

Question 3

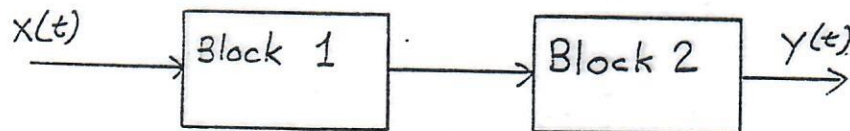
You are given the block diagram shown below. The unit impulse response for "Block 1" is

$$\text{Block 1: } h(t) = \begin{cases} 3e^{-t} & \text{for } t \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

The transfer function for "Block 2" is,

$$\text{Block 2: } G(s) = \frac{25(s+2)}{s^2 + 0.5s + 25}$$

What is the unit step response of the system shown below (i.e. $x(t) = u(t)$)



Question 4

Draw an accurate Bode Diagram for a system with the following transfer function:

$$H(s) = \frac{25(s+30)}{(s+0.3)(s^2+0.1s+25)}$$

Make a table with headings, frequency, magnitude of $H(s)$ and phase of $H(s)$, at the frequencies, $\omega = 0.4$ r/s, $\omega = 5.0$ r/s and $\omega = 50$ r/s. Clearly plot these points on the Bode Diagram. Include in your plot the sum of the asymptotes, clearly mark the slope of each portion of the sum of asymptotes.

D.C. Gain, Height of peak.

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Question 4

$$H(s) = \frac{25(s+30)}{(s+0.3)(s^2+0.1s+25)}$$

D.C. gain = 100 = 40 dB

Height of peak = $\frac{1}{2\zeta} = 50$

= 33 dB

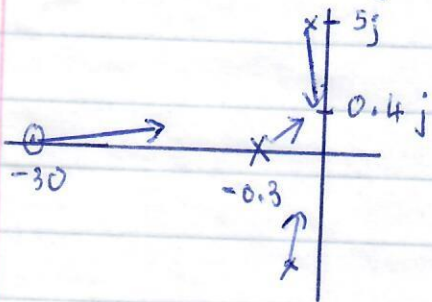
The complex poles: $\omega_n = 5, \quad 2\zeta\omega_n = 0.1$

$2\zeta 5 = 0.1$

$\zeta = 0.01$

$$p, \bar{p} = -\zeta\omega_n \pm j\omega_n\sqrt{1-\zeta^2}$$

$$= -0.05 \pm 5j$$



$$|H(0.4j)| = \frac{25(30)}{(0.5)(4.6)(5.4)}$$

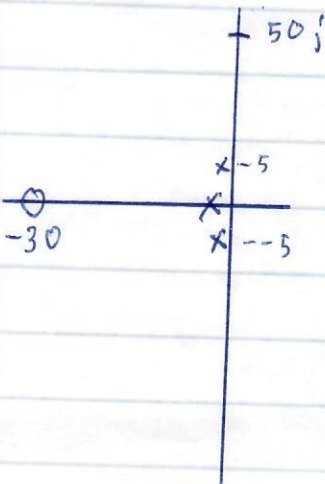
= 60.38 = 35.6 dB

$$\angle |H(0.4j)| \approx 0^\circ - 90^\circ + 90^\circ - 53.1^\circ$$

= -53.1°

$$|H(5j)| = \frac{25(30.4)}{(5)(10)(0.05)} = 304 \checkmark = 49.6 \text{ dB}$$

$$\angle H(5j) = \frac{9.46^\circ = \tan^{-1}(5/30)}{+90 + 90^\circ + 0^\circ} = 9.46 - 90^\circ - 90^\circ = -170.5^\circ$$



