1. AMPLITUDE MODULATION AND DEMODULATION

1.1 Objective

To construct an amplitude modulator circuit using transistor with V_c=50mv, V_m=8v to satisfy under modulation condition and generate amplitude modulated signal. Calculate the modulation index and also demodulate using envelope detector and reconstruct the modulating signal. Simulate Amplitude Modulation (AM) wave in time domain using SCILAB.

1.2 Hardware Required

S.No	Equipment/Component name	Specifications/Value	Quantity
1	Cathode Ray Oscilloscope	(0 – 20MHz)	1
2	Audio Frequency Oscillator	(0-2) MHz	2
3	Regulated power supply	(0 -30V), 1A	1
4	Resistors	1.5K Ω 10 K Ω 20 K Ω 100 K Ω	2 3 1 2
5	Capacitors	0.1 µf 0.01 µf 0.001 µf 22 µf	1 1 3 1
6	Semiconductor Device(Transistor)	BC108	1
7	Semiconductor Device(Diode)	OA79	1

1.3 Theory

Modulation is defined as the process by which some characteristics of a carrier signal is varied in accordance with a modulating signal. The base band signal is referred to as the modulating signal and the output of the modulation process is called as the modulation signal.

AM Modulation Circuit Diagram

Specifications

R1 = R2 = R5 = 10KΩ; R3 = 1.5KΩ; R4 = 20KΩ; C1 = 0.01µF; C2 = 0.001µF;

C3 = 0.1 µf; Vc = 50mV; fc = 500KHZ; Vm = 8V; fm = 1KHZ; V_{CC} = 30V

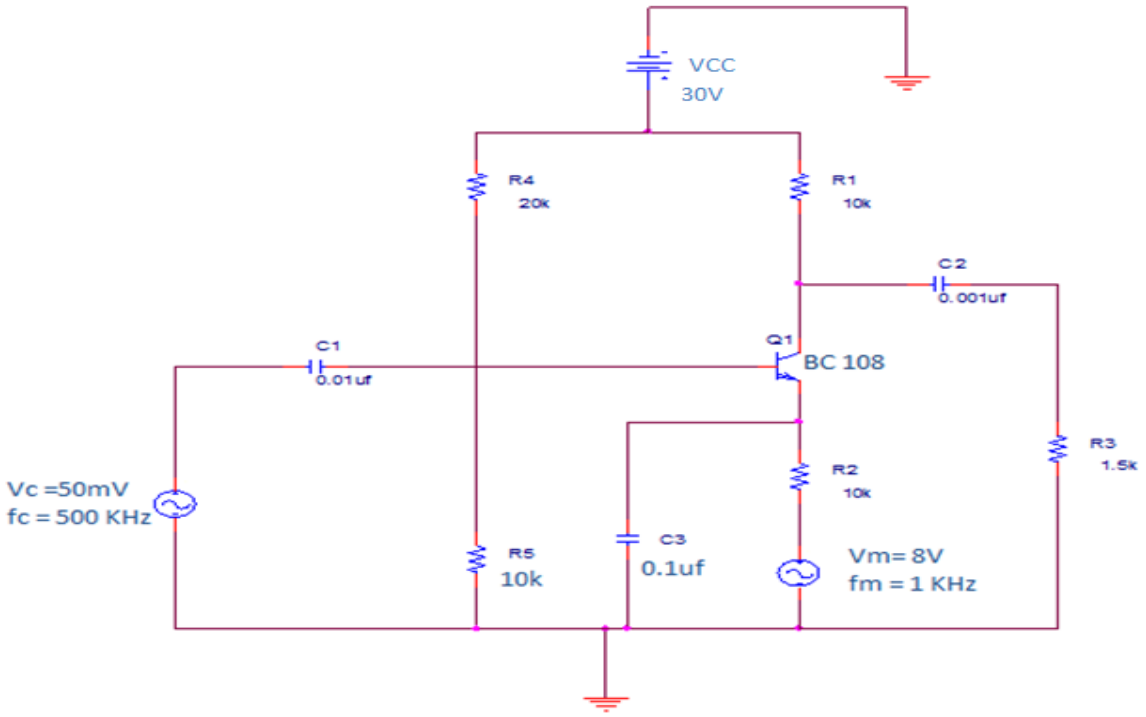

Fig. 1.1 AM Modulator Circuit

1.3.1 Amplitude Modulation

Amplitude modulation is defined as the process in which amplitude of the carrier wave is varied in accordance with the instantaneous values of the modulating signal. The envelope of the modulating wave has the same shape as the base band signal provided the following two requirements are satisfied

1. The carrier frequency f_c must be much greater then the highest frequency components f_m of the message signal m (t)

   i.e. $f_c >> f_m$

2. The modulation index must be less than unity. If the modulation index is greater than unity, the carrier wave becomes over modulated.

1.3.2 Amplitude Demodulation

The process of detection provides a means of recovering the modulating Signal from modulating signal. Demodulation is the reverse process of modulation. The envelope detector circuit is employed to separate the carrier wave and eliminate the side bands. Since the envelope

of an AM wave has the same shape as the message, independent of the carrier frequency and phase, demodulation can be accomplished by extracting envelope.

An increased time constant RC results in a marginal output follows the modulation envelope. A further increase in time constant the discharge curve become horizontal if the rate of modulation envelope during negative half cycle of the modulation voltage is faster than the rate of voltage RC combination ,the output fails to follow the modulation resulting distorted output is called as diagonal clipping : this will occur even high modulation index.

