Communication

Lecture - 9

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Generation of Amplitude Modulation(Modulator) :

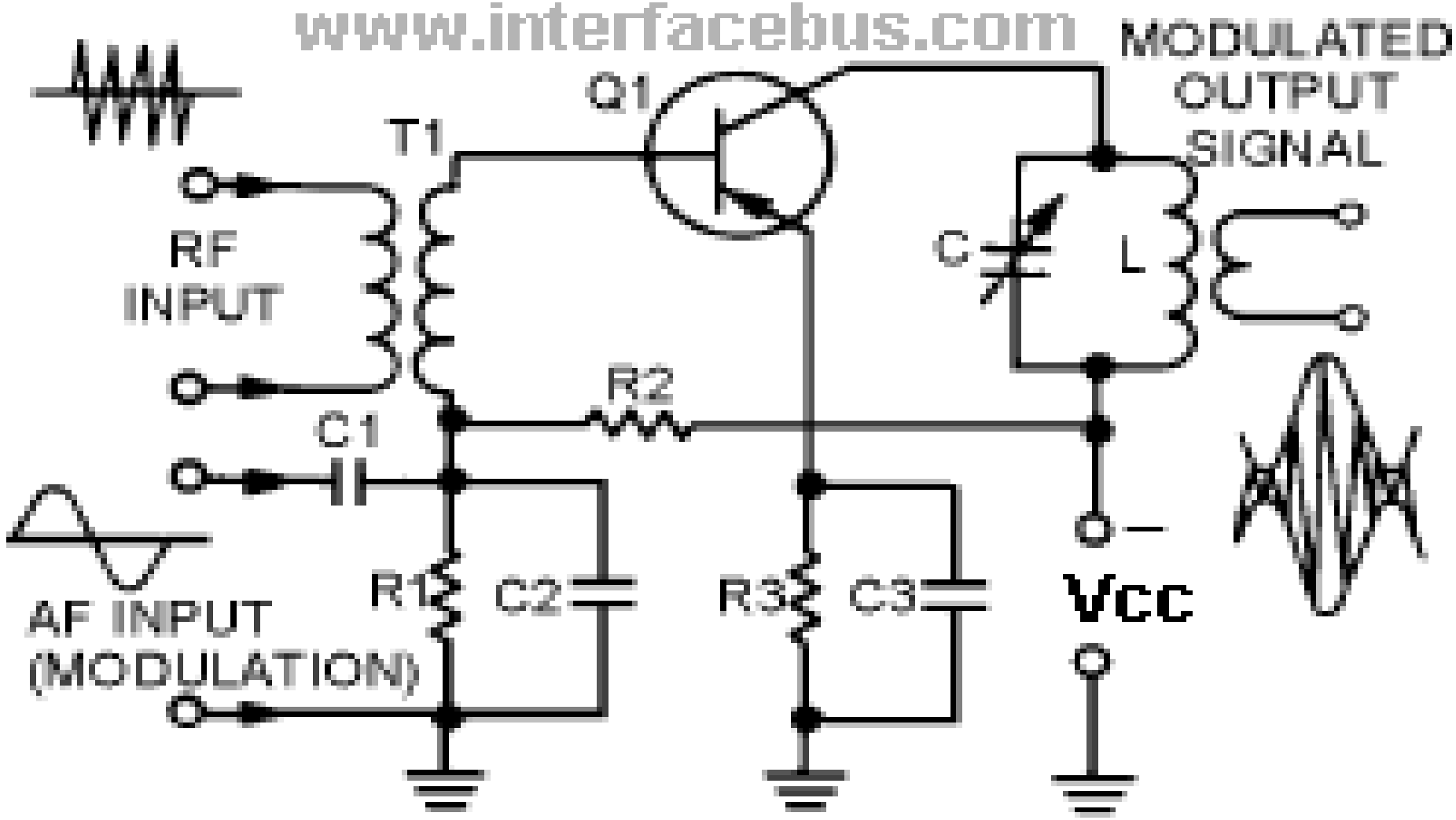
An amplitude – modulated carrier can be obtained by passing the output of a carrier frequency oscillator through an amplifier whose gain is varied by the modulating signal .

This amplifier is called an amplitude- modulated amplifier or simply a **modulator** .

The circuit diagram of such an amplifier in CE mode of connection as shown in figure below .

The carrier and the modulation voltages are fed into the base and the emitter respectively .

The resistors R_1 , R_2 and R_3 and the supply voltage V_{CC} establish the DC operating point of the amplifier . The capacitors C_1 , C_2 and C_3 are chosen as to bypass the carrier wave only .



The gain of a transistor amplifier is highly dependent upon the quiescent emitter current .

Since the modulation is injected at the emitter, the total emitter current follows the instantaneous modulating signal and is given by

$$i_E = I_E + K_1 E_m \cos \omega_m t \qquad (1)$$

where I_E is the quiescent value of the emitter current and K_1 is a constant .

Amplitude modulation results if $K_1 E_m$ is smaller than I_E .

As the voltage amplification of the amplifier A_V is a function of the total emitter current i_E

we get

$$A_V = K_2 i_E = K_2 (I_E + K_1 E_m \text{Cos } \omega_m t) \quad (2)$$

K_2 is a another constant .

