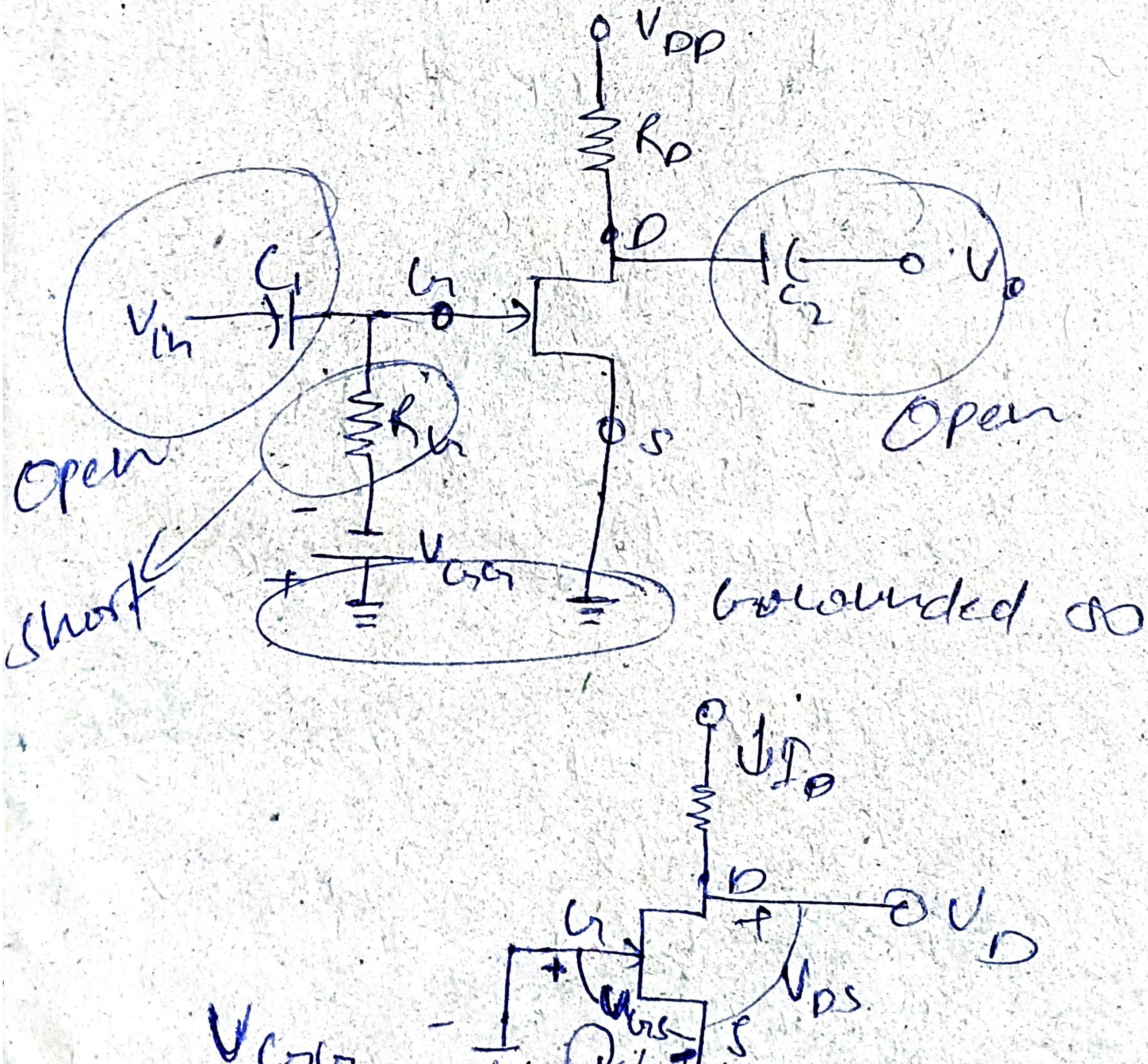
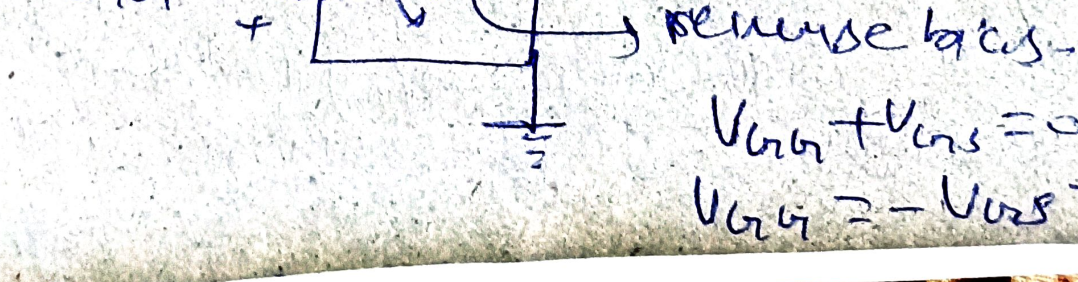
Biasing of JFET

