COURSE CODE & TITLE : 21ECC 2025

ANALOG & LINEAR ELECTRONICS.

PART-A.

1) a) Limits the low frequency response

2) b) $I_E = 1.025$ $\beta = 40$

3) b) Decreases

4) b) Reducing channel length

5) a) 6kΩ

PART-B

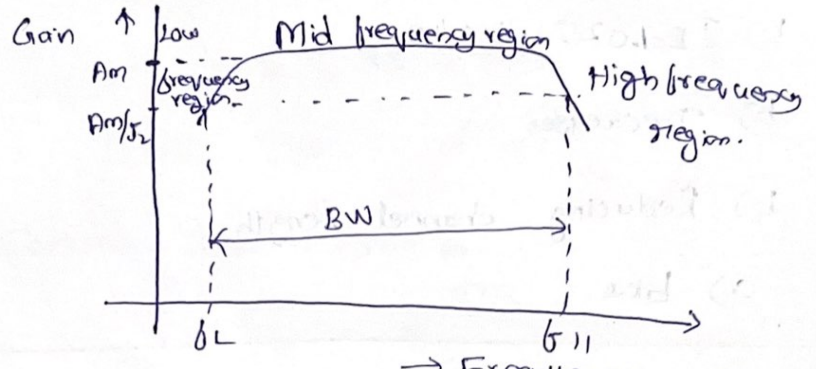
6. CHARACTERISTICS OF CE, CB, CC amplifiers.

| | Input impedance | Output impedance | Gain |
|---|---|---|---|
| CE | Low | High | $A_i, A_v$ = High |
| CB | Very low | Very high | $A_i < 1$<br>$A_v$ less than CE |
| CC | Very high | Low | $A_i$ is High<br>$A_v < 1$ |

(4 marks)

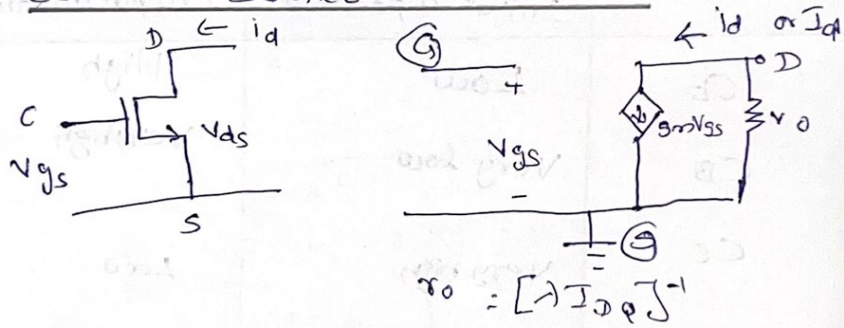
7. The half-power or 3-dB bandwidth is the width of the range of positive frequencies where a peak value at

Zero or infinite frequency (low-pass and high pass signals) or at a center frequency (bandpass signals) is attenuated to 0.707 the value at a peak (2 marks)




(2 marks)

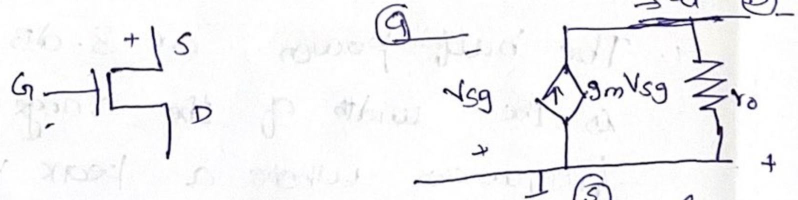
8. SMALL SIGNAL EQUIVALENT OF COMMON SOURCE WITH NMOS




$r_o = [\lambda I_{DQ}]^{-1}$

(2 marks)

COMMON SOURCE WITH PMOS TRANSISTOR




(2 marks)

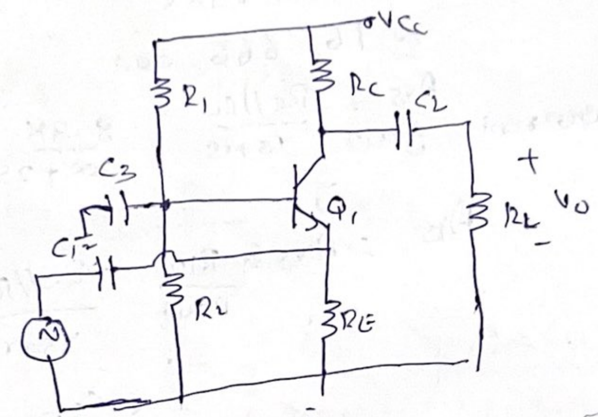
## PART-C

9a. Derive expressions for the input resistance $R_{in}$, output resistance $R_{out}$, Voltage gain $A_v$ and Current gain $A_i$.

