15ECE381 Circuits and Communication Laboratory

B. Tech (ECE) – V Semester

Experiment 6

Amplitude Modulation and Demodulation

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SECTION : ECE-C

GROUP : C2

Aim :

To design simple circuits to demonstrate the concepts of Amplitude modulation and demodulation.

Instructions:

1. All resistors used in your design should be from the E24 series
2. You may make use power supplies of ±10 V.

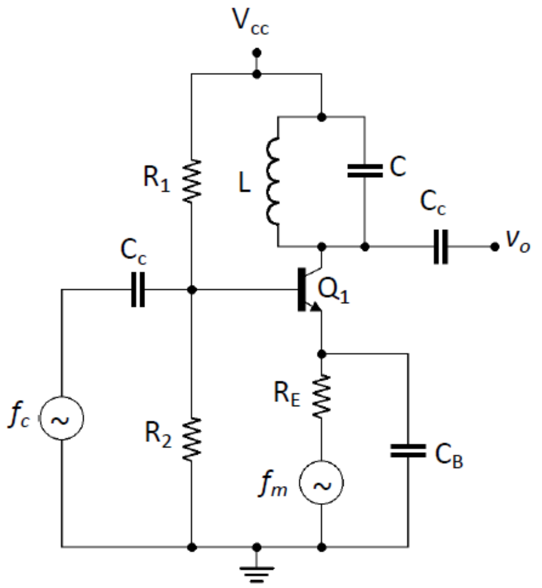


Fig. 1

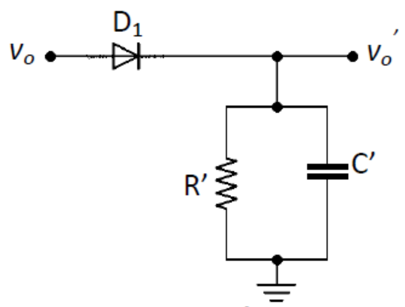


Fig. 2

Procedure:

1. Consider the circuit shown in Fig. 1. Set up the amplifier consisting of the BJT Q_1 and the resistors R_1 and R_2 along with R_E and the bypass capacitor C_B. Use the SL100 for Q_1. The tuned circuit formed by L and C is part of the load impedance for this amplifier. Set V_{cc} = 10 V. The values of the various components are as follows: R_1= 220 kΩ; R_2 = 56 kΩ; R_E = 1 kΩ; L = 100 mH; C = 100 nF. The emitter-bypass capacitance may be assumed to be as large as 1 µF. Please note that all capacitors are of ceramic type. For this part of the experiment, f_c and f_m, which are two function generators, need not be connected.
2. Determine the quiescent point of the transistor and note down your readings in Table 1.

Table 1: operating point of the transistor Q_1.

V_B	V_C	V_E	I_E

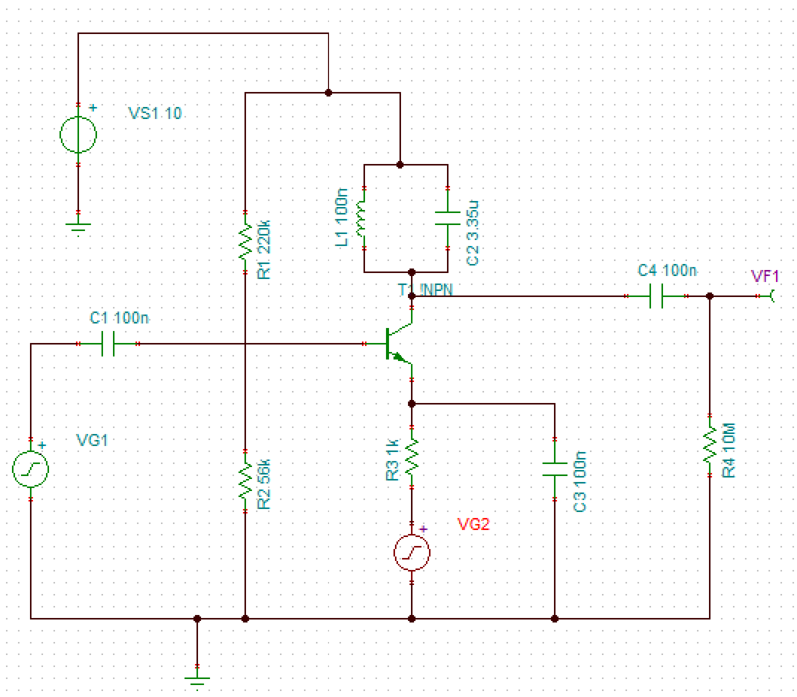
3. Now connect up the function generators f_c and f_m as shown in Fig, 1, where f_c stands for the carrier frequency and f_m represents the modulating frequency.
4. For the chosen values of the resistances and capacitances, estimate the required carrier frequency and the function generator f_c may be set to an amplitude of 5 V and the estimated frequency.
5. Similarly, f_m may be adjusted to provide a signal of amplitude 2 V or less and of frequency 1 kHz.
6. The coupling capacitors C_c may be taken as 1 mF (ceramic).
7. Note down the waveform at v_o. (You might have to adjust f_c and f_m to obtain a clean waveform at v_o).
8. Repeat 6 for different values of the amplitude of f_m. Calculate the modulation index in each case.

