Tutorial 5 – Amplitude Modulation

1. For the AM signal, $v_{AM}(t)$, shown in Figure T5.1
   (a) Determine V_S, V_C, f_S, f_C.
   (b) Calculate the modulation index, m
   (c) Write the equation for the modulating signal, $v_S(t)$
   (d) Write the equation for the AM signal, $v_{AM}(t)$
   (e) Sketch the double-sided amplitude spectrum of $v_{AM}(t)$
   (f) Calculate the bandwidth of $v_{AM}(t)$

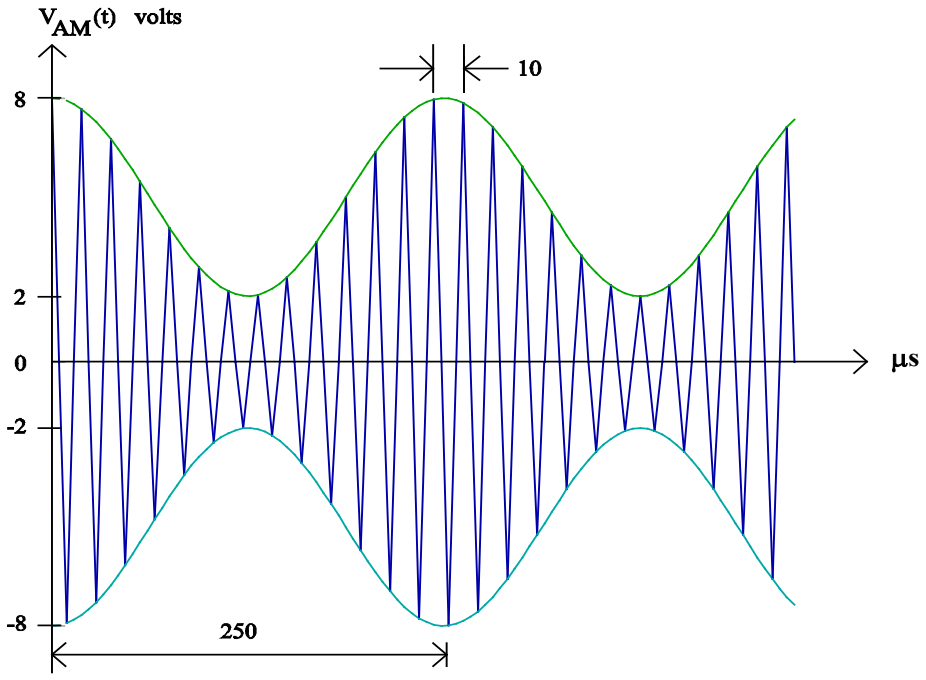

Figure T5.1 An AM signal

2. The AM signal spectrum is shown in Figure T 5.2.
   (a) Determine the frequency values of A and B.
   (b) Sketch the spectrum of the modulating signal and state its bandwidth.
   (c) Write the equation for the modulating signal.

