**Faculty of Engineering and Technology**
**Electrical and Computer Engineering Department**

**Computer Communication Lab**
**ENEE 4113**

# Experiment No. 1 pre-lab
## Normal Amplitude Modulation

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Section: 2
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# Title: Theoretical Analysis of Normal Amplitude Modulation and Demodulation

## Introduction:

This prelab report delves into the theoretical foundations of Normal Amplitude Modulation (AM) and Demodulation, pivotal techniques in the realm of communications for transmitting and retrieving information over varying distances

## Objective:

To explore and articulate the theoretical and mathematical concepts of Normal Amplitude Modulation and Demodulation, elucidating the principles and equations that define their operation.

## Theoretical Background:

### Normal Amplitude Modulation (AM):

*Definition and Principles:*

AM is a technique used in electronic communication, primarily for transmitting audio and video signals through a carrier wave. The basic principle involves varying the strength (amplitude) of the carrier wave in direct proportion to that of the signal wave, without altering the carrier's frequency.

*Mathematical Representation:*

The mathematical formula for a modulated signal can be represented as:

$$s(t) = [A_c + m(t)] \cos(2\pi f_c t)$$

where:

s(t) is the AM signal,

Ac is the amplitude of the carrier wave,

m(t) represents the message or information signal,

fc is the frequency of the carrier wave, t is time.

### *Spectrum of AM Wave:*

An AM wave consists of a carrier and two sidebands. The spectrum can be analyzed to show these components, with the sidebands containing the actual information being transmitted.

### *Modulation Index:*

The modulation index (m) is a key concept in AM, defined as the measure of the extent of modulation applied to the carrier wave.

### *Power Distribution in AM:*

The total power of an AM signal is distributed among the carrier and the sidebands.

## Demodulation of AM Waves:

### *Envelope Detector:*

The envelope detector is a simple, commonly used method for demodulating AM signals. It captures the variations in the envelope of the modulated signal, which corresponds to the original message signal.

### *Coherent demodulation:*

Coherent demodulation is a technique used to decode information from a modulated carrier wave by leveraging a reference signal that is phase-locked to the carrier.

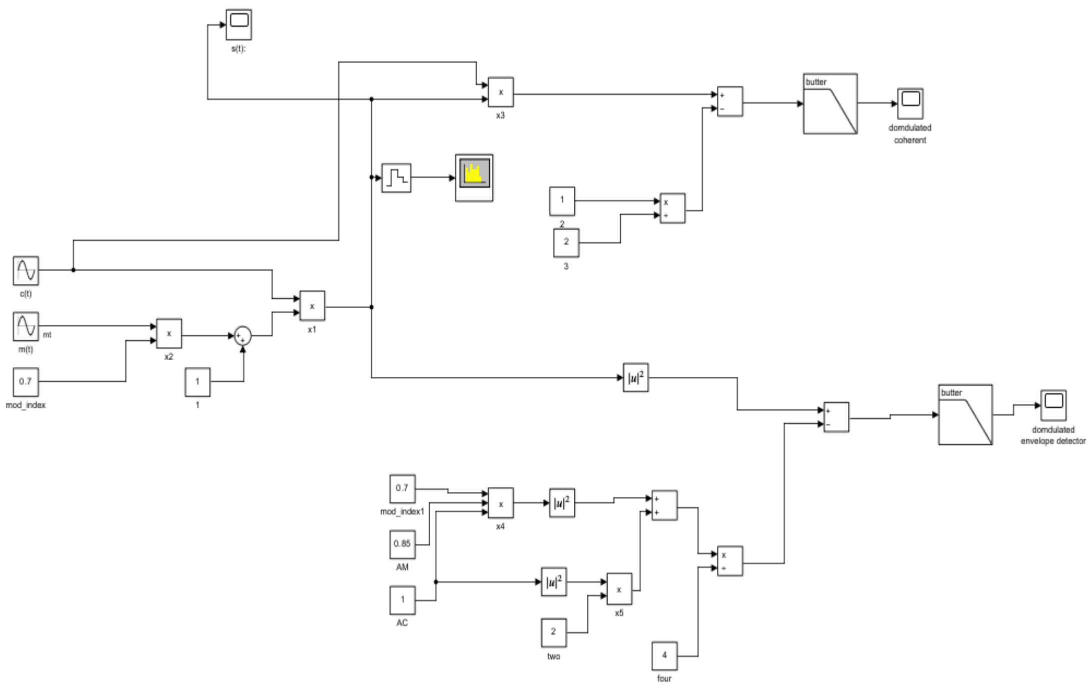
### *Mathematical Principle of Demodulation:*