Demodulation:

9. Connect up the circuit shown in Fig. 2. The diode D_1 can be chosen as OA79 or any high frequency point contact diode. R' is chosen as 330 kΩ and C' as 1 nF.
10. Connect the output of your modulator (Fig. 1) to the input of Fig. 2. Plot the waveform obtained at the output v_o'. How is this different from the modulating signal f_m?
11. Replace the D_1 with the 1N4007 diode and repeat 9. What do you observe?

<u>Questions</u>:

1. If the carrier of an amplitude modulation system is given by $V_c(t) = 5\ sin(wt)$, f = 275k Hz and the information to be coded is represented as $V_m(t) = 0.2\ sin(2\pi*1000t)$, design a suitable system and demonstrate its operation. Determine the modulation index, m. Plot $v_c(t)$, $v_m(t)$ and the output of the AM system.



Amplitude Modulation→

w.k.t,

$$2\pi f_c = \frac{1}{\sqrt{LC}}$$

Given, $f_c = 275k$

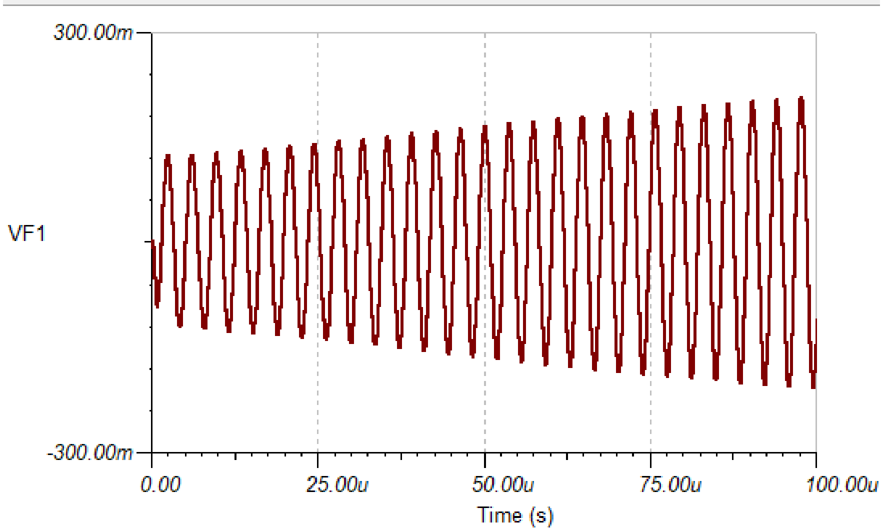
assume $L = 0.1\mu H$

$$\Rightarrow 2\pi(275k) = \frac{1}{\sqrt{(0.1)\mu C}} \Rightarrow 0.1\mu C = \left(\frac{1}{2\pi\, 275k}\right)^2$$

