Date ....

Expt. No. 01

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Task - 1

Design and Generation of Amplitude Modulation

Aim: To generate the amplitude modulated signal and determine the percentage of modulation.

Components required.

(i) BJT (BC107)
(ii) Resistors
(iii) Capacitor
(iv) Bread board
(v) Function Generator

Procedure

1) The connections are made as per the circuit diagram.
2) The message signal of 1kHz and carrier signal of 11 kHz (approx) are set.
3) The output is observed on the CRO and the AM wave is traced.
4) The modulation index is further calculated.

Calculations.

$$m = \frac{V_{max} - V_{min}}{V_{max} + V_{min}}$$

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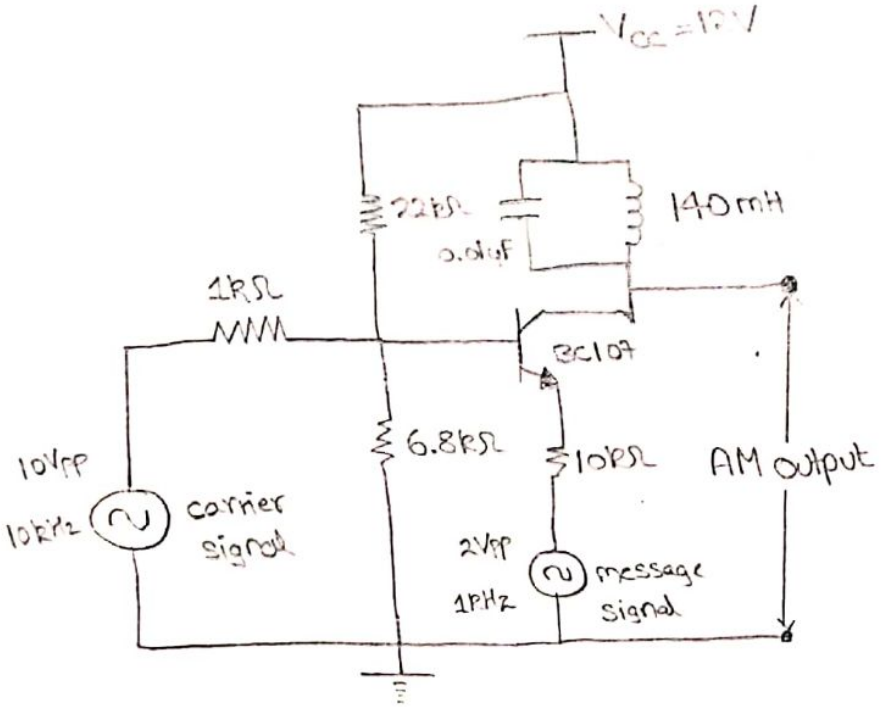
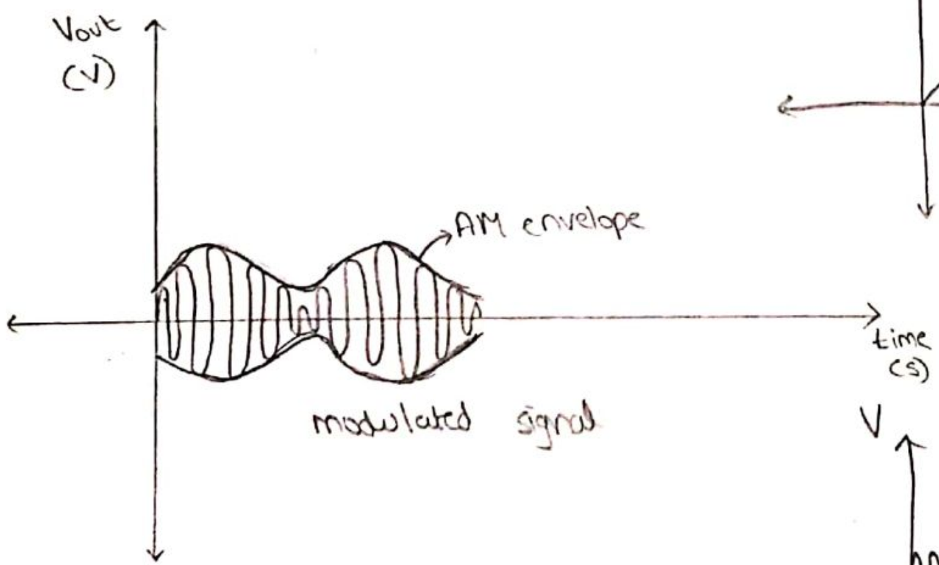
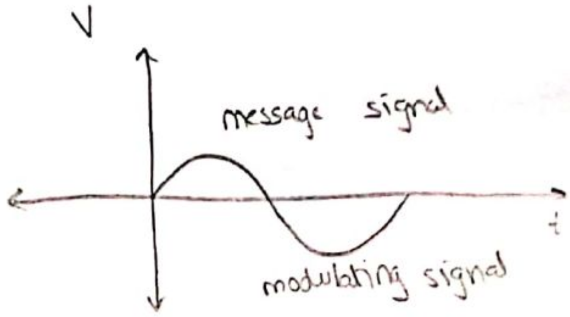
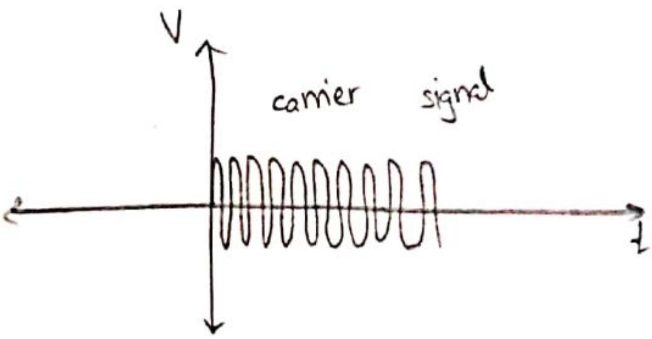
Circuit diagram.



