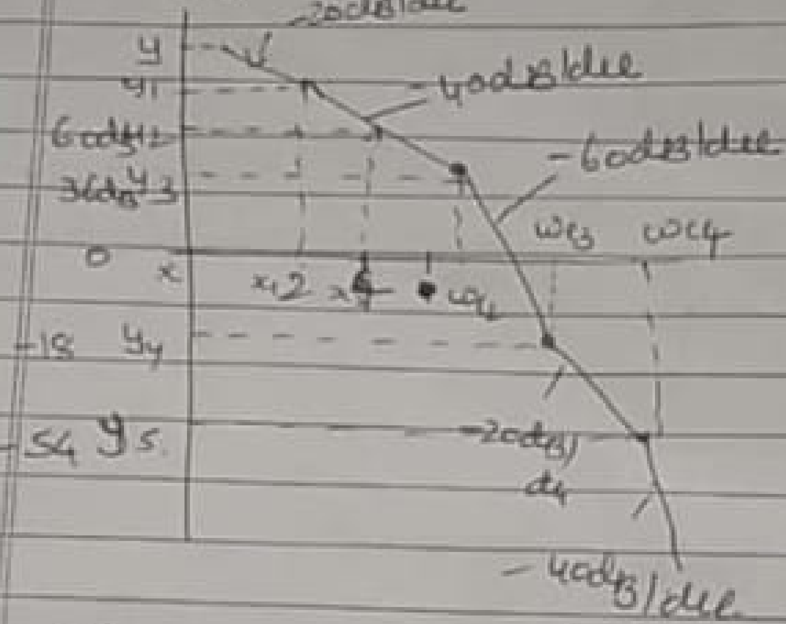
3) Find the open loop T.F of a single loop unity f/b s/m as shown in fig



Change of -20dB/dec slope is given thus one pole at origin is consider ie $\frac{1}{s}$

To find the K (gain)

$$y_1 - y_2 = m(\log x_1 - \log x_2)$$

$$y_1 - 60 = -40(\log 2 - \log 4)$$

$$y_1 - 60 = +12.04$$

$$y_1 = 72.04 \text{ dB}$$

To find y

$$y - y_1 = m(\log x - \log x_1)$$

$$y - 72.04 = -20(\log 0.1 - \log 2)$$

$y - 72.04 = 26.02$

$y = 98.06$

$20 \log k$

(K in dB) + Slope = Max Value || K in dB + slope × $\log \omega_{line}$ = Gain Mag

K in dB + 20 = 98.06

K in dB = 78.06

$20 \log K = 78.06$

$\log K = 3.903$

$K = 7998.3$

At $\omega = \omega_{c_1}$ there is a slope change of

$\omega = \omega_{c_1} = 2$ rads/sec

Change in Slope = final − initial

$= -40 - (-20) = -20$ dB/dec

∴ simple pole at $\omega_{c_1} = 2$ rads/sec

$T = 1/\omega_{c_1} = 1/2 = 0.5 = \frac{1}{1 + 0.5s}$

At $\omega = \omega_{c_2}$ there is a slope change of

$= -60 - (-40) = -20$ dB/dec

∴ simple pole at ω_{c_2}

$y_2 - y_3 = m(\log x_2 - \log \omega_{c_2})$

$60 - 36 = -40(\log 4 - \log \omega_{c_2})$

$-0.6 = \log 4 - \log \omega_{c_2}$

$\log \omega_{c_2} = 1.202$

$\omega_{c_2} = 16$ rads/sec

$T_2 = 1/16 = 0.0625 = \frac{1}{1+0.0625S}$

At $\omega = \omega_{c3}$ there slope change of

$= -20 - (-60)$

$= +40\ dB/dec$

∴ simple zero is to be considered

$36 - (-18) = -60(\log 16 - \log \omega_{c3})$

$54 = -72 + 60 \log \omega_{c3}$

$\log \omega_{c3} = 2.1$

$\omega_{c3} = 126\ rad/sec$

$T = \frac{1}{126} = 0.00793$

Simple zero is $(1 + 0.0793S)$

At $\omega = \omega_{c4}$ There is a slope change of

$= -40 - (-20) = -20\ dB/dec$

simple pole at ω_{c4}

$(-18 - (-54)) = -20(\log 126 - \log \omega_{c4})$

$36 = -42 + 20 \log \omega_{c4}$

$\omega_{c4} = 7943\ rad/sec$

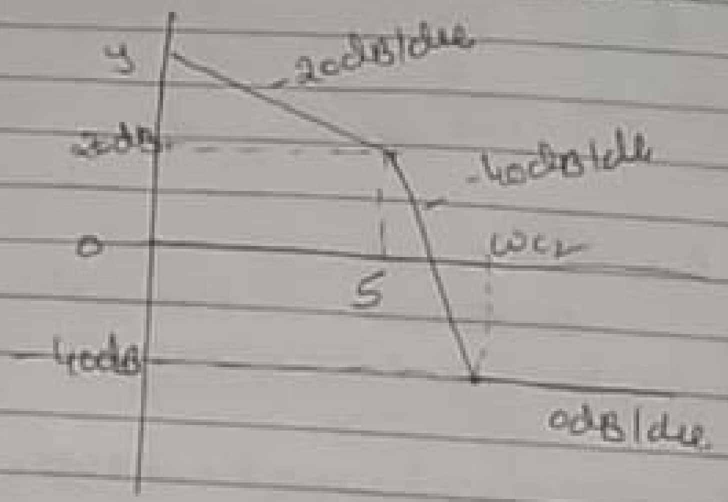
$1/T = \frac{1}{7943} = 0.000125$

Simple pole is $\frac{1}{1+0.000125}$

overall TF

$$TF = \frac{7998.3(1+0.0793S)}{S(1+0.0625S)(1+0.00012S)}$$

4) Find the TF which has the Bode plot shown in fig



K is unknown
The slope given is of -20dB/dec here one Pole at origin $= \frac{1}{s}$