1) fixed bias circuit
2) Voltage divider circuit } syllabus
3) Self bias circuit → o/f

1) fixed bias circuit





$V_{GG} + V_{GS} = 0$

$V_{GG} = -V_{GS}$ ①

$V_{GS} = -V_{GG}$ — (I)

(II) $I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2$ — (II)

(III) KVL at o/p

$V_{DD} - I_D R_D - V_o = 0$

$$\boxed{V_o = V_{DD} - I_D R_D}$$

$V_o = V_{DS} = V_{DD} - I_D R_D$

(AAA) i) $V_{GSQ} = -V_{GG}$

ii) $I_{DQ} = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2$

any given point

iii) $V_{DSQ} = V_{DD} - I_D R_D$

Quadiant Point Imp

Que (1) $V_{DD} = 16V$, $R_D = 2\,k\Omega$

$V_{GG} = 8V$

$I_{DSS} = 20\,mA$

$V_P = -8V$

$V_{GS} = -V_{GG}$

$= -8V$

find V_{GSQ}, ii) I_{DQ} iii) V_{DSQ}

iv) V_D

Sol i) $V_{GSQ} = -V_{GG} = \boxed{-4\ \text{volt} \to V_{GG}}$

$I_{DQ} = 20\times10^{-3} \times \left(1 - \frac{(-4)}{-8}\right)^2$

$20\times10^{-3}\left(1-\frac{1}{2}\right)^2$

$= 20\times10^{-3} \times \frac{1}{4} = 5\,mA$

$\boxed{I_{DQ} = 5\,mA}$

iii) $V_{DSQ} = 16 - \underbrace{5\,mA \times 2\times10^{3}}$ $\to 5\times10^{-3}\times2\times10^{3} = 10$

$16 - 10 = 6$ Volt

$\boxed{V_{DSQ} = 6\ \text{Volt}}$

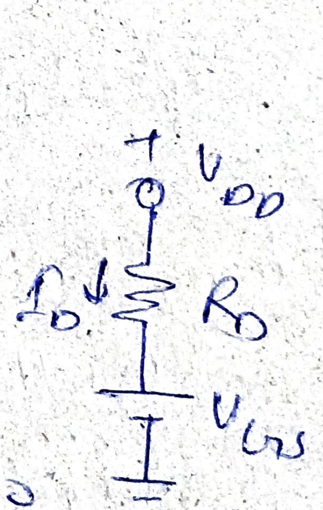
iv) $V_{DS} = V_D - V_S$ $\to 0$

$V_S \to$ source (grounded).