Model graph







$m \Rightarrow \frac{160}{980} = 0.1632. \Rightarrow 16.32\%$

$m = \frac{V_m}{V_c} = 0.133 \Rightarrow 13.33\%$

Inference

(i) Modulation Index is directly proportional to V_m.
(ii) For proper modulation, $f_c >> f_m$.

Theory

In amplitude modulation, the instantaneous amplitude of carrier wave is varied in accordance with the instaneous amplitude of modulating signal. Main advantages of AM are small bandwidth and simple transmitter and reciever designs. Amplitude modulation is implemented by mixing the carrier wave in a non-linear device with the modulating signal. This produces upper and lower sidebands, which are the sum and differences frequencies of the carrier and modulating signal.

Carrier signal $\Rightarrow V_c(t) = V_c \cos(\omega_c t)$.

Modulating signal $\Rightarrow V_m(t) = V_m \cos(\omega_m t)$.

Amplitude of modulating signal $\Rightarrow V_c + V_m(t) = V_c(1 + m_a \cos(\omega_m t))$.

$$V_{AM}(t) = V_c \cos \omega_c t + \frac{m_a V_c}{2} \cos(\omega_c - \omega_m)t + \frac{m_a V_c}{2} \cos(\omega_c + \omega_m)t$$

Result: The AM wave is generated for all types of modulation index. Modulation index is calculated for generated AM signal and verified with theortical principle.

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Tabulation

Message signal		Carrier signal		A.M output	
Frequency	Voltage	Frequency	Voltage	Frequency	Voltage
1kHz	1Vpp	11KHz	7.5Vpp	570mV	410mV

Design.

Take $V_{CC} = +15V$, $I_C = 1mA$, $\beta = 100$

Therefore $I_B = 10\mu A$; $V_{CE} = 40\%$ of $V_{CC} = 6V$; $V_{RE} = 10\%$ of $V_{CC} = 1.5V$

$R_E = (V_{RE} + I_C) = 1.5k\Omega$ since $I_E \sim I_C$

$V_{R_2} = (V_{RE} + V_{BE}) = 2.2V$

$V_{R1} = (V_{CC} - V_{R_2}) = 12.8V$

From circuit diagram; $V_{R1} = 10 I_B * R_1$ & $V_{R_2} = 9 I_B * R_2$

$\Rightarrow R_1 = 51.62k\Omega$; $R_2 = 10k\Omega$

Design of capacitance.

$X_{C_1} \leq R_{in}/10$; $R_{in} = R_1 \| R_2 \| (1 + h_{fe} * r_e) = 91.4$

$X_{C_1} < 91.4$; $C_1 \geq 0.34$ use $22\mu F$; $X_{CE} \leq R_E/10 = 9.15$; $C_E \geq 0.02\mu F$