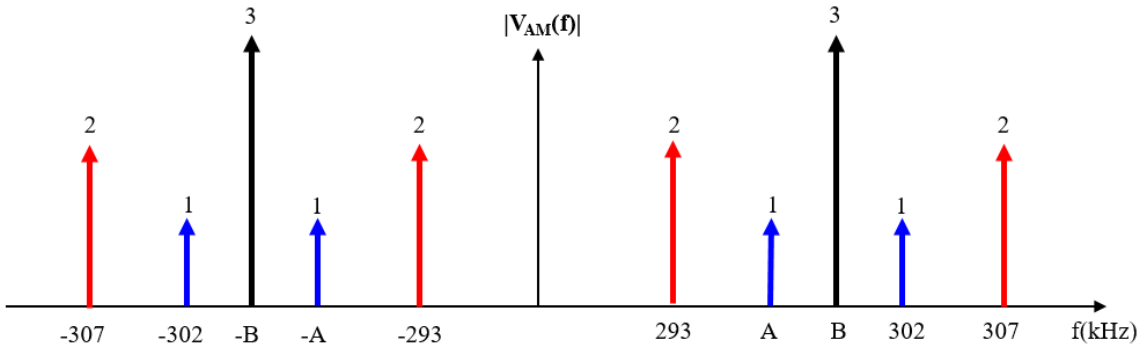

Figure T5.2

3. When a carrier, $8\cos 1200\times10^{3}\pi t$ is amplitude modulated by a modulating signal, $v_s(t)$. The spectrum of $v_s(t)$ is given in Figure T5.3.
   (a) Sketch the block diagram to produce the AM signal.
   (b) Sketch the double-sided amplitude spectrum of the AM signal.

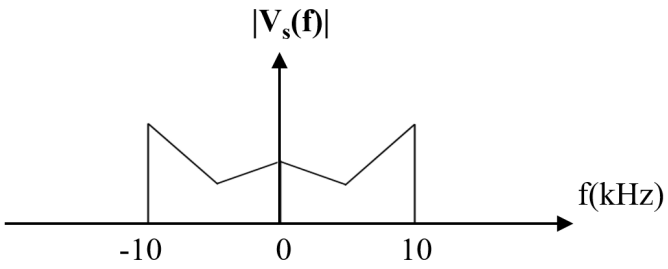

Figure T5.3

4. For the amplitude spectrum shown in Figure T5.4, what is the modulation index of the AM signal?
   (a) 0.20 (b) 0.33
   (c) 0.40 (d) 0.67

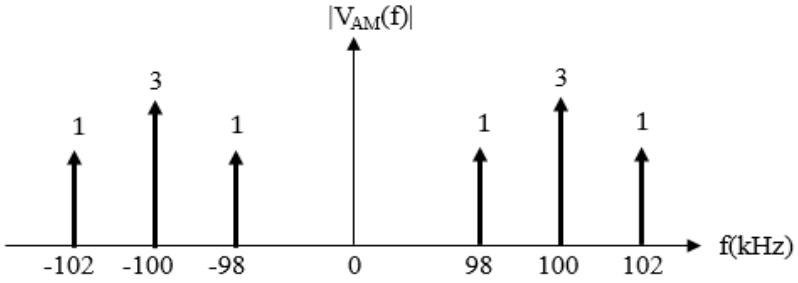

Figure T5.4

5. Sketch the double-sided spectrum of an AM signal, $v_{AM}(t)$ whose carrier $v_C(t) = V_C\cos\omega_C t$ is modulated by the modulating signal, $v_S(t)$.

$$v_S(t) = V_1\cos\omega_1 t + V_2\cos\omega_2 t + V_3\cos\omega_3 t \quad \text{where } V_1 > V_2 > V_3 \text{ and } f_3 > f_2 > f_1$$

6. A 4 V_{peak} carrier with frequency 100 kHz is modulated in a balanced modulator by the signal $v_s(t) = 6\cos(4\pi \times 10^3)t + 4\cos(10\pi \times 10^3)t$. Draw the double-sided spectrum appearing at the output of the balanced modulator.

7. If the modulated signal in Q6 is fed to the circuit in Figure T5.7,
   (a) Sketch the spectrum at V_X and V_o. Given that frequency of $v_C(t)$ in Figure T5.7 is 100 kHz and the cut-off frequency of the LPF is 5 kHz.
   (b) If the frequency of the carrier at the demodulator in Figure T5.7 is offset by 1kHz, what is the effect on the output?

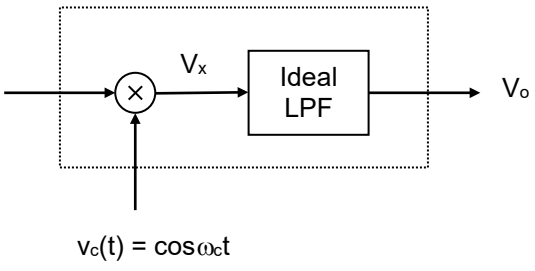

Figure T5.7