$$(y - y_1) = m\,(\log x - \log x_1)$$

$$y - 20 = -20(\log 0.1 - \log 5)$$

$$y = 53.97 \simeq 54\,dB$$

$$K\,in\,dB + \text{Slope}^{\times \log\omega} = \text{Maximum Value of } dB$$

$$K\,in\,dB + (-20)^{\times \log(0.1)} = 54 \quad \| \quad K\,in\,dB + (-20)(-1) = 54$$

$$K\,in\,dB = 74\,dB$$

$$20 \log K = 74$$

$$K = 5.011$$

At $\omega = \omega_{c1} = 5$ rad/sec The slope change is $-40 - (-20) = -20$dB/dec

Thus the Simple pole exist

$T_1 = \frac{1}{\omega_{c1}} = \frac{1}{5} = 0.2$

simple pole is $\frac{1}{1+0.2S}$

at $\omega = \omega_{c2}$ the slope change of
$0-(-40) = +40\,dB/dec$
the slope indicate the simple zero

$0-(-40) = -40(\log 0.1 - \log \omega_{c2})$

$40 = -40 \log 0.1 + 40 \log \omega_{c2}$

$-1 =$

$20-(-40) = -40(\log 5 - \log \omega_{c2})$

$-\frac{60}{40} = \log 5 - \log \omega_{c2}$

$\log \omega_{c2} = 2.198$

$\omega_{c2} = 158.11\ rads/sec$

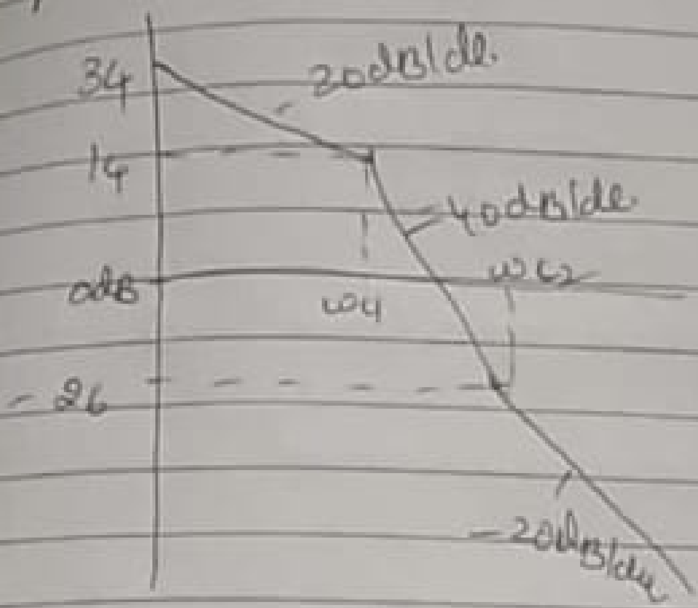
$T_2 = 1/\omega_{c2} = 0.00632$

Simple ~~pole~~ zer = $\frac{1}{1+0.00632S}$ Simple zero = $(1+0.0063$

overall TF is.

$$TF = \frac{5.011(1+0.00632S)}{S(1+0.2S)}.$$

5) The bodeplot of unity feedback sim is shown find TF.



There is a slope change of -20dB/dec Thus the one pole at origin.

Gain Maximum value

$20\log K = 34$ $K \text{ in dB} + \text{slope} \times \log\omega = \text{Gain}$

$K = 50.11$ $K\text{ in dB} + (-20) \times (0.1) = 34$

$K\text{ in dB} = 34 - 20 = 14$

$20\log K = 14 \quad K = 5$

At $\omega = \omega_{c1}$ the slope change is of.

$-40 - (-20) = -20\text{dB/dec}$

$$(34 - 14) = -20(\log 0.1 - \log\omega_{c1})$$

$$20 = 20 + 20\log\omega_{c1}$$

$$0 = \log\omega_{c1}$$

$$\omega_{c1} = 1 \text{ rads/sec}$$

$$T = 1/\omega_{c1} = 1$$

simple pole is $\frac{1}{1+s}$

At $\omega = \omega_{c_2}$

$$14 - (-26) = -40\,(\log 1 - \log \omega_{c_2})$$

$$-1 = \log 1 - \log \omega_{c_2}$$

$$\log \omega_{c_2} = 1$$

$$\omega_{c_2} = 10 \text{ rad/sec}$$

$$T_2 = 1/\omega_{c_2} = 1/10 = 0.1$$

The slope change of $-20 - (-40) = +20\,\text{db/dec}$

one simple zero is considered : $\underline{(1+0.1s)}$

Overall TF is

$$TF = \frac{5\,(1+0.1S)}{S(1+S)}$$

At $\omega_3 = 50$ rads/sec there is slope change of $-40 - (-20) = -20\,\text{db/dec}$

one simple pole is available

$$T_3 = \frac{1}{50} = 0.02 = \frac{1}{1+0.02S}$$

Thus the overall TF is

$$TF = \frac{50.11\,(1+0.1S)}{S(1+S)(1+0.02S)}$$