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.

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.

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 fc must be much greater then the highest frequency components fm of the message signal m (t)

   i.e. fc >>fm

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 (Rl>Zm) results in clipping of negative peaks of modulating signal. It is called “negative clipping “

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;

1.4 AM MODULATION CIRCUIT DIAGRAM

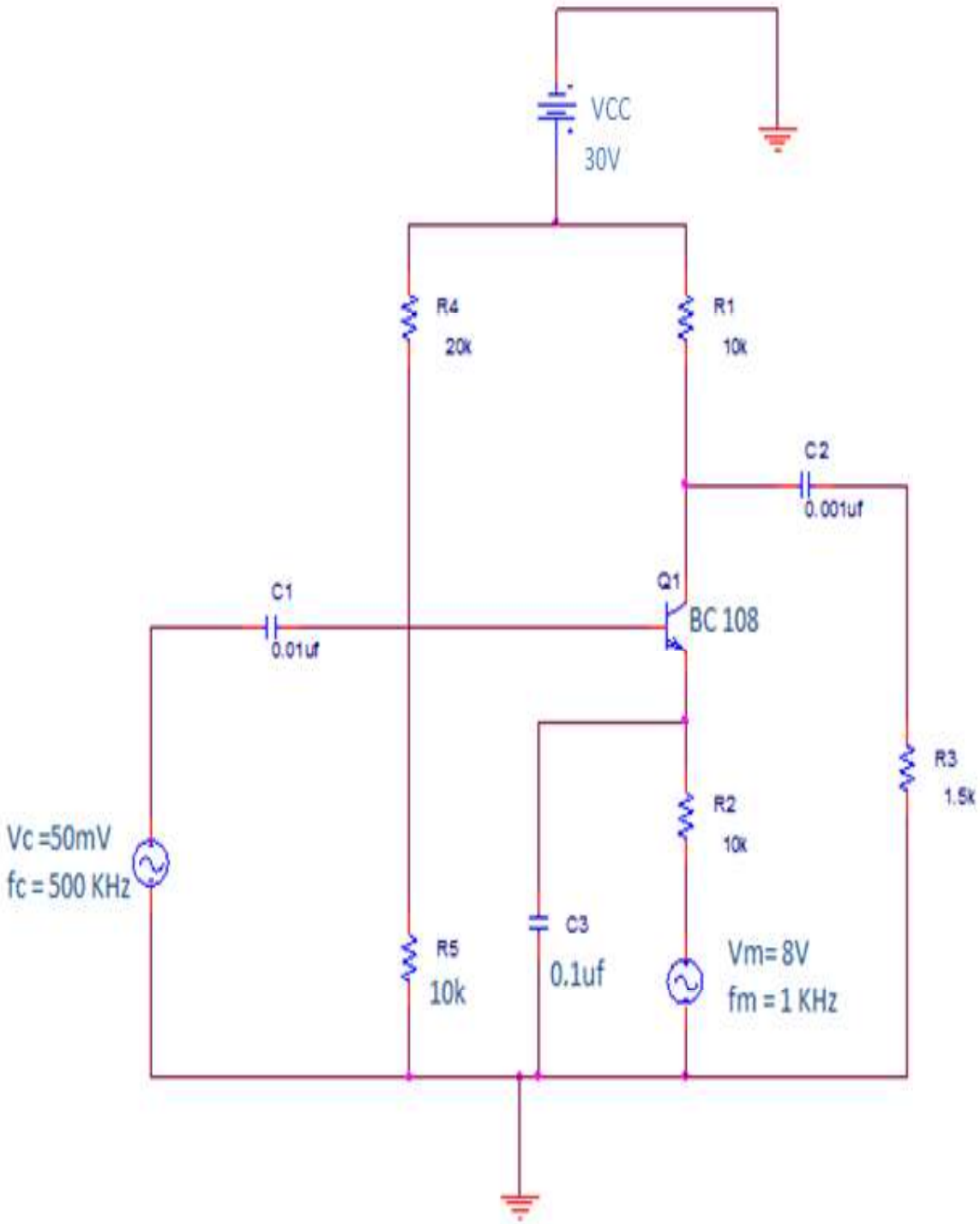

Fig. 1.1 AM Modulator Circuit

1.5 MODEL GRAPH

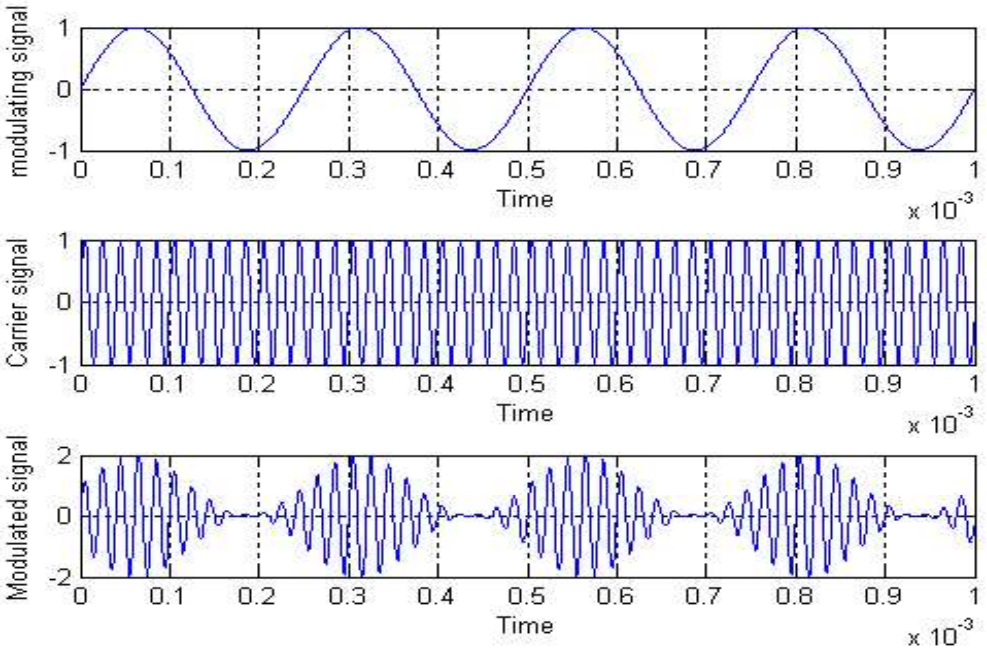

Fig. 1.2 AM Modulated Waveform

SPECIFICATIONS

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

1.6 AM DEMODULATION CIRCUIT DIAGRAM

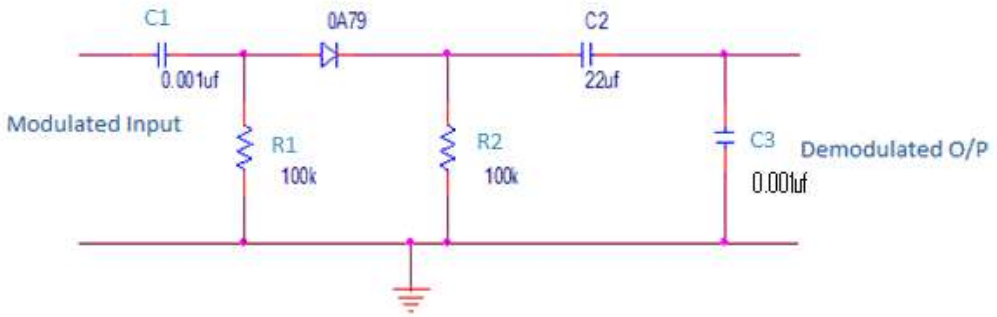

Fig. 1.3 AM Demodulator Circuit

1.7 PRE LAB QUESTIONS:

1. Define Modulation.
2. Why Modulation is necessary for communication system.
3. What is Baseband signal?
4. Differentiate analog and Digital Modulation.
5. Define Amplitude Modulation and Demodulation?
6. Mention the degrees of Modulation.
7. What is Pilot Carrier?
8. Write an expression for the total power of the Amplitude Modulated wave.
9. What is the efficiency of AM signal?
10. What are the applications of AM system?

1.8 LAB PROCEDURE:

I). 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 1KHz and 8volt sinusoidal signal in AFO
4. Set the carrier signal f_c as 500KHz and 50 millivolt sinusoidal signal in AFO
5. The AmplitudeModulated Output is taken from the collector of the Transistor.
6. Calculate Emax and Emin from the Output waveform.
7. Calculate modulation index using the formula.

   $$\text{Modulation index (m)\%} = \frac{\text{Emax} - \text{Emin}}{\text{Emax} + \text{Emin}} \times 100$$
8. Plot the input signals and obtained AM output waveforms in the graph sheet

OBSERVATION:

Modulating signal				Carrier signal			
Signal Type	**Time Period**	**Frequency**	**Amplitude**	**Signal Type**	**Time Period**	**Frequency**	**Amplitude**
Sine wave				Sine wave			

Modulated Output			
Signal Type	**E_{min}**	**E_{max}**	**Modulation index**
AM			

II).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

OBSERVATION:

Demodulated output			
Signal Type	**Time Period**	**Frequency**	**Amplitude**
Sine wave			

1.9 LAB RESULT:

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