

## Assignment 16 (ELEC 341 L16\_FrequencyResponse)

### Problem 1:

Convert the given transfer function into frequency response function, i.e., into  $G(j\omega)$  form. Also, compute  $M(\omega) = |G(j\omega)|$  and  $\phi(\omega) = \angle G(j\omega)$ . Find  $20 \log M(\omega)$  and  $\phi(\omega)$  at  $\omega = 20$ .

$$G(s) = \frac{(s+3)(s+5)}{s(s+2)(s+4)}$$

### Solution:

$$|G(j\omega)| = \frac{\sqrt{\omega^2+9} \sqrt{\omega^2+25}}{\omega \sqrt{\omega^2+16} \sqrt{\omega^2+4}}$$

$$\angle G(j\omega) = \left\{ \tan^{-1}\left(\frac{\omega}{3}\right) + \tan^{-1}\left(\frac{\omega}{5}\right) \right\} - \left\{ 90^\circ + \tan^{-1}\left(\frac{\omega}{4}\right) + \tan^{-1}\left(\frac{\omega}{2}\right) \right\}$$

$$\text{e.g.: for } \omega = 20 \rightarrow |G(j20)| = 0.0508 \rightarrow$$

$$20 \log_{10} 0.0508 = -25.8$$

$$\text{Also, } \angle G(j20) = \left\{ \tan^{-1}\left(\frac{20}{3}\right) + \tan^{-1}\left(\frac{20}{5}\right) \right\} - \left\{ 90^\circ + \tan^{-1}\left(\frac{20}{4}\right) + \tan^{-1}\left(\frac{20}{2}\right) \right\}$$

$$\rightarrow \underline{\angle G(j20) = -95.54^\circ}$$