Since the input to the another amplifier is carrier voltage

$$e_c = E_c \text{Cos } \omega_c t$$

the output voltage $V_o = A_V E_c \text{Cos } \omega_c t$ (3)

substituting for A_V from Eq.(2) in Eq.(3) we get

$$V_o = K_2 (I_E + K_1 E_m \cos \omega_m t) E_c \cos \omega_c t$$

$$= K_2 I_E E_c \cos \omega_c t + K_1 K_2 E_c E_m /2 [\cos (\omega_c + \omega_m)t + \cos (\omega_c - \omega_m)t]$$

$$= K_2 I_E [E_c \cos \omega_c t + K_1 K_2 E_c E_m /2I_E \{\cos (\omega_c + \omega_m)t + \cos (\omega_c - \omega_m)t\}]$$

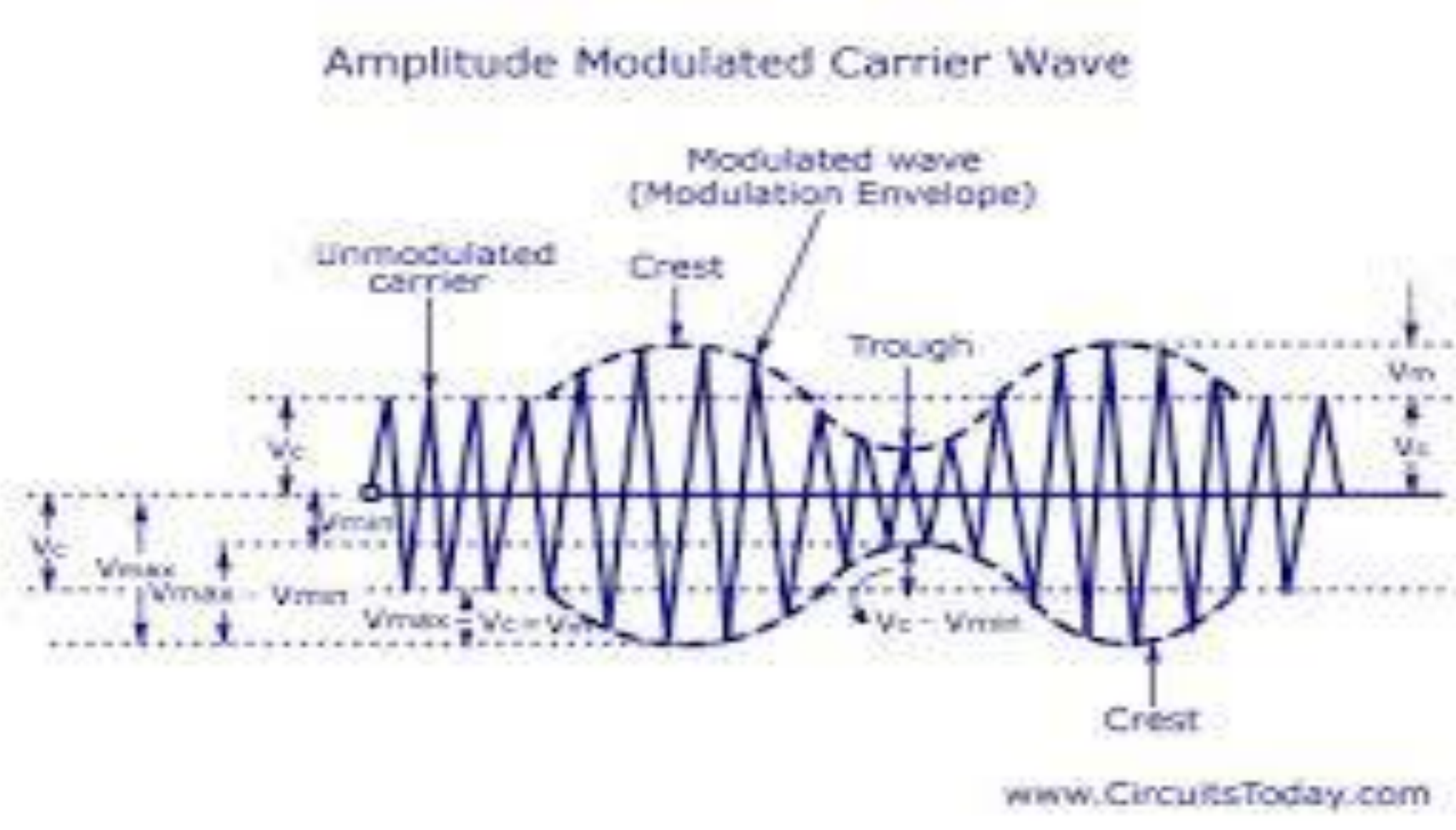
$$= K [E_c \cos \omega_c t + m E_C /2 [\cos (\omega_c + \omega_m)t + \cos (\omega_c - \omega_m)t] \qquad (4)$$

Where $K = K_2 I_E$ and $m = K_1 E_m / I_E$

Equation (4) represents an amplifier – modulated wave .

Since distortion is always present in an amplifier , signals of unwanted frequencies also appear at the output .

The tuned circuit at collector of the modulator stage eliminates these undesirable signals.


Amplitude Modulated Carrier Wave
Modulated wave
(Modulation Envelope)
Unmodulated
carrier
Crest
Trough
Vm
Vc
Vmin
Vmax
Vmax - Vmin
Vmax = Vc + Vm
Vc - Vmin
Crest
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