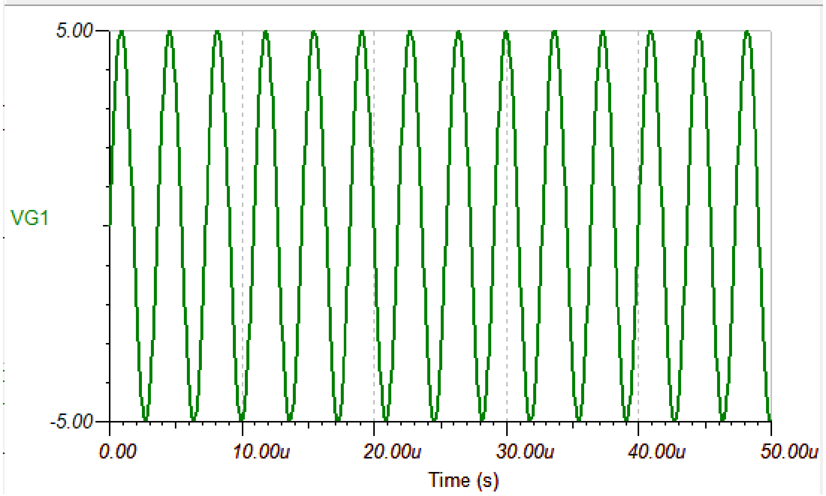
$$0.1\mu C = 3.35\times10^{-13}$$

$$\Rightarrow \boxed{C = 3.35\mu F}$$

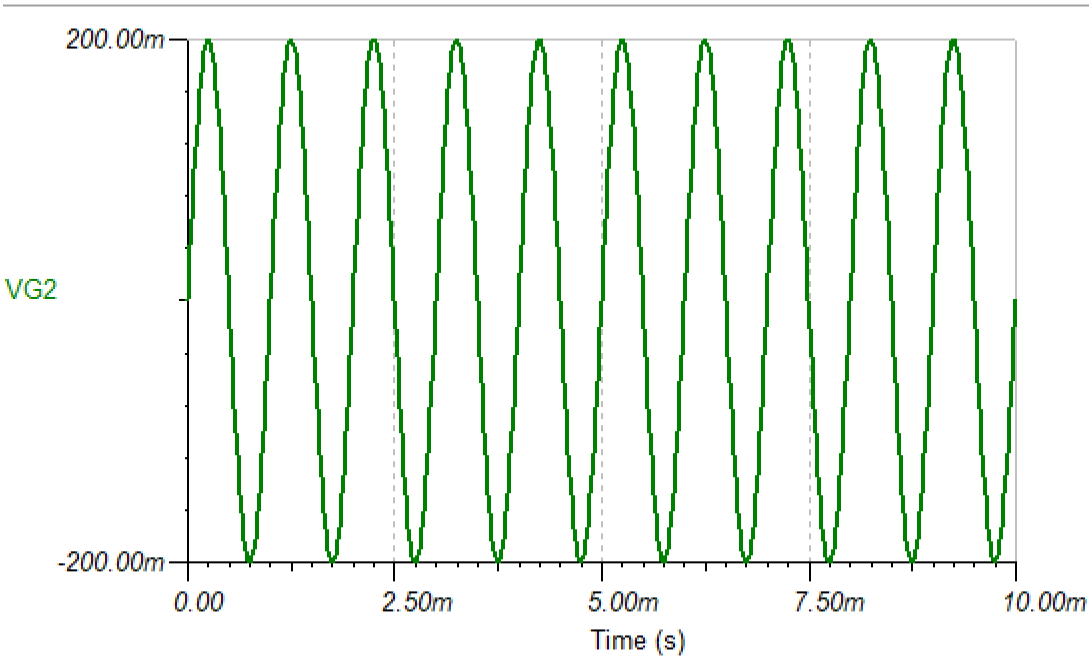
Amplitude Modulation

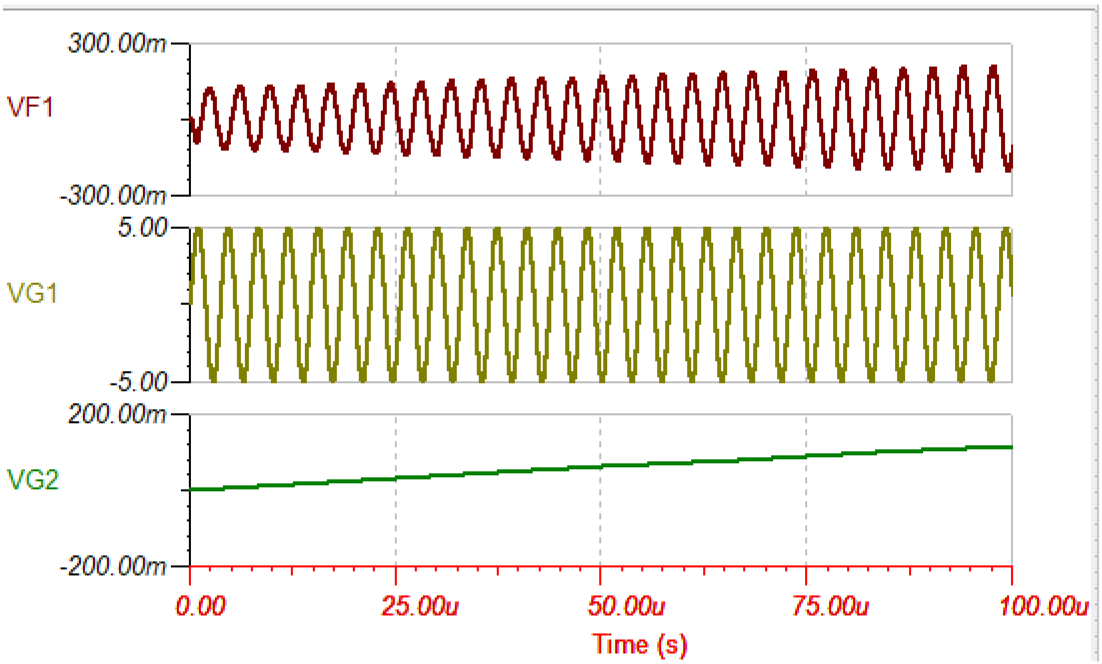


Carrier Signal



Message Signal





We know that modulation index =Am/Ac

Given Am=200mVolts =0.2 Volts