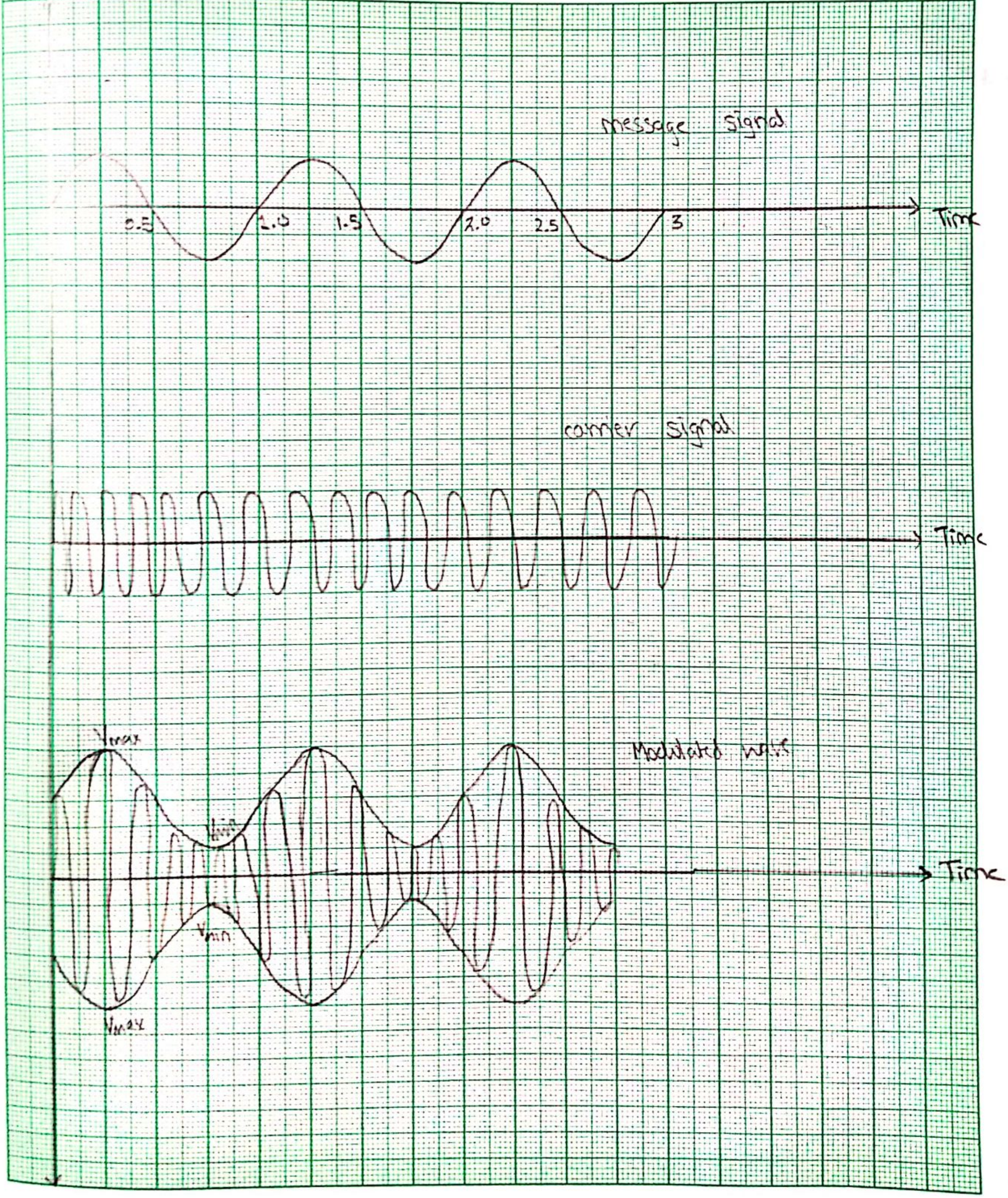
Design of C_{C_1}, C_{C_2}.

$X_C \leq R_{in}/10$; $R_{in} = R_1 \| R_2 \| (1 + h_{fe} * r_e)$; $X_C \leq 0.123K$

$C_C \geq 1/2\pi f * (0.12 \times 10^3)$, $C_C \geq 0.133 \times 10^{-6}$.

use $0.1\mu F$.

AMPLITUDE MODULATION



Matlab Code

```
Ac=input('enter carrier signal amplitude'
Am=input('enter message signal amplitude'
fc=input('enter carrier frequency');
fm=input('enter message frequency');% fm<
m=input('enter modulation index');
t=input('enter time period');
t1=linspace(0,t,1000);
y1=sin(2*pi*fm*t1); % message signal
y2=sin(2*pi*fc*t1); % carrier signal
eq=(1+m.*y1).*(Ac.*y2);
subplot(311);
plot(t1,y1);
xlabel('Time');
ylabel('Amplitude');
title('Message signal')
subplot(312)
plot(t1,y2);
xlabel('Time');
ylabel('Amplitude');
title('Carrier signal');
subplot(313);
```

```
m=input('enter modulation index');
t=input('enter time period');
t1=linspace(0,t,1000);
y1=sin(2*pi*fm*t1); % message signal
y2=sin(2*pi*fc*t1); % carrier signal
eq=(1+m.*y1).*(Ac.*y2);
subplot(311);
plot(t1,y1);
xlabel('Time');
ylabel('Amplitude');
title('Message signal')
subplot(312)
plot(t1,y2);
xlabel('Time');
ylabel('Amplitude');
title('Carrier signal');
subplot(313);
plot(t1,eq);
plot(t1,eq,'r');
xlabel('Time');
ylabel('Amplitude');
title('Modulated signal');
```

