

DSP and C Robbie young

by Robbie Young

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File name: 32858_Robbie_Young_DSP_and_C_Robbie_young_529633_604678439.docx (89.5K)

Word count: 2013

Character count: 9201

Use of 1st Person Voice

I want to say what each one is used for and brief description and results.

The aim of my simulations is to input random data, modulate it, add noise, demodulate the signal, and then test the demodulated signal against the original signal to establish a bit error rates at different noise levels. Different amplitude and phase shifts will be tested and to get accurate results, 10 simulations will be done. The 4 different models that will be tested are ASK, PSK, QPSK

First use AM. There are different use cases for each one of these models for example, ASK modulators are typically used for very short-range wireless transmission applications, such as wireless keys or

Contraction pressure sensors, this is because there is limited noise during transmission. As ASK systems work well with noise. It does however work very well for fibre optics and with no noise it can transmit data very quickly with high precision. QPSK is better used in long range transmission, such as satellite communication or video calls, due to it being able to handle noise better and be able to send 2 bits of data simultaneously allowing for high speeds, making it very efficient at these roles. PSK's, although similar to QPSK's they can only send 1 bit of data during transmission. This makes them very effective in blue tooth communication as it has a very limited range but can send information quickly. QAM specialises in WIFI, due to it sending 4 bits of data simultaneously. This allows for extremely high speeds of data to be transmitted; however, noise can very easily affect the transmission, giving it a rather limited range.

Add more>?

ASK

ASK modulation works by changing the amplitude of the carrier wave, when a digital signal is present a binary 1 is represented by the amplitude staying the same. When the binary value is 0 the amplitude is decreased. There are different methods to accomplish this, either a conventional convertor, or what I have used in the simulations a simple switch. The switch uses the data to switch between sending the carrier signal and a no modulated signal. Then demodulating the signal, it multiplies the received signal by the carrier signal, then goes through a low pass filter to smooth out data to remove any inaccuracies within the data.

Simulink model

Figure x is my model of an ASK Modem, both sine waves are identical and are timed using simulation time with a frequency of 10, with a low pass filter running at 1000hz. I have set to 5 and Fstop at 75. Setting this up I could run my simulations with a 25 sample time.

Results

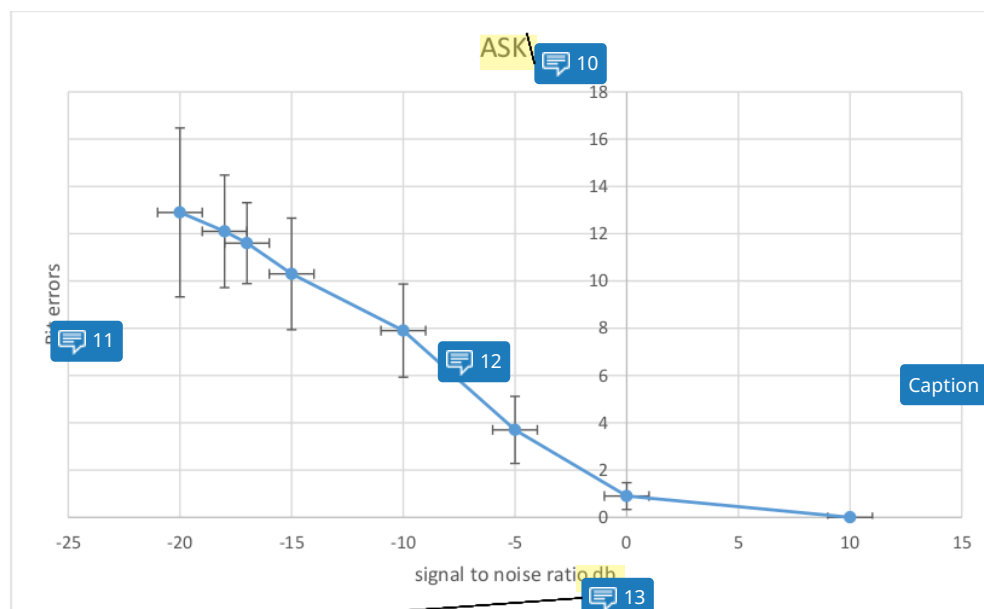


Figure x shows a graph of the ten tests done, plotted against the average error rate, with the error bars set at the standard deviation. At 10db of noise there is no error in the demodulated signal and at -18db there is an average fail rate of 11, this mean that when de modulating a signal has a 50% chance of each bit to be correct, therefore it is impossible for the signal to be interpreted correctly, as it can't decipher which 50% is correct.

