1. Small-signal models of BJTs and MOSFETs: π model and T model

   Lecture note 6-50 for BJT: \( g_m r_e = \beta \), \( g_m = I_C / V_T \)

   Lecture note 8-18 for MOSFET: \( g_m = k(V_{GS}-V_t) = kV_{OV} = 2I_D / V_{OV} \),

   \( k = (W/L)C_{ox} \mu (W/L)k' \),

   \( g_m = \sqrt{2k_n \sqrt{W / L \sqrt{I_D}}} \)

2. How to design the biasing circuit for a BJT or a MOSFET amplifier?
   (I) Resistor bias network

   (II) Current-source bias network

   (III) Active load

   Current source as a load, transistor (diode-connected) as a load (see 8-38)

3. Short-circuit time constant (coupling and by-pass capacitors) and open-circuit time constant (high-frequency response). Dominant pole approx.

4. Miller’s effect & Miller’s approximation

5. Three basic amplifier configurations and their frequency response:
   (I) CE or CS (Miller’s approximation)
(II) CB or CG (independent poles)
(III) CC or CD (follower)

\[
\omega_H \approx \frac{1}{C_\mu R_{C_\mu} + C_\pi R_{C_\pi}} \approx \frac{g_m}{C_\mu (R_\pi + r_\pi)g_m + C_\pi}
\]

   (open-circuit time constance and Miller’s approximation for BJT cascode)
   (S & S page 722 for MOS cascode)

7. Basic BJT differential pair as a differential amplifier: single-ended output \((g_mR_c/2)\),
   double-ended output gain, input and output impedance for both differential and
   common-mode signals, CMRR\((g_mR)\)

   BJT Wilson current mirror: \(\beta r_o/2\)
   MOS Wilson current mirror: \(\mu r_o\)


10. Basic structure of an op-amp. and effect of \(C_C\).

11. Design a simple BJT op-amp.

12. Design a two-stage MOS op-amp.

   ----design of current bias.
   ----input stage and its equivalent circuit
   ----second gain stage
   ----output class-AB power stage