The depth of modulation at the detector output greater than unity and circuit impedance is less than circuit load ($R_l > Z_m$) results in clipping of negative peaks of modulating signal. It is called "negative clipping "

AM Demodulation Circuit Diagram

Specifications

C1=0.001µf, C2=22 µf, C3=0.001µf, R1=100KΩ and R2=100KΩ.

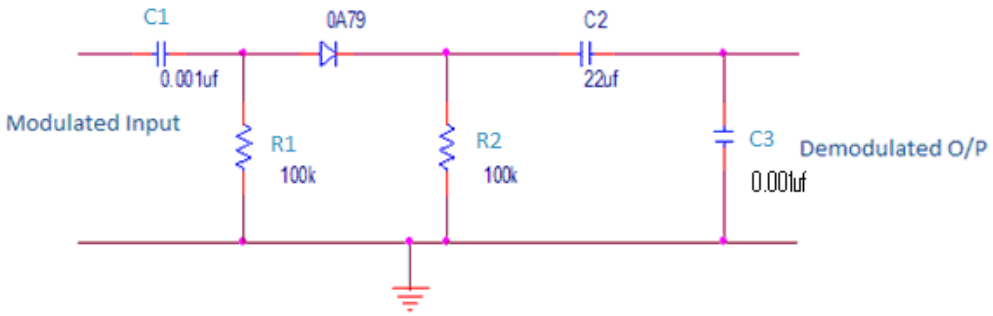

Fig. 1.2 AM Demodulator Circuit

1.4 Pre Lab Questions

1. Define Modulation.
2. Why Modulation is necessary for communication system.
3. The maximum peak-to-peak voltage of an AM wave is 16 mV and the minimum peak-to-peak voltage is 4 mV. Calculate the modulation factor.
4. The load current in the transmitting antenna of an unmodulated AM transmitter is 8A. What will be the antenna current when modulation is 40%?
5. Define Amplitude Modulation and Demodulation?

1.5 Lab Procedure

1.5.1 Amplitude Modulation

1. The circuit connection is made as shown in the circuit.
2. The power supply is connected to the collector of the transistor.
3. Set the input signal f_m as 1 KHz and 8 volt sinusoidal signal in AFO
4. Set the carrier signal f_c as 500 KHz and 50 millivolt sinusoidal signal in AFO
5. The Amplitude Modulated Output is taken from the collector of the Transistor.
6. Note down E_{max} and E_{min} from the Output waveform.
7. Calculate modulation index using the formula.

$$\text{Modulation index m} = \frac{\text{Emax} - \text{Emin}}{\text{Emax} + \text{Emin}}$$

8. Plot the input signals and obtained AM output waveforms in the graph sheet

1.5.2 Amplitude Demodulation

1. The circuit connections are made as shown in the circuit diagram.
2. The amplitude modulated signal from AM generator is given as input to the demodulator circuit.
3. The demodulated output is observed on the CRO
4. Plot the obtained AM demodulated output waveforms in the graph sheet

1.6 Observation - Hardware

Signal name	Amplitude	Frequency	Time period
Modulating signal			
Carrier signal			
Modulated signal			
Demodulated signal			

1.6.1 Model graph

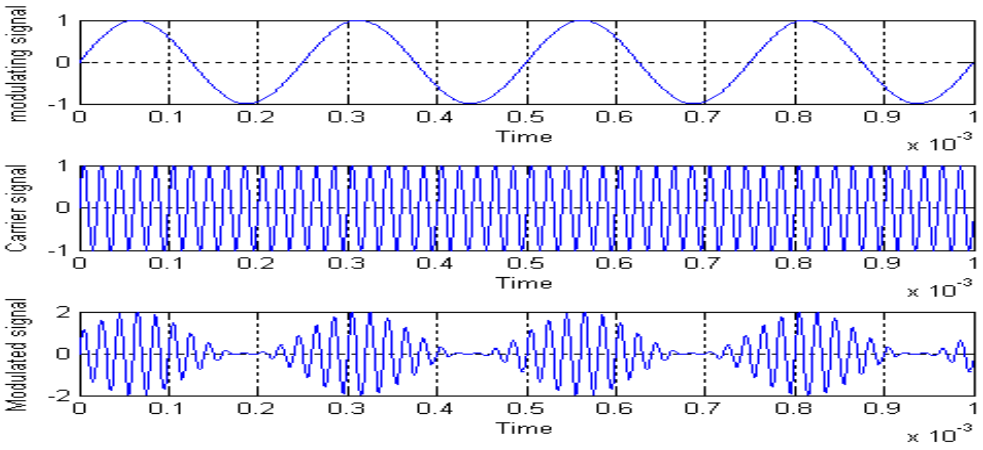

Fig. 1.3 Amplitude Modulation waveforms

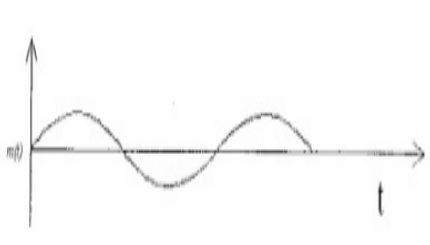

Fig. 1.4 AM Demodulated Waveform

1.7 Post Lab Questions

1. Use SCILAB to produce AM wave with the following specification

Modulating Wave	Sinusodal
Modulation Frequency	1kHz
Carrier frequency	20kHz
Percentage Modulation	75%

1.8 Lab Result

Thus the amplitude modulation and demodulation were performed and the modulation index for various modulating voltage were calculated.