TE 461 Marking Scheme

Title: Computer Applications and Project Design(TE 461) - Marking Scheme

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Question 1

The filter's transfer function characteristics,

$$H(\omega) = \frac{\frac{1}{j\omega C}}{R + \frac{1}{j\omega C}} = \frac{1}{1 + j\omega CR}$$

And, $|H(\omega)| = \left[\frac{1}{1+(\omega CR)^2}\right]^{\frac{1}{2}}$

Therefore, $|H(\omega)|^2 = \frac{1}{1+(2\pi fCR)^2} = \frac{1}{1+\left(\frac{f}{f_0}\right)^2}$

Where, $f_0 = \frac{1}{2\pi CR}$

1. The output power spectral density becomes

$$G_{no}(f) = |H(\omega)|^2 G_{no}(f) = \frac{1}{1 + \left(\frac{f}{f_0}\right)^2} . \frac{N_0}{2}$$

The average noise power is found by integrating $G_{no}(f)$,

$$P_n = \int_{-\infty}^{\infty} G_{no}(f) df = \frac{N_0}{2} \int_{-\infty}^{\infty} \frac{1}{1 + \left(\frac{f}{f_0}\right)^2}$$

Let $\tan\theta = \frac{f}{f_0}$, $\quad f = f_0 \tan\theta$, $\quad \frac{df}{d\theta} = f_0 sec^2\theta$, $\quad df = f_0 sec^2\theta$

$$P_n = \frac{N_0}{2} \int_{-\pi/2}^{\pi/2} \frac{1}{1 + \tan^2\theta} . f\, sec^2\theta d\theta$$

$$P_n = \frac{N_0}{2} f_0 \int_{-\pi/2}^{\pi/2} \frac{1}{1 + \tan^2\theta} . sec^2\theta d\theta$$

$$P_n = \frac{N_0}{2} f_0 \int_{-\pi/2}^{\pi/2} df$$

$$P_n = \frac{N_0}{2} . f_0 . \left[\frac{\pi}{2} + \frac{\pi}{2} \right]$$

$$P_n = \frac{N_0}{2} \pi f_0$$