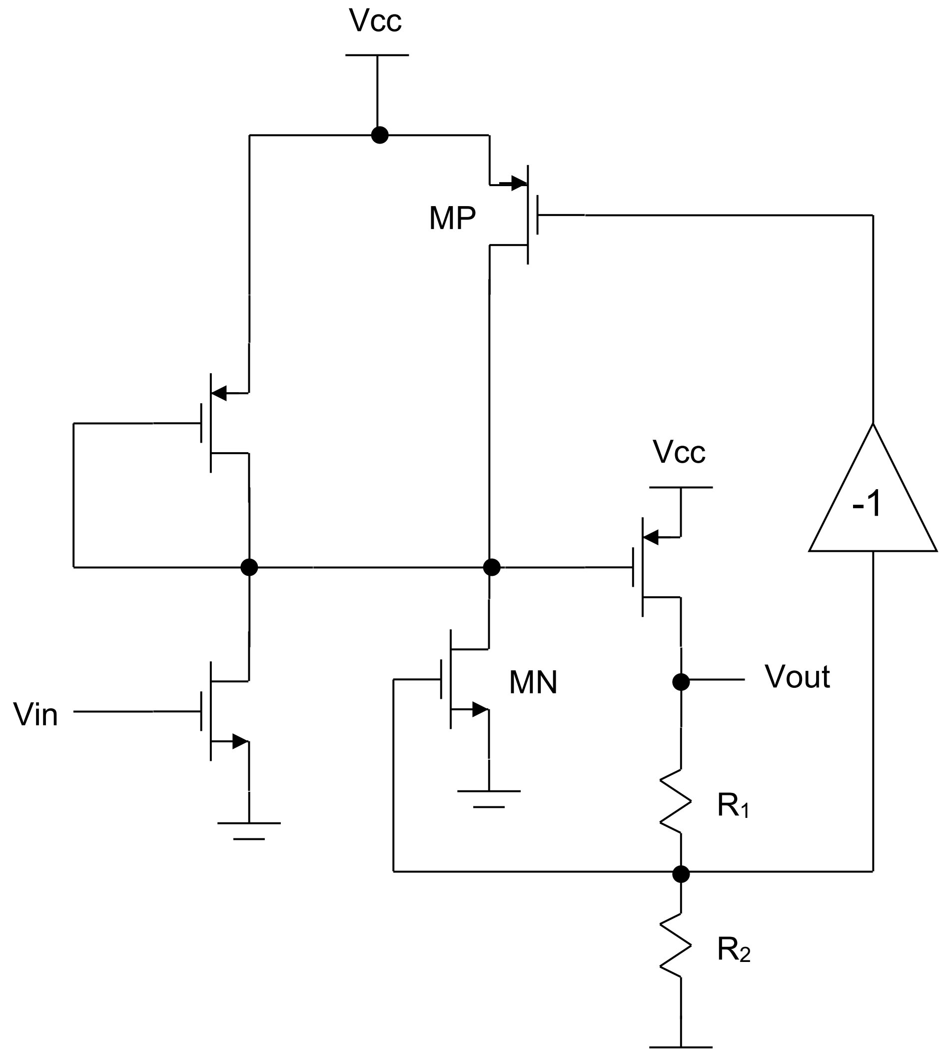
ECE 323 HW # 6

Prob-1. Determine in which of the two cases (a) $g_{mp} > g_{mn}$ (b) $g_{mp} < g_{mn}$ the circuit will be unstable and why? g_{mp} and g_{mn} are respective transconductances of MP and MN.



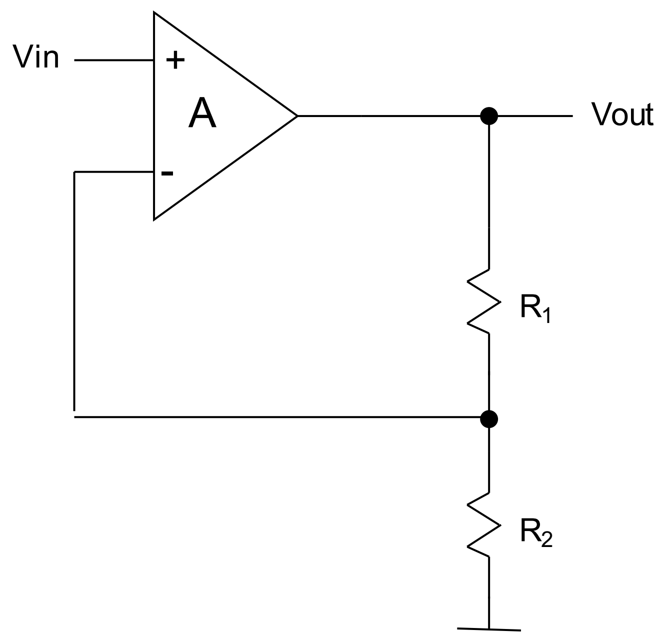
ECE 323 HW # 6

Prob-2. A second order system has an open loop transfer function $H(s) = \dfrac{2000}{(\frac{s}{10}+1)(\frac{s}{p}+1)}$ and feedback factor of *ß*.