Discussion

To start the simulation, although not plotted, the test was run with no noise present. This gave me an accuracy of 100%, which proved that my simulation model was correct. This gave me a starting base to add noise into the system and see how it reacted, allowing me to fill out my table to get an average bit error rate. At noise level of 0db I had an average of just below 1 bit in every 25 be incorrect. The reason for the error is the noise induced on the signal is at the correct amplitude to bypass the filter and cause an error. As the noise level increases the average bit error goes up relative to the increase in noise. Once it hit the signal level of -15db the gradient of change in the error rate decrease. The reason for this is the error rate is already close to 50%, so takes longer to reach the fail rate.

screen shot of the scope shows the signals inputted and outputted and any variants in between, at a noise level of -10db. The sixth line of results is the final demodulated signal. When the signal is rapidly switching between 1 and 0, a digital 1 is represented, when the signal is at a much lower switching rate a digital 0 is represented. Line five in the scope is the signal after line four has been filtered, showing the filter removing the majority of noise from the signal. Then going through a switch were show deviation from the original signal more clearly. The deviation occurs because false readings occur because there is only 1 switch point, determining if the signal is a digital 1 or 0. This allows noise to rapidly trigger the switching point to create false readings.

PSK

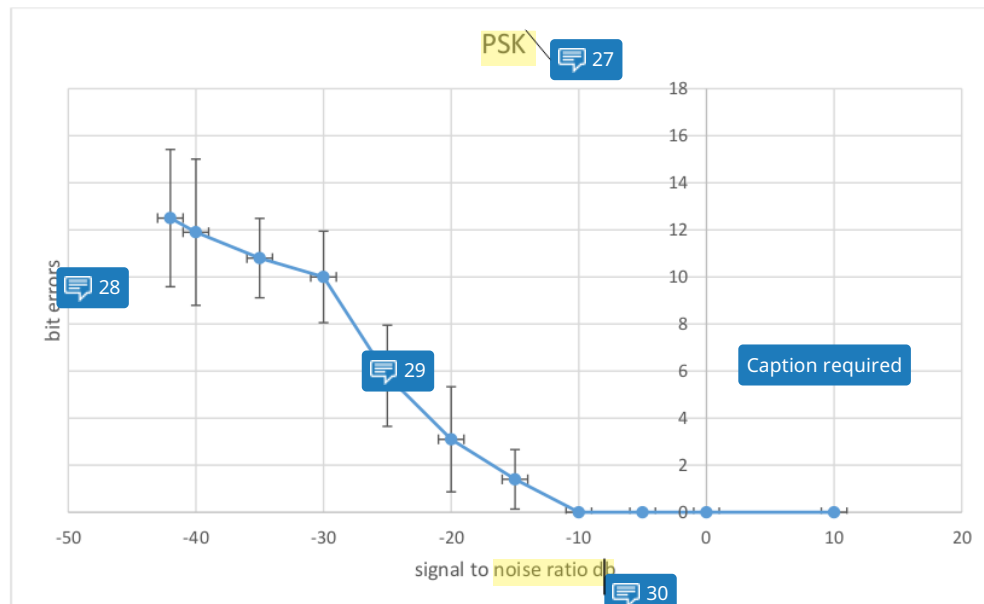
Digital Signal Processing and Communications

Phase Shift Keying (PSK) works by using 2 different phases to represent 2 digital bits. These 2 phases are always inverse of one another, allowing for data to be transferred across the system. A binary 1 is represented by the normal phase, 0 is represented by the inverse phase, allowing for systems to understand what is being transferred.

Simulink model

The diagram above is my Simulink model for a PSK. The sine waves are the same, with time set as simulation time, with the frequency set at $2\pi \times 2$ sample time of $1/1000$. To create the inverse wave, I used a product of the sine wave and multiplied by -1. The filter is set 1000hz, with Fpass at 0.025 and an Fstop of 0.125.

Results



As you can see from the graph, the PSK deals well with noise, as no errors occur until -15db. At -42db the system has a fail rate of 0.5, where information becomes unrecoverable, and the system breaks. However, the PSK is close failing at -30db, but it still takes another 12db to break down.

