A) Pasa - bajos, Butter, orden 2: $H(s) = \frac{1}{s^2+\sqrt{2}\,s+1}$

Desnormalizamos con $w_c = 2\pi\, 1KHz$

$\downarrow$

$$H(s) = \frac{1}{\left(\frac{s}{w_c}\right)^2 + \frac{s}{w_c}\sqrt{2} + 1} = \frac{w_c^2}{s^2 + s.\sqrt{2}\,w_c + w_c^2}$$

Luego, aplicamos la transformada Bilineal:

$s = 2fs\left(\frac{z-1}{z+1}\right) \rightarrow fs = 100KHz$

$\downarrow$

$$H(z) = \frac{w_c^2}{\left(2fs\left(\frac{z-1}{z+1}\right)\right)^2 + \sqrt{2}.w_c\left[2fs\left(\frac{z-1}{z+1}\right)\right] + w_c^2}$$

Finalmente:

$$\boxed{H(z) = \frac{z^2(39478417) + z(78956835) + (39478417)}{z^2(41816631592) - z(79921043164) + (38262325242)}}$$

B) Realizamos el mismo desarrollo, solo variando $fs = 10KHz$.

$$\boxed{H(z) = \frac{z^2(39478417) + (78956835).z + 39478417}{z^2(617193735) - (721043164).z + 38262325242}}$$

c) Pasa-altos, Butter, orden 2: $H(s) = \frac{s^2}{s^2+\sqrt{2}\,s+1}$

Desnormalizamos con $w_c = 2\pi\, 6KHz$

$\downarrow$

$$H(s) = \frac{(s/w_c)^2}{\left(\frac{s}{w_c}\right)^2 + \frac{s}{w_c}\sqrt{2} + 1} \rightarrow H(s) = \frac{s^2}{s^2+\sqrt{2}.w_c.s + w_c^2}$$

NOTA

Luego, aplicamos la transformada Bilineal:

$$s = 2fs\left(\frac{z-1}{z+1}\right) \longrightarrow fs = 100\,kHz$$

$$\downarrow$$

$$H(z) = \frac{\left[2fs\left(\frac{z-1}{z+1}\right)\right]^2}{\left[2fs\left(\frac{z-1}{z+1}\right)\right]^2 + \sqrt{2}\,wc\left[2fs\left(\frac{z-1}{z+1}\right)\right] + wc^2}$$

Finalmente:

$$\boxed{H(z) = \frac{z^2\,(4\times10^{10}) - z\,(8\times10^{10}) + 4\times10^{10}}{z^2\,(5\times10^{10}) - z\,(8\times10^{10} + 3\times10^{10}}}$$

d) Utilizamos pre-warping en el pasa-altos.