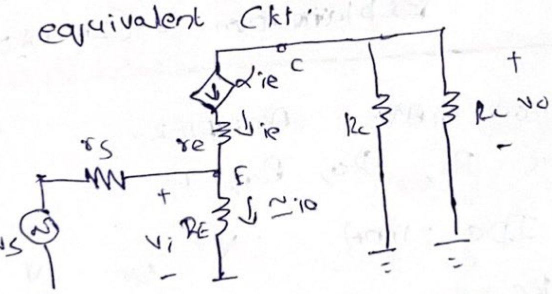
Given $R_E = 10k\Omega$, $R_C = 50k\Omega$, $R_L = 10k\Omega$, $r_s = 200\Omega$, $V_{CC} = 12V$

$V_{BE} = 0.7V$. $\alpha = 100$

Common Base Amplifier.




AC equivalent Ckt




(2 marks)

Explanation (2 marks)

Input Resistance $R_{in} = R_E \parallel r_e$ $\qquad r_e \simeq \frac{1}{g_m} = \frac{V_T}{I_C}$

$I_C = 1mA$.

$R_{in} = 25\Omega \simeq r_e$.

(2 marks)

Output ~~part~~ resistance $R_o = R_C // R_L$

$R_o = 8.3k\Omega$. (2 marks)

Voltage Gain $A_{vo} = \frac{V_o}{V_i}\Big|_{R_L=\infty} = \frac{\alpha i_e R_C}{i_e(r_e // R_E)} \simeq \frac{R_C}{r_e // R_E}$

$\simeq \frac{R_C}{r_e} = g_m R_C$

$= (0.04)(50,000)$

$A_{vo} = 2000$

$A_v = A_{vo} \times \frac{R_C}{R_C + R_L} = 2000(8.3k\Omega)$

$\simeq 16,666,000$ (2 marks)

Current gain $A_{vs} = \frac{R_C // R_L}{r_s + r_e} = \frac{8.3K}{200+25} = 37$

$A_{is} = A_{vs} \times \frac{R_{in}}{R_{out}} = \frac{R_C // R_L}{r_s + r_e} \times \frac{r_e}{R_C // R_L} \simeq 1$

(2 marks)

Explaination - (2 marks)

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95) COMMON GATE AMPIFIER.

Derive $R_i$, $R_o$, $A_v$, $A_i$

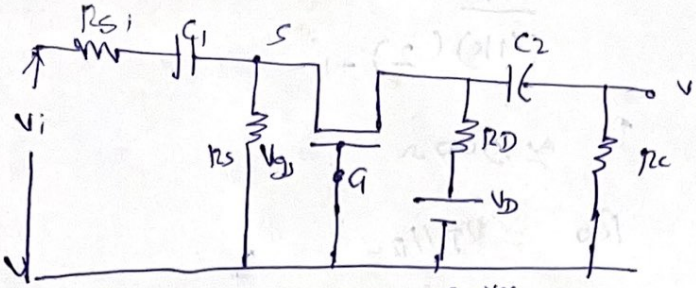
Give $I_{DQ} = 1mA$ $V^+ = 5V$ $V^- = -5V$

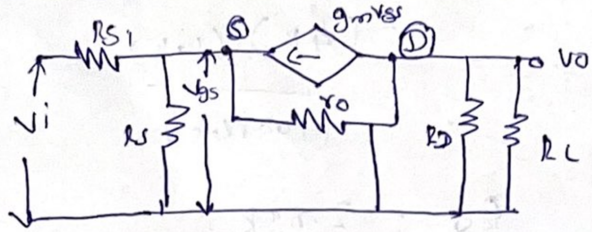
$R_G = 500k\Omega$ $R_D = 4k\Omega$. $R_L = 10k\Omega$

$V_{TN} = 1V$ $K_n = 1mA/V^2$ $\lambda = 0$

$R_S = 4k\Omega$ $R_{Si} = 50K$

COMMON GATE AMPLIFIER




(2 marks)

$R_i = R_s \parallel \frac{1}{g_m}$

$R_o = R_D \parallel R_L$

$A_v = \frac{g_m}{1+g_m R_{si}} (R_D \parallel R_L)$

$A_i = \frac{I_o}{I_1} = \left(\frac{R_D}{R_D+R_L}\right)\left(\frac{g_m R_{si}}{1+g_m R_{si}}\right)$

(6 marks)

$I_Q = I_{DQ} = K_n (V_{GSQ} - V_{TN})^2$

$1 = 1 (V_{GSQ} - 1)^2$

$V_{GSQ} = 2V.$

$g_m = 2K_n (V_{GSQ} - V_{TN})$

$= 2(1)(2-1) = 2 mA/V$

$R_i = R_s \parallel 1/g_m = \frac{R_s/g_m}{R_s + 1/g_m} = \frac{R_s}{g_m R_s + 1}$

$$R_i = \frac{4k}{(4k)(2)+1}$$

$$R_i \simeq 500\Omega$$

$$R_o : R_D // R_L$$

$$= \frac{(4k)(10k)}{(10k+4k)}$$

$$R_o = 2.85k$$

$$A_v = \left(\frac{g_m}{1+g_m R_{si}}\right) R_D // R_L$$

$$= \left(\frac{2}{1+2(50k)}\right)\left[2.85k\right)$$

$$= \left[\frac{2}{1+2(50)}\right]\left[2.85k\right]$$

$$A_v = \cancel{633.33}\ 56.43$$ (4 marks)