Discussion

To prove my system was functional no noise was used as a testing point to prove the model was working. Low levels of noise don't really affect the system because it doesn't trigger a change in phase over long enough periods of time. As seen from the screen shot of the scope, noise can still trigger minor interference, but won't affect the data, due to the sample rate, because the noise isn't intrusive enough to continually stay on the switching level causing changes. However, with more noise present the switching level is continually pushed triggering multiply errors as the system believes these are phase shifts.

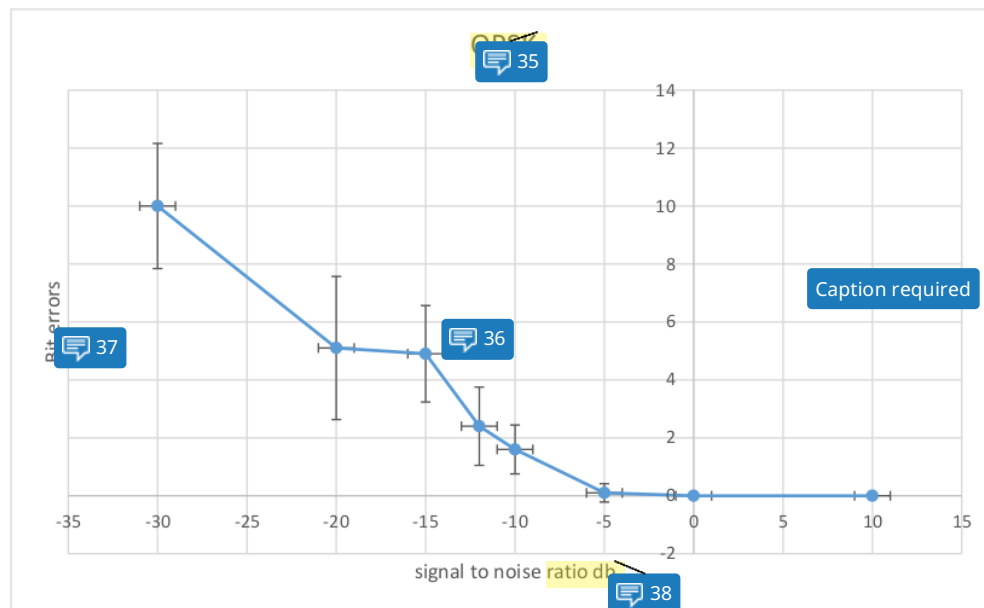
QPSK

Quadrature Phase Shift Keying (QPSK) works by modulating two bits at the same time, then uses one of four carrier phases, allowing for double the bit rate whilst using the same bit rate as a PSK. QPSK works by shifting the phase of the frequency to represent a change in the bit.

Simulink model

Figure x shows my model of the QPSK modem. The 2 top sine waves use $\sin$ with a frequency of $2\pi \times 100\text{Hz}$ and a phase of 0 , the bottom ones have a phase of $\pi/2$, making them 90 degrees out of phase. The filters are identical, set at a Fpass of 0.75 , a Fstop of 2.25 and an Astop at 30dB .

Results



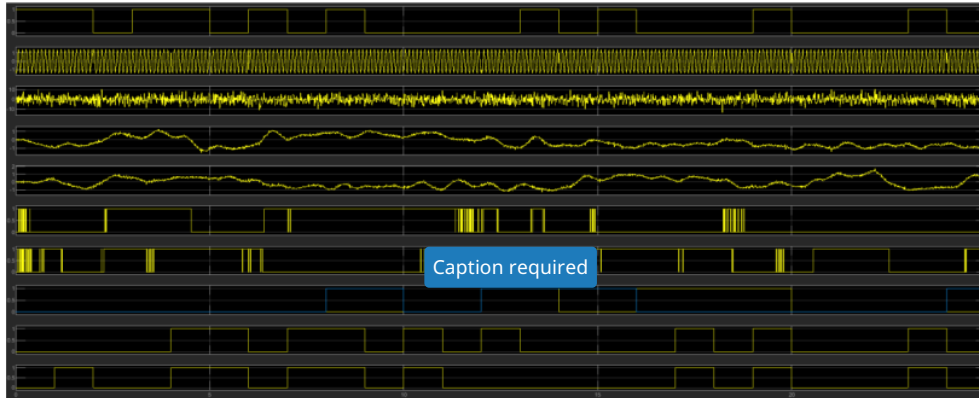
The graph shown displays the average bit error rate across 10 attempts, vs the noise ratio. At -5dB the first error inking of possible errors shows up, indicating the model is starting to fail. By the time you get to -30dB the model has failed, as it's reached a 50% fail rate.