Ac=5 volts

So μ= 0.2/5=0.04

So modulation Index is 0.04

Demodulation:

Demodulation

w.k.T,

$f_o = \frac{1}{2\pi RC}$ where f_o is cutting frequency.

and

$f_m \le f_o \le f_c$

$f_o = \sqrt{f_c \times f_m} = \cancel{\sqrt{820k}}$

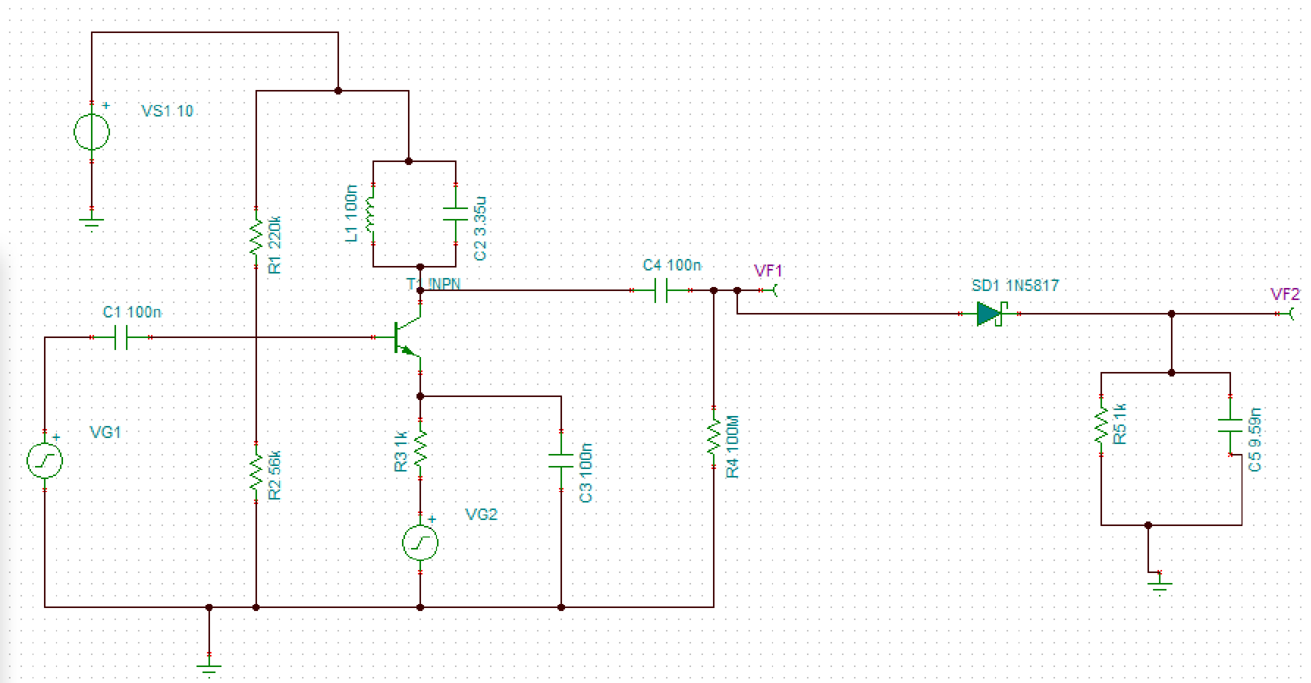
$f_o = \sqrt{275k \times k} = \sqrt{275}\ k = 16583$