Determine the location of pole *p* for which the loop phase margin is *45°* if (a) *ß=1/2* and (b) *ß=1/20*. Show the bode plot of loop transfer function for both the cases.

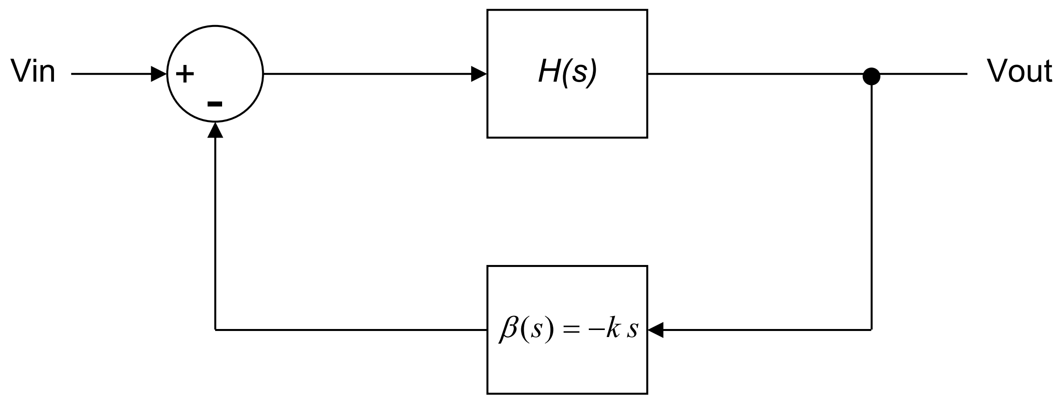
ECE 323 HW # 6

Prob-3. Figure below shows a non-inverting amplifier achieved by connecting an opamp in negative feedback configuration. Assuming open loop gain of opamp $A=\infty$, the closed loop gain $Vout/Vin$ of the circuit is given by $1+R1/R2$ which is simply $1/\beta$ where β is the feedback factor $R2/(R1+R2)$. Find the expression for closed loop gain if A is finite and determine % error in the closed loop gain for (a) $A=1000$ and (b) $A=10000$.



ECE 323 HW # 6

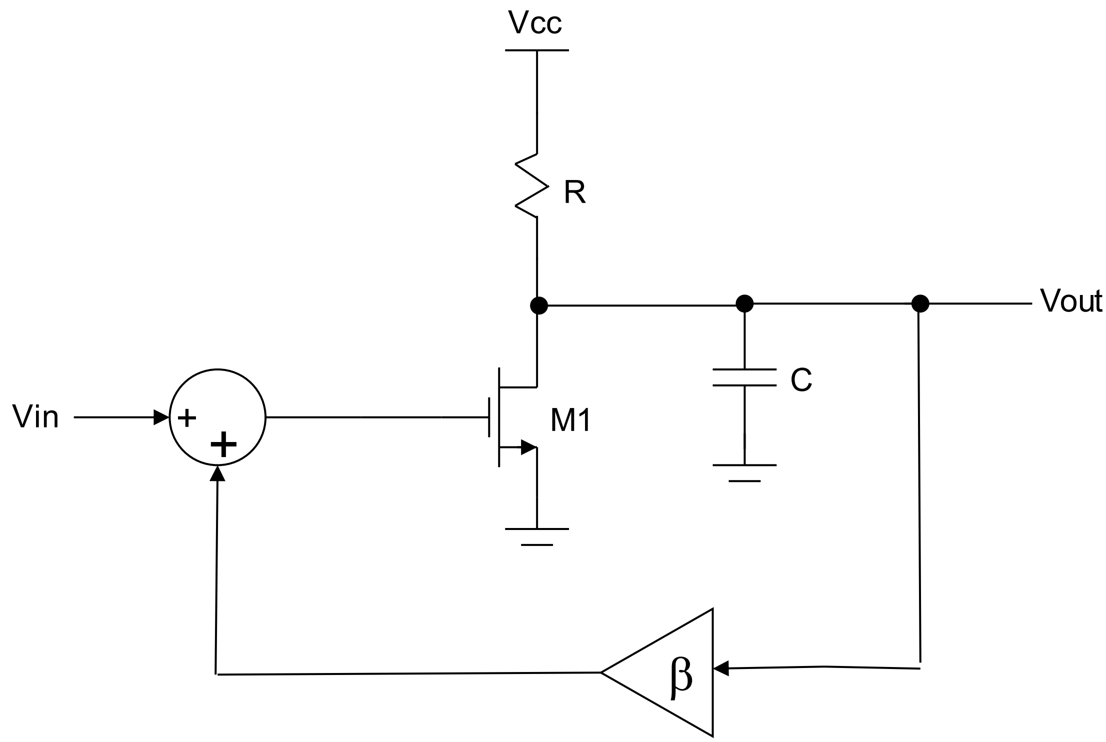
Prob-4. A system is said to be unstable if any of the poles lie in right half of the s-plane. This property can be used to convert a second order system into oscillator by using negative feedback and choosing a proper feedback function. Find the closed loop transfer function *Vout(s)/Vin(s)* of the system and show how the location of poles change w.r.t *k* in s-plane.