Discuss

Again, simulations were done with no noise to ensure the model was working. After 10 simulations at various noise levels, the oddities of the results are both curious results, as there is only a 0.2 average bit rate error between them. I believe they should be further apart, this would be proved in future, giving more accurate results. At -20dB the simulation didn't have any error in the bit rate, I believe this skewed the results making the average -20dB lower than expected.

The screen shot of the scope shows the before and after modulation and de modulation, along with what the filters are doing. Where QPSK is transferring more data across the same band width as a PSK but it can be affected by noise as it is a lot more sensitive, due to combining 2 signals together,

so it can send grey encoded data, meaning its easier for noise to interfere with the signal as it can trigger a switch in two directions giving incorrect data as an output.



1 error

QAM

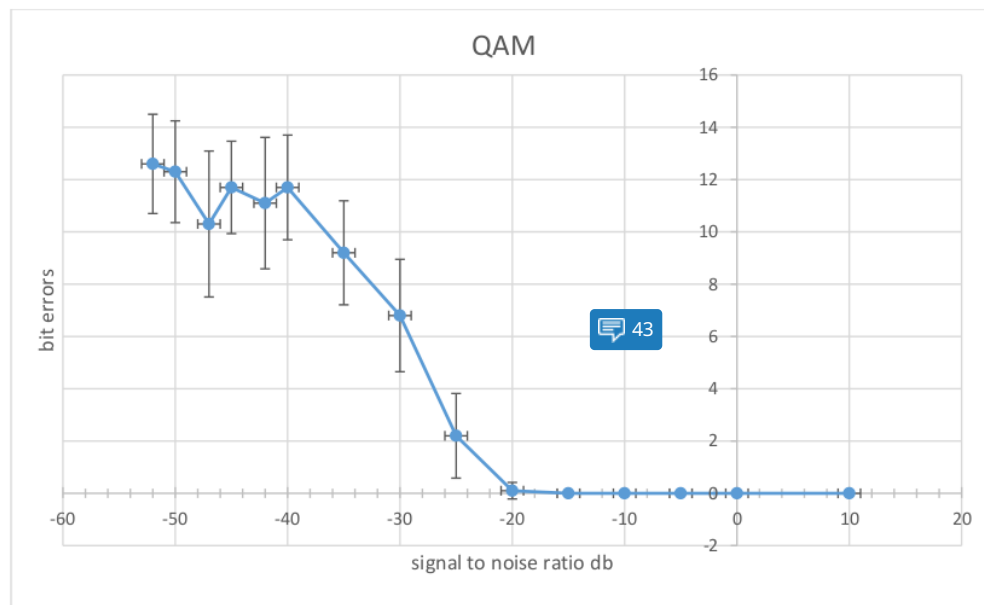
Quadrature Amplitude Modulation (QAM), is a mix between PSK and ASK, as it uses both shifts, in phase and amplitude to send information through a carrier wave. 16 QAM uses a square grid that is grey encoded, this enables QAM to send more information, as you can send 4 bits along the same bandwidth, however this comes with draw backs as it susceptible to noise, due to these points being very close in the grid.

Simulink model

All sine waves are set to 2π with a sample rate 1/10000, however both filters are different, the top design uses the filter from the ASK and the bottom uses one from PSK.

42

Results



From my testing the graph was produced which shows the system I have designed is capable of handling up to -20db of noise without any errors. It then rapidly jumps up close to the bit fail rate but fluctuates for another 12db's before finally reaching the fail rate.

Discussion

My model of a QAM works very well with noise because I've combined my PSK with my ASK. This works really well because after de modulating the signal I multiply them both together meaning for a digital 1 to be outputted by the system both the amplitude and the phase would have to be correct, making my system very capable with noise.

A 16QAM however would be the opposite to this because it would be sending 4 bits of data down the transmission line, this would be susceptible to noise because only 1 bit must be wrong for an incorrect result. This makes QAM very good at high-speed data transfers where limited noise is present.

Conclusion

To conclude my testing I felt like the Simulink modelling and the test run very conclusive and gave me accurate results. To ensure my results have less deviation more simulations would have to be run to make my results more accurate.