Coherent demodulation retrieves m(t) from S(t) = [A + m(t)] cos(2 Pi Fc t) using a synchronized carrier for high-fidelity signal recovery.

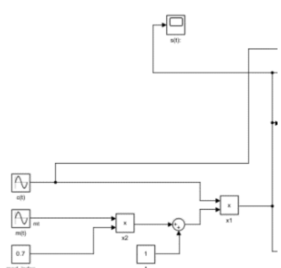
An envelope detector extracts m(t) from S(t) = [A + m(t)] cos(2 Pi Fc t) by rectifying the signal and smoothing it with a low-pass filter.

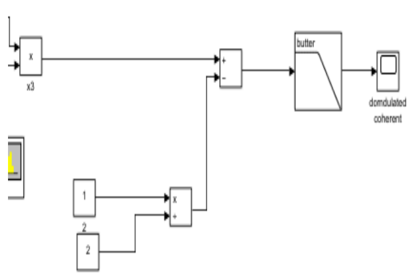
# Title: practical Analysis of Normal Amplitude Modulation and Demodulation

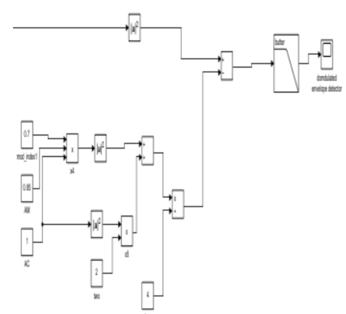
## Circuit design:




The whole circuit design including all about AM communication





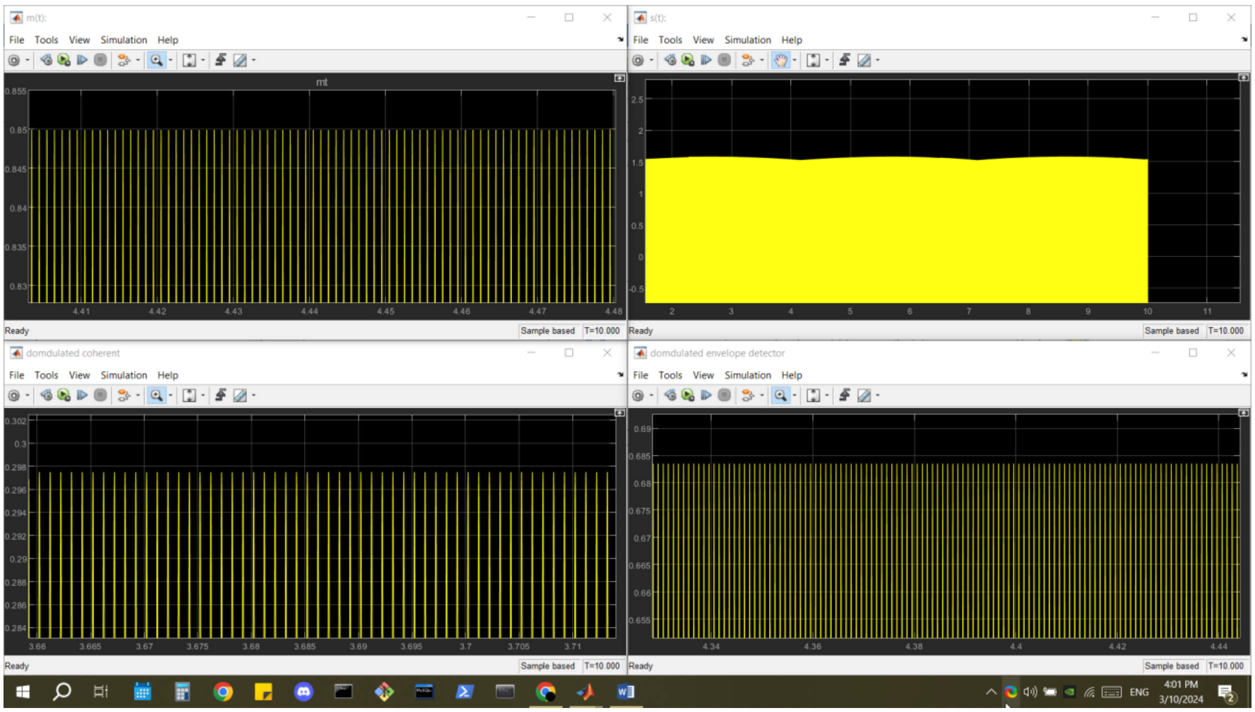



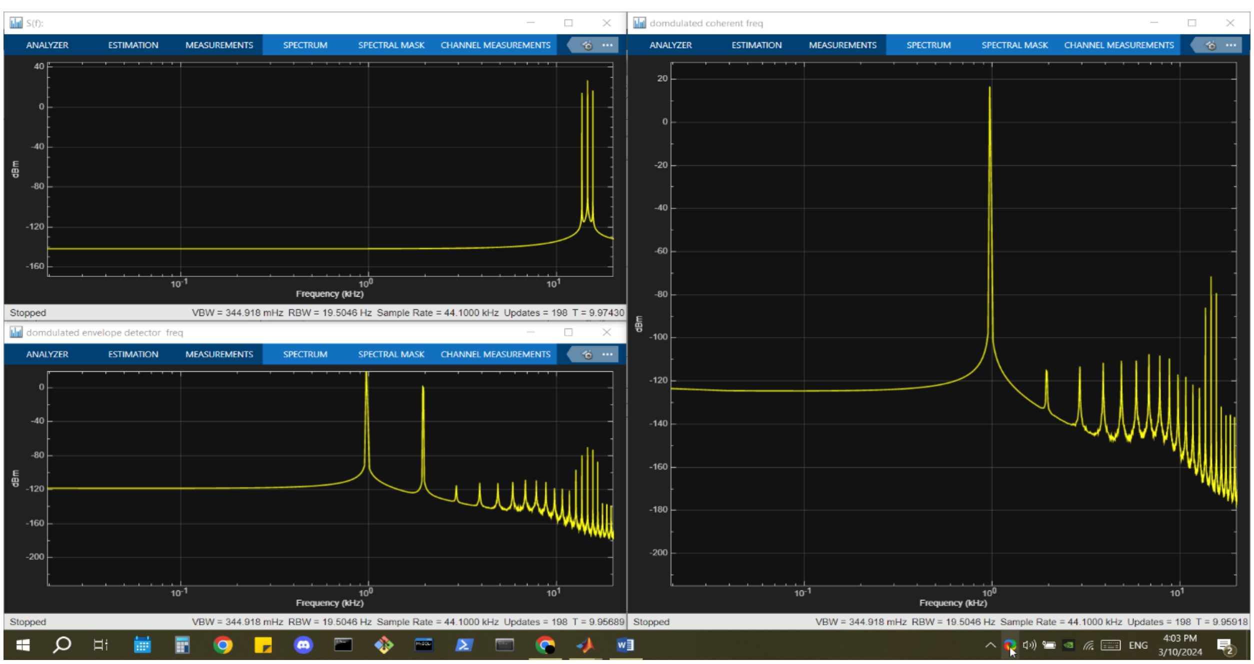
Normal Am modulation coherent demodulation envelop detector demodulation