$$|H(50j)| = \frac{25(58.3)}{50(45)(55)} = 0.01177 = -38.6 \text{ dB}$$

$$\angle H(50j) = 59^\circ - 90^\circ - 90^\circ - 90^\circ = -211^\circ$$

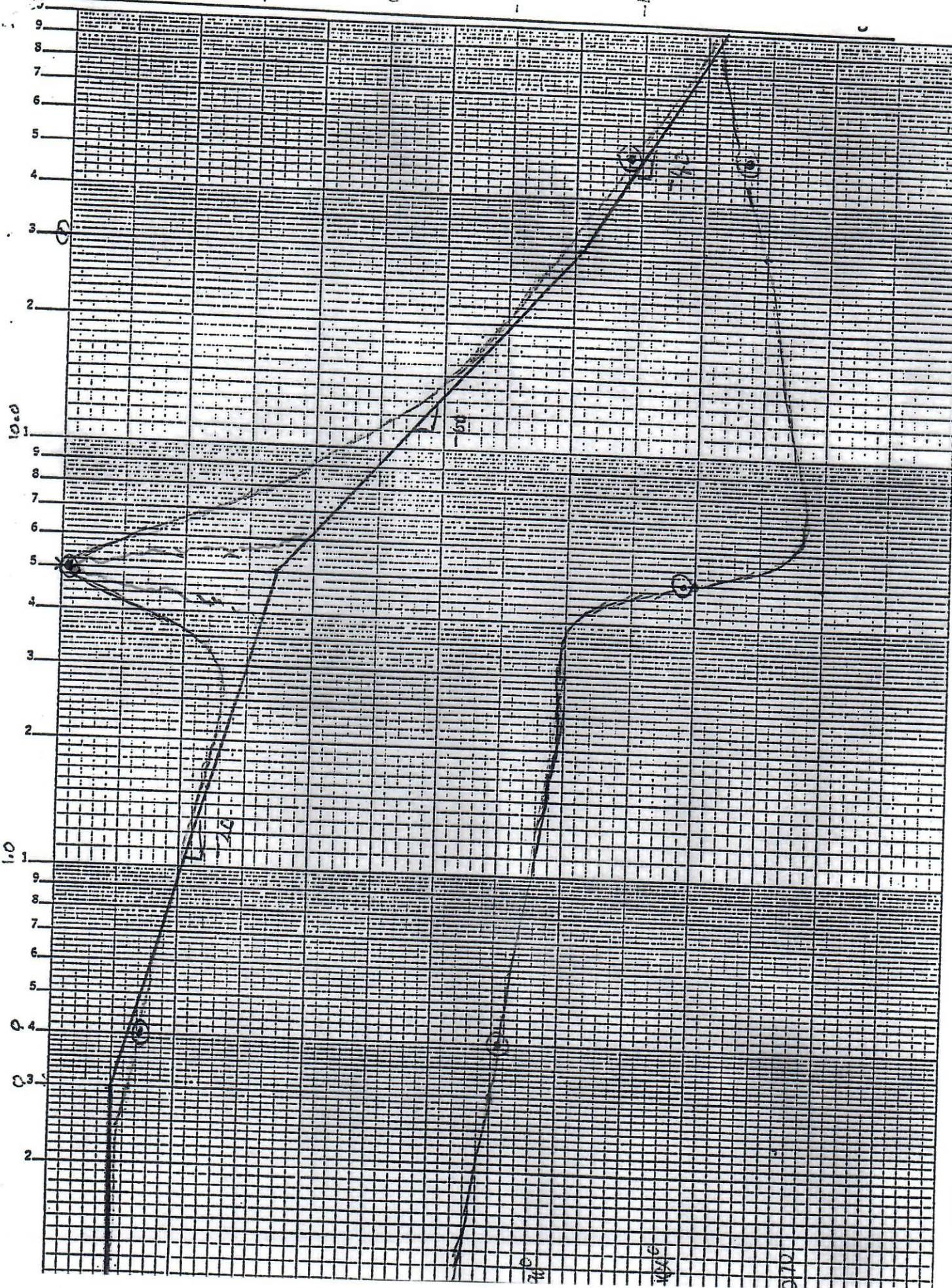
dropping @ 40 dB/dec

Final 1993 Supplemental 94-260

Freq.	indB	L
0.4 r/s	35.6	-53.1
5 r/s	49.6	-170.5
50 r/s	-38.6	-211°

694.200A

Option 4, 2nd Supplemental $H(s) = \frac{25(s+30)}{(s+2)(s+5)^2(s+25)}$
Low gain: 40 dB



HA