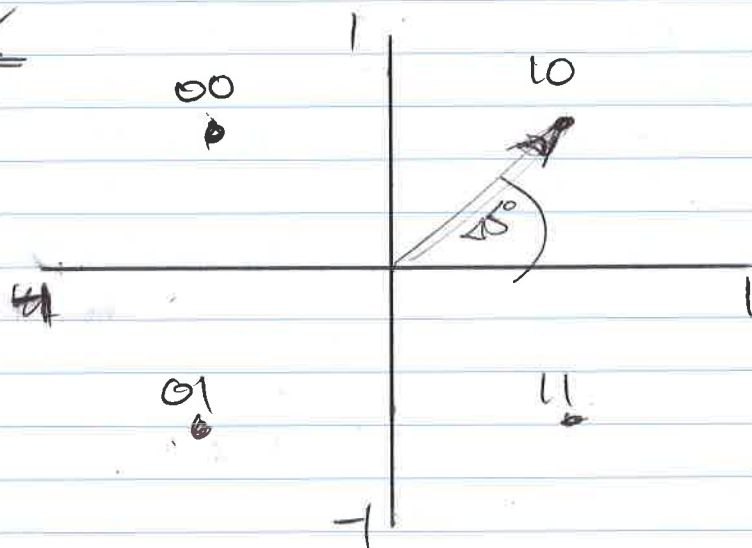
THIS IS WHEN THE AMPLITUDE IS USED TO REPRESENT A SYMBOL. FOR EXAMPLE AN AMPLITUDE OF 1 EQUATES TO A 1 SYMBOL AND NO AMPLITUDE EQUATES TO A 0.



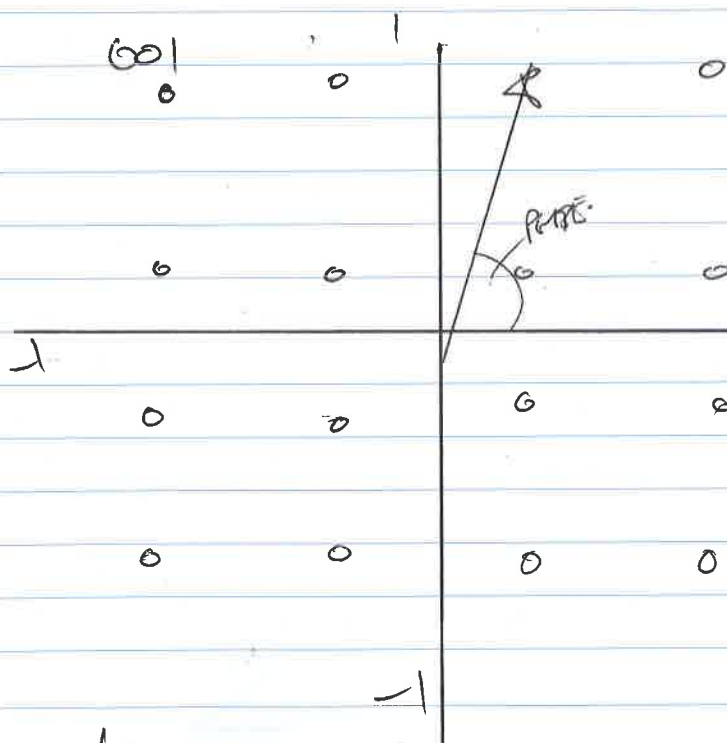
THIS IS KNOWN AS ON OFF KEYING.

IT CAN ALSO BE USED IN THE FOLLOWING. IF AN AMPLITUDE OF 1 OR -1 IS PRESENT. AN AMPLITUDE OF 1 IS = 1 AMPLITUDE OF -1 EQUALS 0.



Q1B) QPSKCONSTELLATION DIAGRAM QPSK.

THIS IS WHEN THE PHASE AND AMPLITUDE ARE ADJUSTED TO CREATE THE 4 SYMBOLS. EACH SYMBOL IS REPRESENTED BY A SPECIFIC PHASE AND AMPLITUDE.

QAM16QAM CONSTELLATION DIAGRAM

THIS IS SIMILAR TO QPSK BUT A MULTITUDE OF PHASES ARE USED TO REPRESENT EACH SYMBOL. 16QAM CAN TRANSMIT 3 SYMBOLS.

THERE ARE MANY QAM, IE 64QAM, 128QAM, 256QAM.

X

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