$V_D = V_{DS} + V_S \to 0$

$\boxed{V_D = 6V}$

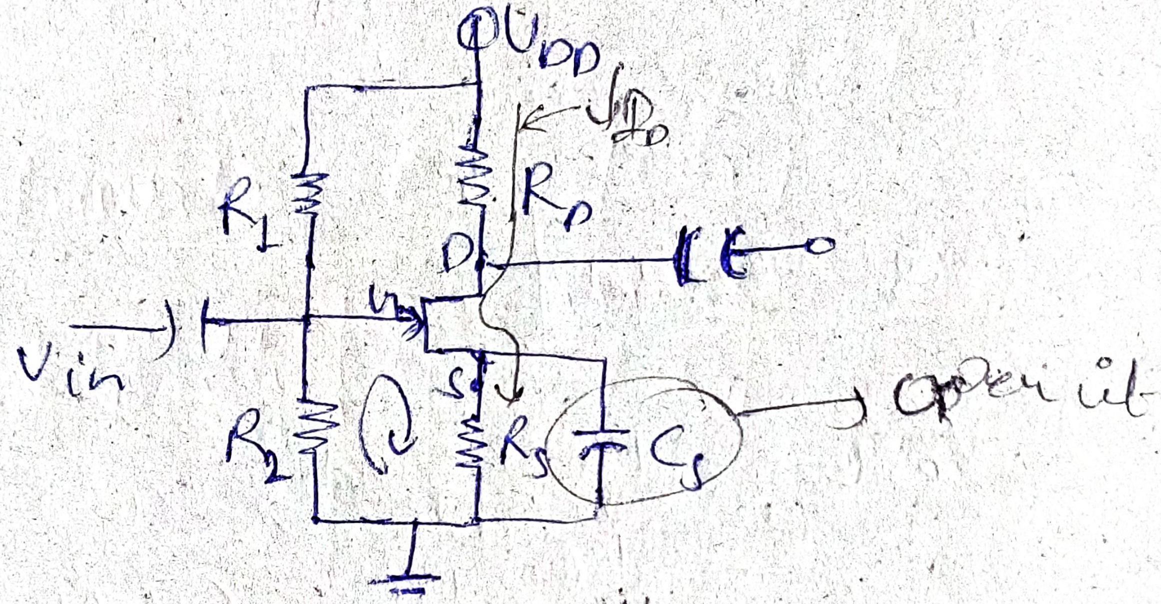
Concept

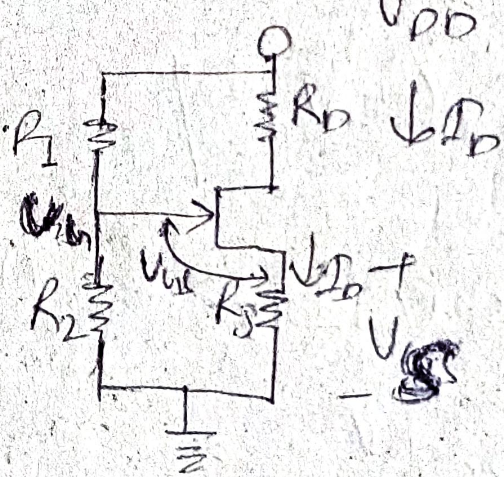


$V_{DD} - I_D R_D \pm V_{GS} = 0$

i) Fixed Bias current :

(ii) Voltage divider circuit :





$\boxed{V_S = I_D R_S}$

i) $\boxed{V_S = I_D R_S \quad (i)}$

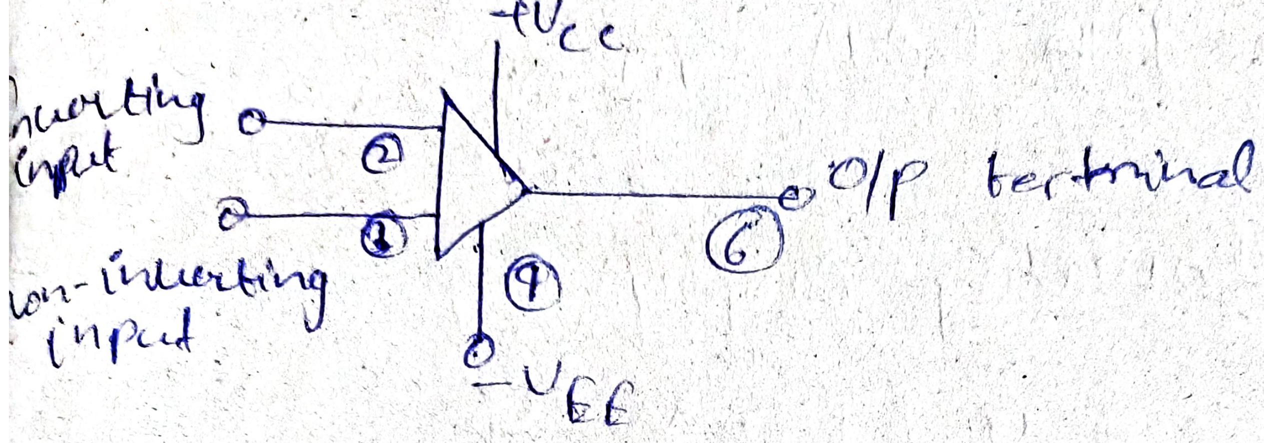
(ii) $\boxed{V_G = \dfrac{R_2}{R_1 + R_2} \times V_{DD}}$ — (ii)

