# THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY ISDN 2602

**Laboratory 3: Frequency Analysis and Analog Modulation (5%)**

**Answer Sheet**

Please write down your answer here and submit your answer on GitHub by Wednesday (Oct 15th) 23:59

Github classroom link:

<https://classroom.github.com/a/LjghOE-Z>

**T ask 1: Modulation**

In this task, you will learn how to modulate a carrier wave by a message signal.

# C heck Point:

* 1. From the second figure, we can observe how modulation changes the spectrum of the signal. Revise the code so that the center of the signal spectrum will be moved to 10kHz.

(Commit the revised codes to GitHub. Show your results to TAs.

* 1. Revise the cut-off frequency of the low pass filter to 3 KHz. Describe how the modulated signal changes due to the cut-off frequency revision. What is the advantage of using a smaller cut-off frequency? What is the cost?

Advantage:

1. High frequency Noise Reduction.
2. Less bandwidth requirements.

Cost:

1.lose some sounds details due to filter.

2.Less information capability.

***Fill in the answers, commit the revised codes to GitHub***

***and show your result to the TA.***

# Task 2 – Demodulation

In this task, you will learn how to demodulate the received signal.

# C heck point:

1. There are three copies of the amplitude spectrum in the third subplot of Figure 1. Do they have the same amplitude? Explain why.

No, after original wave multiplied by carrier wave, which is a cosine function for copy.1 and 1/2 multiple for copy.2 and copy.3, so it will downsize

1. Revise the demodulation carrier frequency to “1.001.\*freq\_carrier” in arguments of the demodulate function. Can you notice the change in the time domain signal? Briefly explain why. How about changing the demodulation frequency to 1.1\*freq\_carrier?

Yes, the redundant frequency multiple involve the new noise in demodulation and deviate the original wave.

Explain:   
In each demodulation period, after the send wave multiplied by a carrier wave, we will get after low- pass filter. And the noise in demodulation frequency will make the signal deviated the original one.

The signal will distort worse.

***Fill in the answers to the blanks and Show your result to the TA.***

# T ask 3 – Estimate carrier frequency

In this task, you will estimate the values of the carrier frequency and the cutoff frequency of the low pass filter from the spectrum of the original and modulated signals.

# C heck point:

1) Determine the carrier and cut-off frequencies. Show your solution codes to the TA for checking.

Carrier frequency:10\*10^3

Cut-off frequency:4\*10^3

(Commit the revised codes to GitHub. Show your results to TAs.)

***Fill in the answers to the blanks. Commit the revised codes to GitHub and***

***Show your result to the TA.***

# T ask 4 – Frequency Division Multiplexing

In this task, we will share a communication channel among three users using frequency division multiplexing. Different users will be assigned to different frequency bands.

# C heck point:

1) Determine the carrier frequencies for three users and show your results to the TA for checking.

15K,35K,60K Hz

(Commit the revised codes to GitHub. Show your results to TAs.)

***Fill in the answers to the blanks. Commit the revised codes to GitHub and***

***Show your result to the TA.***

**----------------------------------End-----------------------------------**