## Results:

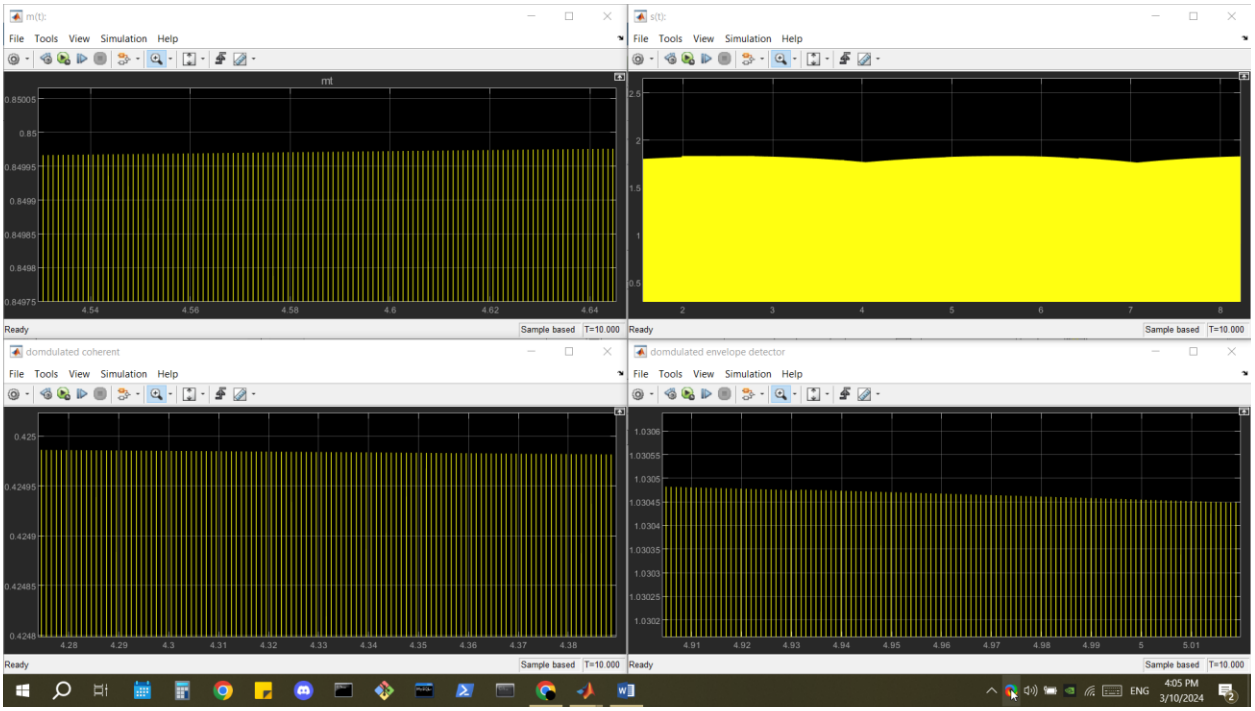
Note: stop time = 10.

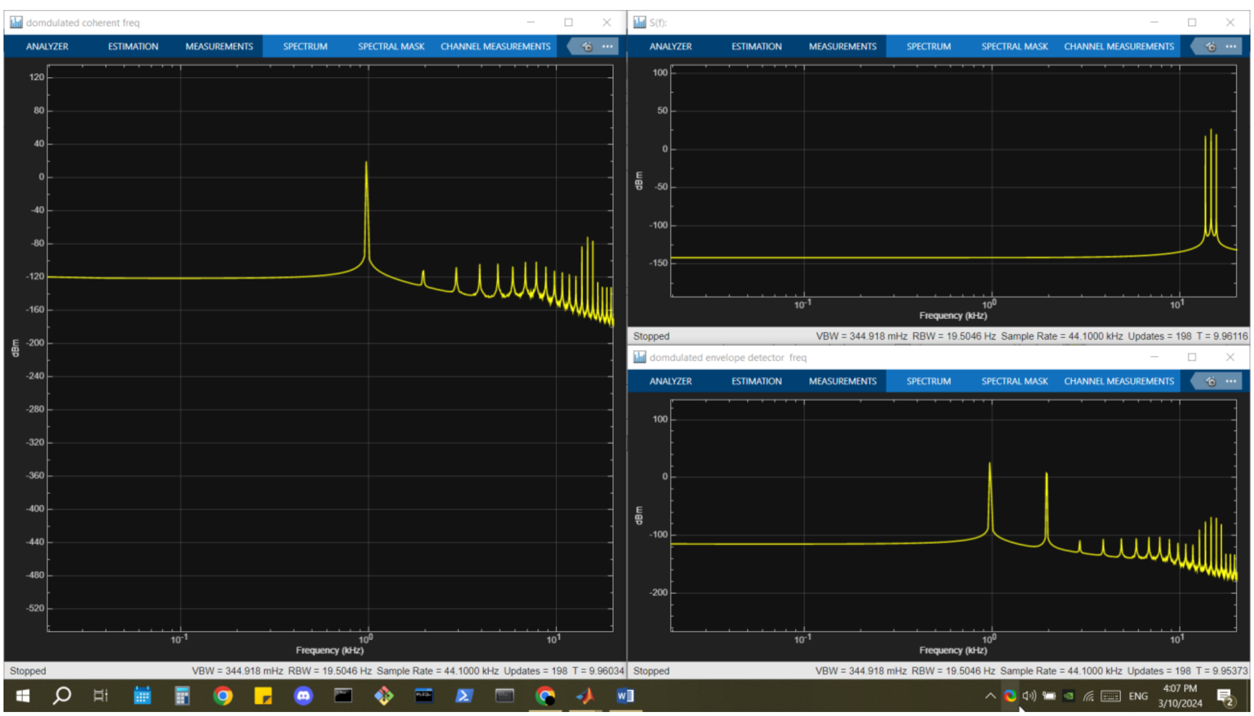
## @ k < 1 = 0.7:



