In order to give you more insight about the answer of Problem 2-d), let me further explain it in the following. An MSK passband signal can be formulated as:

$$\begin{aligned} s(t) &= \sqrt{\frac{2E_b}{T_b}} \cos\left(2\pi f_c t + \sum_{k=-\infty}^{n-1} I_k \pi h + I_n \pi h \left(\frac{t - nT_b}{T_b}\right)\right) \\ &= \sqrt{\frac{2E_b}{T_b}} \cos\left[2\pi\left(f_c + \frac{1}{4T_b} I_n\right) t + \theta_n - \frac{\pi}{2} n I_n\right] \\ &= \begin{cases} \sqrt{\frac{2E_b}{T_b}} \cos\left(2\pi f_1 t + q_1\right), & I_n = -1 \\ \sqrt{\frac{2E_b}{T_b}} \cos\left(2\pi f_2 t + q_2\right), & I_n = 1, \end{cases} \end{aligned}$$

for $nT_b \le t < (n+1)T_b$, where

$$\begin{cases} \theta_n = \frac{\pi}{2} \sum_{k=-\infty}^{n-1} I_k \\ f_1 = f_c - \frac{1}{4T_b} \\ f_2 = f_c + \frac{1}{4T_b} \\ q_1 = \theta_n + \frac{\pi}{2} n \\ q_2 = \theta_n - \frac{\pi}{2} n. \end{cases}$$

This formula indicates that an MSK signal is actually a binary FSK signal with “undue” phase at each transmission interval $T = T_b$. So, one may “ignore” the “undue” phase (that is added solely for the sake of making phase continuous) and only work on the demodulation of f_1 and f_2 in a noncohrent fashion.

Now the question is “Will $f_2 - f_1 = 1/(2T_b)$ affect the noncoherent possibility?” Assume that $2f_1$ and $2f_2$ are multiples of $1/T_b$, which is definitely possible for MSK modulations, and assume without loss of generality that

$\cos(2\pi f_1 t + q_1)$ is the transmitted signal,

$$\begin{aligned}
\ell_1^2 &= \frac{2E_b}{T_b}\left(\int_0^{T_b}\cos(2\pi f_1 t + q_1)\cos(2\pi f_1 t)dt\right)^2 \\
&\quad + \frac{2E_b}{T_b}\left(\int_0^{T_b}\cos(2\pi f_1 t + q_1)\sin(2\pi f_1 t)dt\right)^2 \\
&= \frac{E_b}{2T_b}\left(\int_0^{T_b}\cos(4\pi f_1 t + q_1)dt + \int_0^{T_b}\cos(q_1)dt\right)^2 \\
&\quad + \frac{E_b}{2T_b}\left(\int_0^{T_b}\sin(4\pi f_1 t + q_1)dt - \int_0^{T_b}\sin(q_1)dt\right)^2 \\
&= \frac{T_b E_b}{2}
\end{aligned}$$

and

$$\begin{aligned}
\ell_2^2 &= \frac{2E_b}{T_b}\left(\int_0^{T_b}\cos(2\pi f_1 t + q_1)\cos(2\pi f_2 t)dt\right)^2 \\
&\quad + \frac{2E_b}{T_b}\left(\int_0^{T_b}\cos(2\pi f_1 t + q_1)\sin(2\pi f_2 t)dt\right)^2 \\
&= \frac{E_b}{2T_b}\left(\int_0^{T_b}\cos(2\pi(f_2 + f_1)t + q_1)dt + \int_0^{T_b}\cos(2\pi(f_2 - f_1)t - q_1)dt\right)^2 \\
&\quad + \frac{E_b}{2T_b}\left(\int_0^{T_b}\sin(2\pi(f_2 + f_1)t + q_1)dt + \int_0^{T_b}\sin(2\pi(f_2 - f_1)t - q_1)dt\right)^2 \\
&\approx \frac{E_b}{2T_b}\left(\int_0^{T_b}\cos(\pi T_b t - q_1)dt\right)^2 + \frac{E_b}{2T_b}\left(\int_0^{T_b}\sin(\pi T_b t - q_1)dt\right)^2,
\end{aligned}$$

where we may assume that $f_1 + f_2 \gg 1/T_b$; hence, $\int_0^{T_b}\cos(2\pi(f_2+f_1)t+q_1)dt$ and $\int_0^{T_b}\sin(2\pi(f_2 + f_1)t + q_1)dt$ are respectively much less than the other summands. We then notice that

$$
\begin{aligned}
&\left(\int_0^{T_b}\cos(\pi T_b t - q_1)dt\right)^2 + \left(\int_0^{T_b}\sin(\pi T_b t - q_1)dt\right)^2\\
= &\left(\int_0^{T_b}[\cos(q_1)\cos(\pi T_b t) + \sin(q_1)\sin(\pi T_b t)]dt\right)^2\\
&+\left(\int_0^{T_b}[\cos(q_1)\sin(\pi T_b t) - \sin(q_1)\cos(\pi T_b t)]dt\right)^2\\
= &\left(\cos(q_1)\frac{\sin(\pi T_b^2)}{\pi T_b} + \sin(q_1)\frac{1-\cos(\pi T_b^2)}{\pi T_b}\right)^2\\
&+\left(\cos(q_1)\frac{1-\cos(\pi T_b^2)}{\pi T_b} - \sin(q_1)\frac{\sin(\pi T_b^2)}{\pi T_b}\right)^2\\
= &\frac{\sin^2(\pi T_b^2) + (1-\cos(\pi T_b^2))^2}{\pi^2 T_b^2}\\
= &\frac{4\sin(\pi T_b^2/2)}{\pi^2 T_b^2},
\end{aligned}
$$

which implies

$$
\ell_2^2 \approx \frac{2E_b\sin^2(\pi T_b^2/2)}{\pi^2 T_b^3} \approx \frac{2E_b(\pi T_b^2/2)^2}{\pi^2 T_b^3} = \frac{E_b T_b}{2},
$$

where the second approximation follows from $\sin(\phi) \approx \phi$ for ϕ small. So, under **completely** error-free transmission, it is possible demodulate f_1 noncoherently as long as $\ell_1^2 \neq \ell_2^2$. But since $\ell_1^2 \approx \ell_2^2$, such demodulation is vulnerable after the introduction of noise.

This will give you a clear picture why the noncoherent demodulation for FSK signals require orthogonality among signal frequencies.