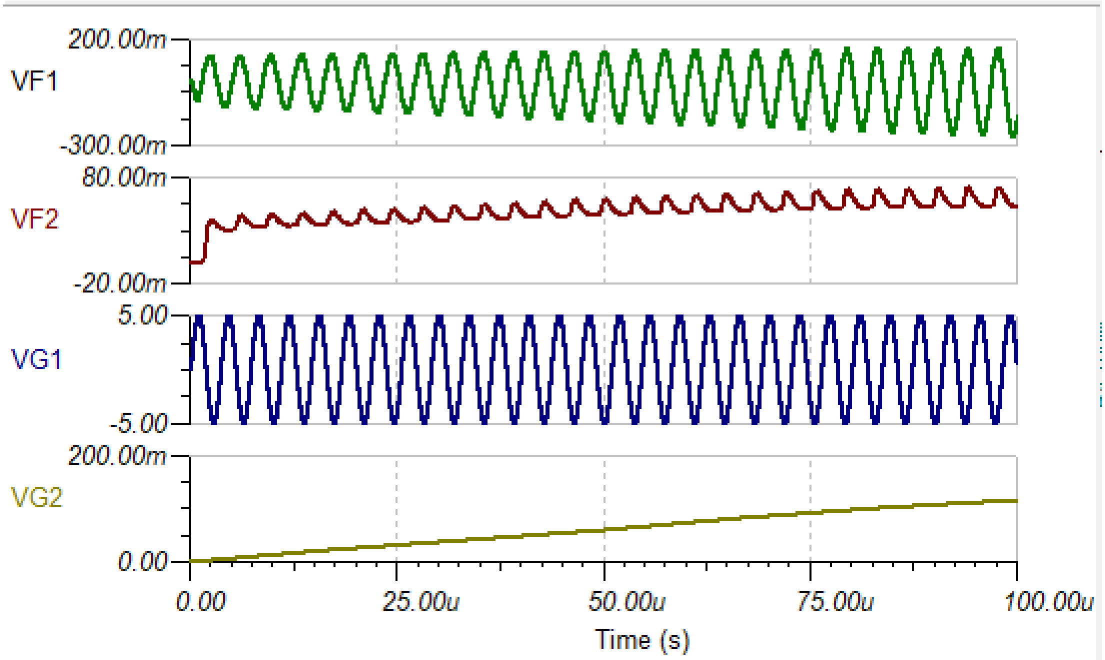
$\Rightarrow RC = \frac{1}{2\pi 16583} = \frac{6.03\times10^{-5}}{2\pi} = \frac{60.3\mu}{2\pi} = 9.59\mu$

assume

$\Rightarrow \boxed{R=1K}$, $\cancel{C = 60.3nF}$ $\boxed{C=9.59nF}$

Circuit:





Inference Questions:

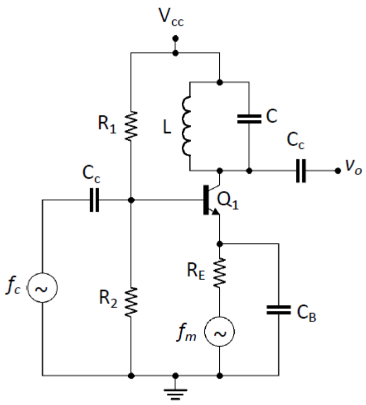


Fig. 1

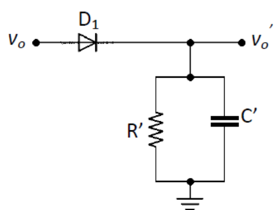


Fig. 2

1. What is the purpose of the tuned LC circuit ? What is its frequency ?

Ans: The purpose of LC circuit is to generate a signal at particular frequency or picking out a signal at particular frequency. And it is also used so that the amplitude of the carrier signal changes instantly according to the message signal.

2. Try for μ = 1 and μ > 1. Give the design and corresponding outputs.

ANS: The μ = 1 is the situation where under modulation takes place .So. the message signal will be 100% modulated. For μ > 1 , over modulation occurs. The signal will be clipped as the envelope detector cannot detect the whole signal. It is when message has more amplitude than carrier.

3. Did you notice any over-modulation in any case?

ANS: No I didn't notice any over modulation for given frequeincies..

4 What is the purpose of the combination of R’ and C’ at the output of the demodulator ? How does it affect the operation of the demodulator ?

ANS: A capacitor is connected across resistor , effectively filtering out the carrier and thus recovering the original modulating signal.

5 What will be the difference in performance when we use 1N4007 and OA79/high frequency diodes.

ANS: The only difference is the maximum repetitive capability which is maximum for IN4007 compared to OA79.