$$H(s) = \frac{A}{s^2 + \frac{w_n}{Q_0} s + w_n^{\,2}}$$

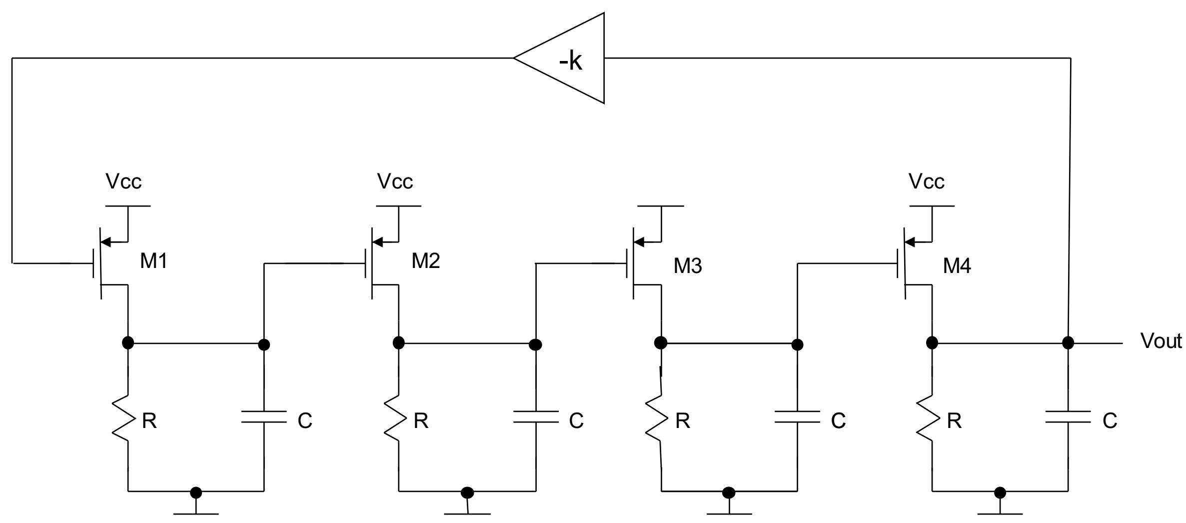
ECE 323 HW # 6

Prob-5. A common source amplifier with DC gain $gm \cdot R$ and pole location $wp=1/RC$ is connected in negative feedback configuration as shown in figure below. Determine the closed loop transfer function $Vout(s)/Vin(s)$, closed loop DC gain and closed loop $-3dB$ bandwidth of the circuit. Show the bode plot for gain and phase for (a) $\beta=0$ (b) $\beta=1$ and (c) $\beta=1/2$ and compare the DC gain and Bandwidth of the closed system with that of open loop gain and bandwidth of common source amplifier. Consider $ro=\infty$.



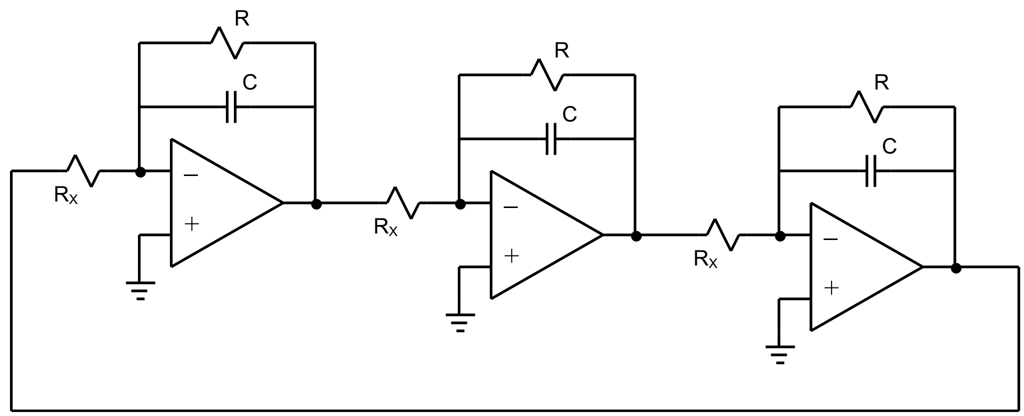
ECE 323 HW # 6

Prob-6 For the circuit shown below, find (a) minimum gain *k* if $R=1K\Omega$ and (b) minimum value of *R* if $k=0.25$ for which the circuit will oscillate and determine the expression for frequency of oscillation in both the cases. Consider $ro=\infty$ and $gm=1m\ A/V$ for all the PMOS.



