Problem 1:
If we have a generic signal $s(t)$ whose Fourier spectrum looks like the following figure:

Now we know that the analytical signal of $s(t)$ is defined as $s_a(t) = s(t) + js^*(t)$, where $s^*$ is the Hilbert transform of $s(t)$. The complex conjugate of the analytical signal is $s_a^*(t) = s(t) - js^*(t)$

$\mathcal{H}(s_a^*(t))$ looks like:

Then $\mathcal{H}(s_a^*(t) e^{j2\pi f_s t})$ will look like:

Now $s_a^*(t) e^{j2\pi f_s t} + (s_a^*(t) e^{j2\pi f_s t})^* = 2 \text{Re}(s_a^*(t) e^{j2\pi f_s t})$ (**)

At the same time, $s_a^*(t) e^{j2\pi f_s t} + (s_a^*(t) e^{j2\pi f_s t})^* = s_a^*(t) e^{j2\pi f_s t} + s_a(t) e^{-j2\pi f_s t}$, and

$\mathcal{H}(s_a^*(t) e^{j2\pi f_s t} + s_a(t) e^{-j2\pi f_s t})$ looks like:

which is just the LSB-SSB we are looking for.

Now the right hand side of equality (**) is

$2 \text{Re}(s_a^*(t) e^{j2\pi f_s t}) = 2 \text{Re}\{ (s(t) - js^*(t)) (\cos(2\pi f_s t) + j \sin(2\pi f_s t)) \}$

$= s(t) \cos(2\pi f_s t) + s^*(t) \sin(2\pi f_s t)$, which is therefore also the LSB-SSB signal sought.
b) The received signal should first pass through a BPF filter, followed by a LO, and then pass through a LPF, as shown by the following figure.

c) To make sure the baseband signal can be separated from the $2f_0$ signal, we must have $2f_0 - w > w$. Hence, we have $f_0 > w$. 
Problem 2:
The Hilbert transform of the pulse:

\[
\frac{1}{\pi} \int_{-T/2}^{T/2} \frac{A}{t-\tau} \, d\tau = \lim_{\epsilon \to 0} \left( \frac{1}{\pi} \int_{-T/2}^{T/2} \frac{A}{t-\tau} \, d\tau + \frac{1}{\pi} \int_{\epsilon}^{T/2} \frac{A}{t-\tau} \, d\tau \right) = \frac{A}{\pi} \log \left( \frac{t + \frac{T}{2}}{t - \frac{T}{2}} \right)
\]

Problem 3:
Haykin's 2.18:

(a,b) The spectrum of the message signal is illustrated below:

[Diagram of spectrum]

Correspondingly, the output of the upper first product modulator has the following spectrum:

[Diagram of modulator output spectrum]
The output of the lower first product modulator has the spectrum:

The output of the upper low pass filter has the spectrum:

The output of the lower low pass filter has the spectrum:

The output of the upper second product modulator has the spectrum:
The output of the lower second product modulator has the spectrum:

Adding the two second product modulator outputs, their upper sidebands add constructively while their lower sidebands cancel each other.

(c) To modify the modulator to transmit only the lower sideband, a single sign change is required in one of the channels. For example, the lower first product modulator could multiply the message signal by $-\sin(2\pi f_0 t)$. Then, the upper sideband would be cancelled and the lower one transmitted.