1 Question 1

Given, f_1 - The outside scene and f_2 - the reflection the window and g_1 and g_2 are the images taken with f_1 and f_2 in focus respectively.

$$g_1 = f_1 + h_2 * f_2$$

$$g_2 = f_2 + h_1 * f_1$$

Taking Fourier transfer on both sides of both the equations, we get the following which is a result of Parseval's theorem.

$$F(g_1) = F(f_1) + F(h_2)F(f_2)$$

$$F(g_2) = F(f_2) + F(h_1)F(f_1)$$

Where $F(x)$ is the fourier transform of the function x.
Solving for $F(f_1)$ an $F(F_2)$, we get the following result.

$$F(f_1) = \frac{F(g_2)F(h_2) - F(g_1)}{F(h_1)F(h_2) - 1}$$

$$F(f_2) = \frac{F(g_1)F(h_1) - F(g_2)}{F(h_1)F(h_2) - 1}$$

Therefore, taking inverse fourier transform on both sides, we get the following for f_1 and f_2.

$$f_1 = F^{-1}(\frac{F(g_2)F(h_2) - F(g_1)}{F(h_1)F(h_2) - 1})$$

$$f_2 = F^{-1}(\frac{F(g_1)F(h_1) - F(g_2)}{F(h_1)F(h_2) - 1})$$

- In the following derivation, if $F(h_1)F(h_2) = 1$, then we will not be able to find f_1 and f_2.
- We are also not considering noise in our calculations. We are implicitly assuming that noise is zero from the equations for g_1 and g_2. We should ideally try to find f_1 and f_2 by trying to minimize the noise or remove it.
- If the value of $F(h_1)F(h_2) - 1$ is small, then it can cause problems in the Fourier transforms of f_1 and f_2 and cause them to shoot up in value and cause interfering patterns. This can happen at high frequencies.