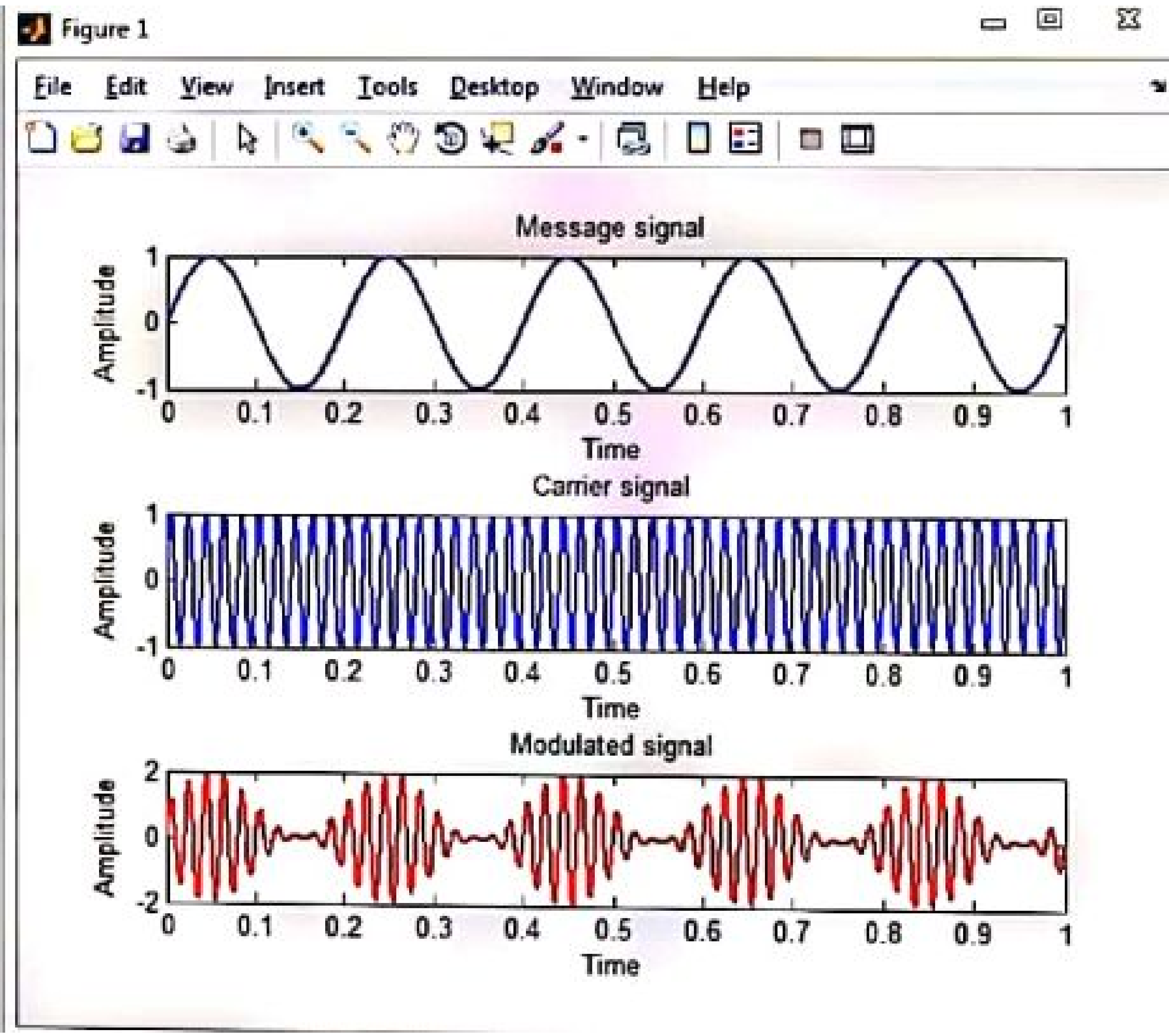


Figure 1
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Message signal
Amplitude
Time
Carrier signal
Amplitude
Time
Modulated signal
Amplitude
Time