Question 3

Pass band attenuation α_p : 3dB
Stop band attenuation α_s : 10dB

Pass band frequency $\omega_p = 2\pi \times 1000 = 2000\pi$ rad/sec
Stop band frequency $\omega_s = 2\pi \times 350 = 700\pi$ rad/sec

$$T = \frac{1}{f} = \frac{1}{5000} = 2\pi \times 10^{-4} \text{ sec}$$

$$\Omega_p = \frac{2}{T} \tan \frac{\omega_p T}{2} = \frac{2}{2\pi 10^{-4}} \tan \frac{(2000\pi \times 2 \times 10^{-4})}{2}$$

$$= 10^4 \tan(0.2\pi)$$
$$= 7265 \text{ rad/sec}$$

$$\Omega_s = \frac{2}{T} \tan \frac{\omega_s T}{2} = \frac{2}{2\pi 10^{-4}} \tan \frac{(700\pi \times 2 \times 10^{-4})}{2}$$

$$= 10^4 \tan(0.07\pi)$$
$$= 2235 \text{ rad/sec}$$

The order of the filter,

$$N \geq \frac{\log \sqrt{\frac{10^{0.1\alpha_s} - 1}{10^{0.1\alpha_p} - 1}}}{\log \frac{\Omega_s}{\Omega_p}}$$

$$= \frac{\log \sqrt{\frac{10^{0.1 \times 10} - 1}{10^{0.1 \times 3} - 1}}}{\log \frac{7265}{2235}} = \frac{\log 3}{\log(3.25)} = \frac{0.4771}{0.5118}$$

$$= 0.932 \approx 1$$

$$\therefore \boxed{N = 1}$$