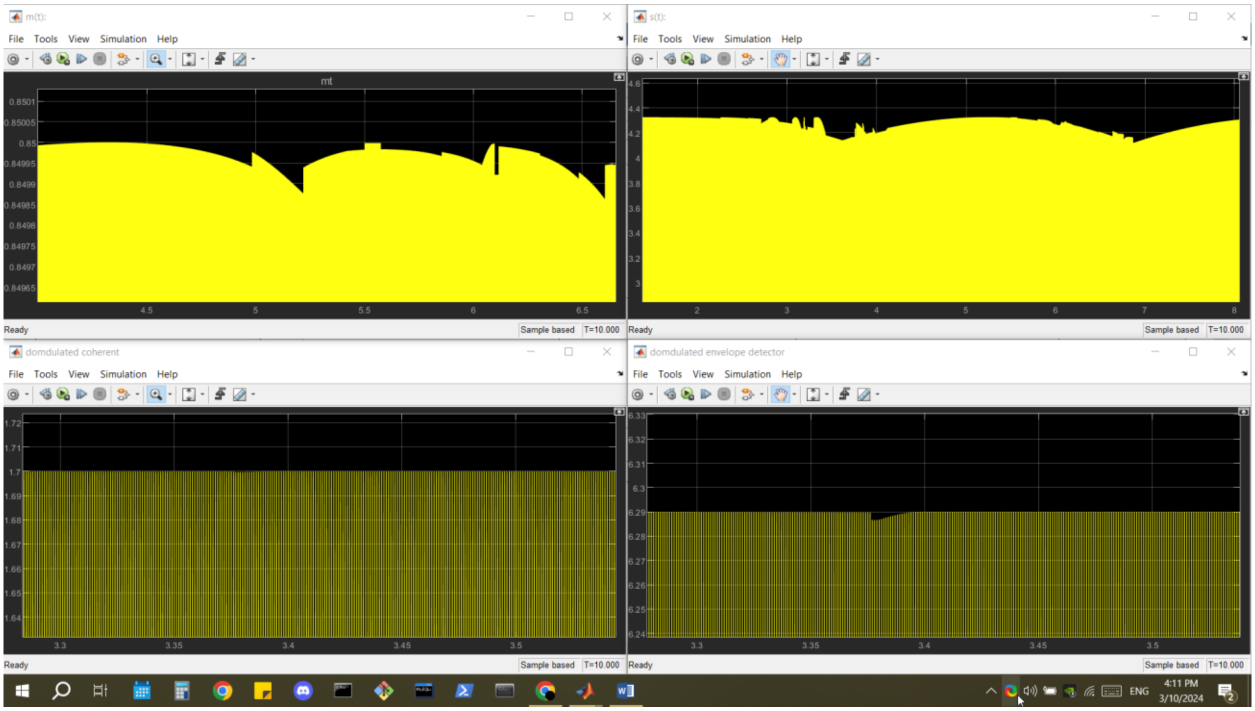



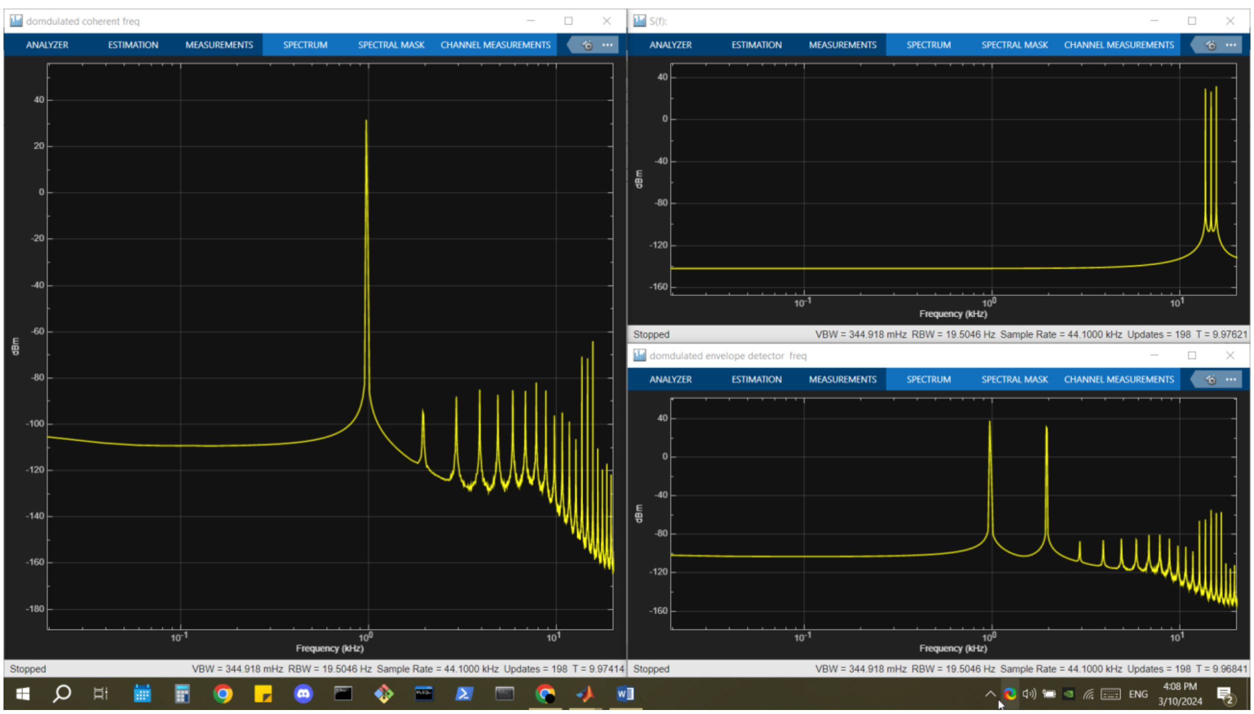
@ k = 1:


m(t):
File Tools View Simulation Help
mt
Ready
Sample based
T=10.000
s(t):
domdulated coherent
domdulated envelope detector


domdulated coherent freq
ANALYZER ESTIMATION MEASUREMENTS SPECTRUM SPECTRAL MASK CHANNEL MEASUREMENTS
dBm
Frequency (kHz)
Stopped
VBW = 344.918 mHz RBW = 19.5046 Hz Sample Rate = 44.1000 kHz Updates = 198 T = 9.96034
S(f):
VBW = 344.918 mHz RBW = 19.5046 Hz Sample Rate = 44.1000 kHz Updates = 198 T = 9.96116
domdulated envelope detector freq
VBW = 344.918 mHz RBW = 19.5046 Hz Sample Rate = 44.1000 kHz Updates = 198 T = 9.95373

@ k > 1 = 4:




Note: m(t) got a lot of noise I tried to look for a reason but I couldn't find any