My results show the use cases of each. Highlighting both their strengths and vulnerabilities. For example, my results of the ASK modem shows its inability to deal with noise, proving it wouldn't be very useful at longer ranges, but due to its cheap design it makes it ideal for fibreoptics and short range wireless transmission, such as wireless keys. In comparison, my results for QPSK prove it can deal well with noise making it ideal for long range transmissions, such as satellite communication, along with its ability to send 2 bits of data simultaneously. However, it is rather expensive to make, therefore making it impractical for short range use. PSK is best used for Blue Tooth technology, and

Digital Signal Processing and Communications

my results demonstrate this, as my model was able to deal with a signal to noise ratio of -15db before 1 bit on average was incorrect. This makes it excellent for this applications as its somewhat cheap to make, whilst having a moderate range, with slow transfer rate. QAM was the last model tested, with my results showing the opposite of its role. The reason I believe this occurred, is because my mode combined both ASK and PSK, where as a 16 QAM ~~workd~~ slightly differently, as its able to send 4 bits of data in 1

Sp.

48

49

DSP and C Robbie young

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

37 /100

PAGE 1



Comment 1

No cover page

No report title

No student name

No student number

No Abstract

Poor structure.

QM

Use of 1st Person Voice

When writing technical reports, do not use first person voice. Instead, use the third person passive voice.

You should not use words like "I", "you", "we" etc..



Comment 2

modulation techniques

QM

First use

You should introduce acronyms and symbols the first time you use them so the reader understands what you are talking about.



Comment 3

this is because it is a low power transmission type - it requires no (or very little) power when transmitting logic 0

QM

Contraction

In formal academic writing, you should avoid using contractions like "aren't" "can't" "don't" etc. instead you should use the full form of the words. "Are not" "Can not", "Do not".



Comment 4

It would have been better if you included the equation for ASK modulation to aid your description



Comment 5

You have not included this figure



Comment 6

Hz not hz



Comment 7

Do you mean with a sample rate of 1kHz?



Comment 8

Missing units.

Do you mean 10 Hz?

QM

Missing Units

What units is this in?

You should always include the units for all quantities you describe in your text. Some quantities have more than one unit. Frequency, for example, can be measured in Hertz (Hz) or radians per sec (rad/s).

Make it clear for your reader and remove any ambiguity.



Comment 9

typo

QM

Missing Units

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QM

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PAGE 2



Comment 10

Give your graphs meaningful titles:

Graph of BER vs SNR for the ASK modem



Comment 11

Should be Bit Error Rate (BER)



Comment 12

not sure why you have horizontal error bars. This value was set in software and so was exact, therefore it cannot have a distribution.

QM

Caption required

You should always include a caption on figures, equations and tables to allow you to refer to them in your text.

e.g. An illustration of this can be seen in figure 2. The relationship of the variables is shown in equation 2. Table 1 shows the results of the first experiment where the control variable, temperature in degrees celsius is shown in the first column....



Comment 13

dB

d = deci, 10^{-1} so lower case

B = Bel, named after Alexander Graham Bell, so upper case



Comment 14

one word



Comment 15

of not off



Use of 1st Person Voice

When writing technical reports, do not use first person voice. Instead, use the third person passive voice.

You should not use words like "I", "you", "we" etc..



Comment 16

ratio



Comment 17

Signal to Noise Ratio - SNR



Comment 18

dB



Comment 19

Signal to Noise Ratio - SNR



Comment 20

Use figure numbers and caption the figure.



Comment 21

One word: demodulated



Comment 22

Signal to Noise Ratio - SNR



Comment 23

This paragraph should have been on the same page as the "screen shot of the scope" it is discussing.



Comment 24

why is the heading at the bottom of the page with nothing under it? It should be on the top of the next page. - Insert a page break (CTRL + ENTER) to do this.

PAGE 3



Comment 25

It would have been better if you included the equation for PSK modulation to aid your description



Comment 26

Diagram Missing.



Comment 27

Give your graphs meaningful titles:

Graph of BER vs SNR for the PSK modem



Comment 28

Should be Bit Error Rate (BER)



Caption required

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e.g. An illustration of this can be seen in figure 2. The relationship of the variables is shown in equation 2. Table 1 shows the results of the first experiment where the control variable, temperature in degrees celsius is shown in the first column....