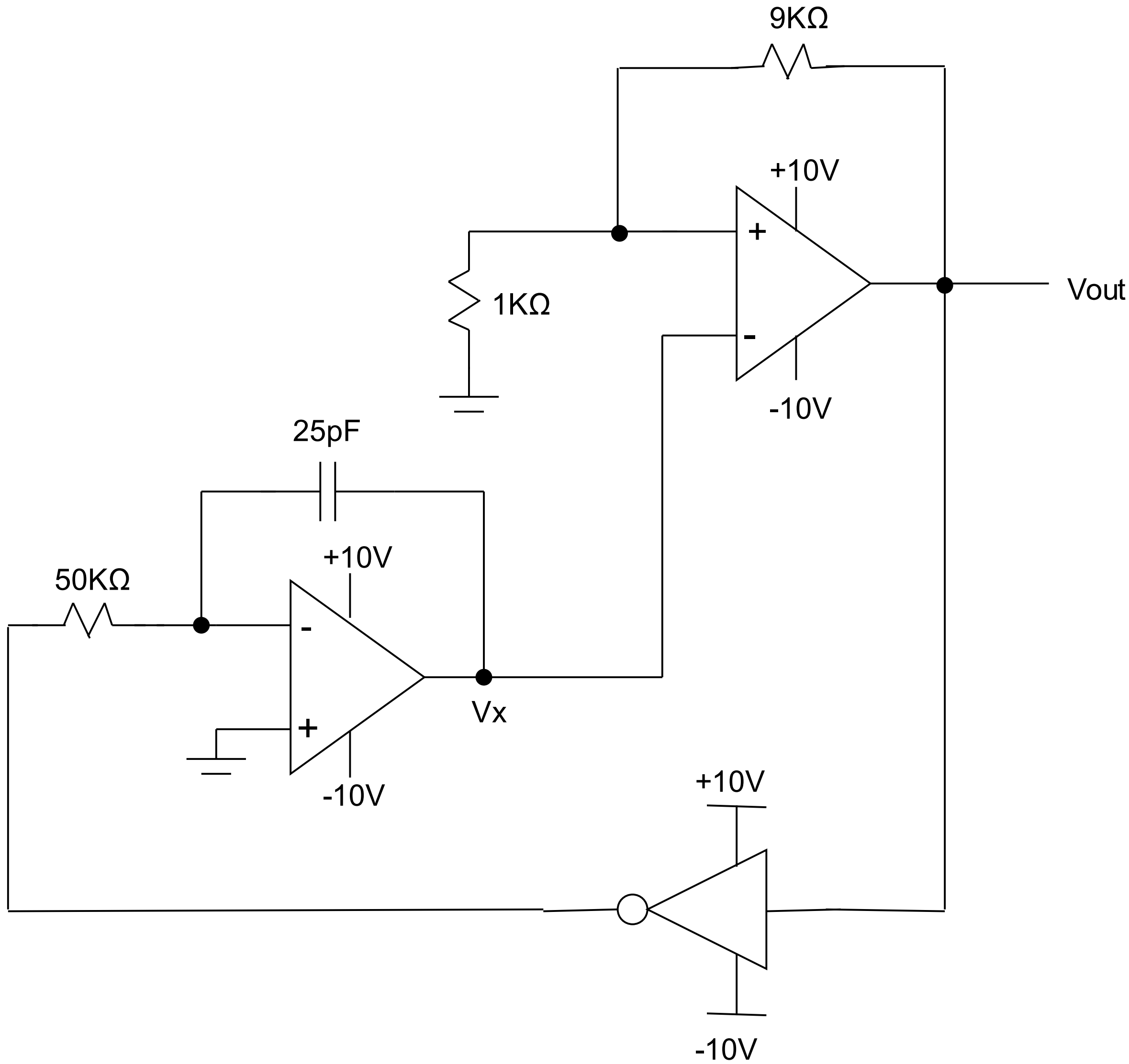
ECE 323 HW # 6

Prob-7. For the linear oscillator shown, find the oscillation frequency ω_o and R_X value required to ensure oscillation.



ECE 323 HW # 6

Prob-8. Plot the waveforms at Vout and Vx. Mark the voltages clearly and determine the frequency of oscillation.



ECE 323 HW # 6

Prob-9. Note all critical voltage levels in the **Vx** waveform. Sketch **Vout** waveform, with proper time alignment and voltages. Find the resulting period (T_{osc}) of oscillation.