Errata:
1. There are typographical errors in Problem 3.22. The waveforms are:

<p>| | | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>$(2 + \cos 2 \pi f_m t) \cos 2 \pi f_c t$</td>
<td>$(0.5 + \cos 2 \pi f_m t) \cos 2 \pi f_c t$</td>
<td></td>
</tr>
<tr>
<td>$(1 + \cos 2 \pi f_m t) \cos 2 \pi f_c t$</td>
<td>$(\cos 2 \pi f_m t) \cos 2 \pi f_c t$</td>
<td></td>
</tr>
</tbody>
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2. In problem 3.25 there should be an envelope detector before the square root device. (The envelope detector is present in some printings of the text, but not in others.)

3.9) Yes, the system will demodulate properly. This would be true for any periodic signal $p(t)$.

3.11) $\sigma^2 = (24^o)^2 = 576$ degrees$^2$

3.22)

<table>
<thead>
<tr>
<th>b</th>
<th>e</th>
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<tbody>
<tr>
<td>d</td>
<td>c</td>
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3.25)

$$y(t) = \frac{1}{\sqrt{2}}(1 + s_2(t))$$

3.21) Envelope detection would recover the spectrum only if $s(t) > 0$ for all $t$.

3.42) After low-pass filtering: $\tilde{S}(f) = \frac{1}{4} S(f)$

3.31) a) Matched filter detector. $T_b = 10$ µs. $P_e = 0.05694$

b) Envelope detector, $P_e = 0.1433$

3.33) $R_b = 137.4$ kbps

3.45) $\text{SNR}_e = 14.95$ dB
3.18) Using an IF frequency of 455 kHz and high-side conversion, the local oscillator would need to produce frequencies in the range 2.155 MHz – 2.455 MHz. A non-tunable RF BPF can be used before the mixer. It should have a center frequency of \( f_o = 1.85 \) MHz and a bandwidth of \( \text{BW} = 0.3 \) MHz.

3.19) 

a) Using high-side conversion: \( 165 \) MHz \( \leq f_{\text{LO1}} \leq 166 \) MHz. The second local oscillator would operate at a fixed frequency of either 20 MHz or 40 MHz.

b) There are several image frequencies. If \( f_{\text{LO2}} = 20 \) MHz, there is an image frequency of 10 MHz at the input to the second mixer. Reflected to the antenna, the images are at \( f_c' = 145 – 146 \) MHz and \( f_c'' = 175 – 176 \) MHz. The 30 MHz frequency at the input to the second mixer has images at \( f_c' = 195 – 196 \) MHz.

c) Images of the 10 MHz signal will be removed by the IF1 filter. Images in the 195-196 MHz range can be removed with an RF BPF that passes frequencies only in the desired 135 – 136 MHz range. This filter will further suppress the other images as well.

3.20) The LO oscillator would need to be modified to produce signals in the 3.455 MHz – 3.955 MHz range. The IF filter would need to be replaced with one having a BW of 20 kHz.

Alternatively, the antenna input could be beat down to the 1 – 1.5 MHz range by mixing with a 2 MHz signal. This is in the standard AM range and could be sent through an unmodified AM receiver. If the IF filter were not replaced, all frequencies above 5 kHz would be lost.