Comment 29

not sure why you have horizontal error bars. This value was set in software and so was exact, therefore it cannot have a distribution.



Comment 30

dB

d = deci, 10^{-1} so lower case

B = Bel, named after Alexander Graham Bell, so upper case



Comment 31

It would have been better if you included the equation for QPSK modulation to aid your description



Comment 32

Figure missing



Missing Units

What units is this in?

You should always include the units for all quantities you describe in your text. Some quantities have more than one unit. Frequency, for example, can be measured in Hertz (Hz) or radians per sec (rad/s).

Make it clear for your reader and remove any ambiguity.



Comment 33

10 Hz?



Missing Units

What units is this in?

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Make it clear for your reader and remove any ambiguity.



Comment 34

100Hz not 100hz



Missing Units

What units is this in?

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Make it clear for your reader and remove any ambiguity.



Comment 35

Give your graphs meaningful titles:

Graph of BER vs SNR for the QPSK modem



Caption required

You should always include a caption on figures, equations and tables to allow you to refer to them in your text.

e.g. An illustration of this can be seen in figure 2. The relationship of the variables is shown in equation 2. Table 1 shows the results of the first experiment where the control variable, temperature in degrees celsius is shown in the first column....



Comment 36

not sure why you have horizontal error bars. This value was set in software and so was exact, therefore it cannot have a distribution.



Comment 37

Should be Bit Error Rate (BER)



Comment 38

dB

d = deci, 10^{-1} so lower case

B = Bel, named after Alexander Graham Bell, so upper case



Comment 39

You should have only one discussion section where you discuss and compare all the results. Having separate sections does not allow for comparison



Use of 1st Person Voice

When writing technical reports, do not use first person voice. Instead, use the third person passive voice.

You should not use words like "I", "you", "we" etc..



Comment 40

dB

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Comment 41

This sounds like Investigator Bias. You should not hold any preconceptions of the results, or allow any preconceptions to skew your analysis of the results. Respect the data!

PAGE 5



Caption required

You should always include a caption on figures, equations and tables to allow you to refer to them in your text.

e.g. An illustration of this can be seen in figure 2. The relationship of the variables is shown in equation 2. Table 1 shows the results of the first experiment where the control variable, temperature in degrees celsius is shown in the first column....



Comment 42

Why are they different? They should be identical. Different filters will give different delays, which will cause errors when the data is recombined.

PAGE 6



Comment 43

See comments on previous graphs



Comment 44

This is a reflection, not a conclusion.



Comment 45

No they don't. The use cases of each system were stated in the introduction. ASK - low power, short distance, fibre comms.

QPSK - satellite and video

QAM - Wifi



Comment 46

You have shown that it cannot "deal with" noise, but you have not explained WHY.



Comment 47

Bluetooth - one word

PAGE 7

QM

Sp.

Spelling error



Comment 48

send 4 bits of data in 1..... what?

incomplete sentence.



Comment 49

There should be references for this work. By not including any references you are throwing marks away.

GRADING FORM: SMU GENERIC_SMOSEY

ROBBIE YOUNG

36.70

ENGAGEMENT WITH LITERATURE

including reading, referencing, academic conventions and academic honesty



You have not engaged with any literature. You NEED to show that you understand the theory by providing some background information on the subject AND REFERENCING sources you've found to back up your work

0

KNOWLEDGE & UNDERSTANDING

Knowledge of the basic underlying concepts and principles of a subject.



Evidence of basic knowledge and understanding of the relevant concepts and underlying principles.

8

COGNITIVE & INTELLECTUAL

Evaluate underlying concepts and principles of a subject and interpret qualitative and quantitative data in order to develop lines of argument and make sound judgements.



Some evidence of analytical intellectual skills, but for the most part descriptive. Ideas/findings sometimes illogical and contradictory. Generalised statements made with scant evidence. Conclusions lack relevance.

11.4

PRACTICAL APPLICATION SKILLS

Different approaches to solving problems in particular contexts.



An adequate awareness and mostly appropriate application of well-established methods, materials, tools and/or techniques.

13.5

Basic appreciation of the context of the application.

TRANSFERABLE SKILLS

Communicate the results of their study/work accurately and reliably, and with structured and coherent arguments; the qualities needed for employment requiring the exercise of some personal responsibility within a structured and managed environment.



Media is poorly designed and/or not suitable for the audience.

Work lacks structure, organisation, and/or coherence

3.8