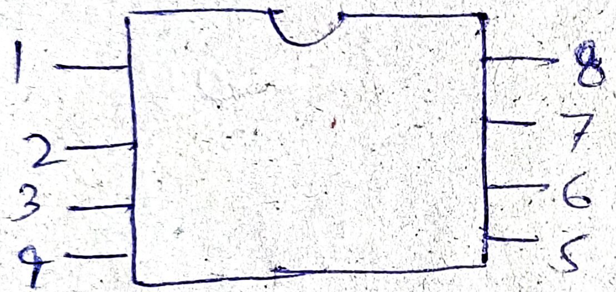
(iii) $V_G - V_{GS} - V_S = 0$

$\boxed{V_{GS} = V_G - V_S}$ — (iii)

UNIT-4

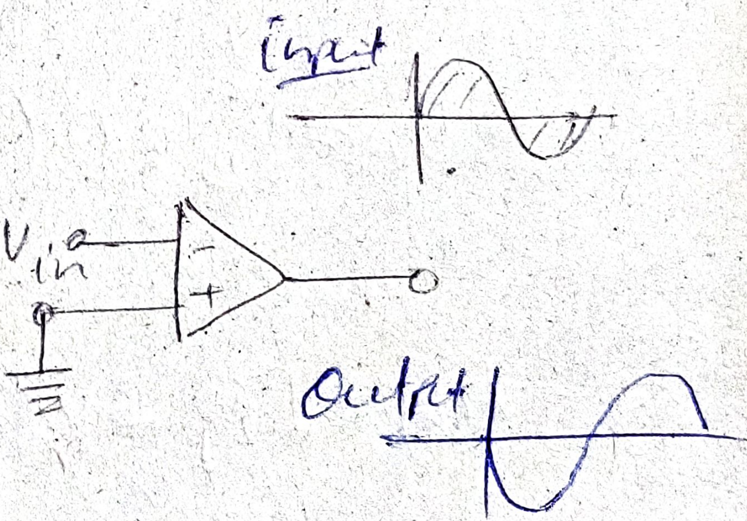
Operational Amplifier



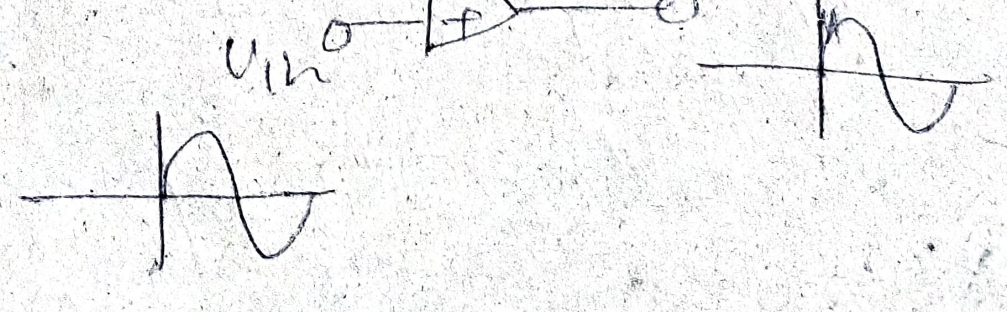


Cases:

i) Inverting

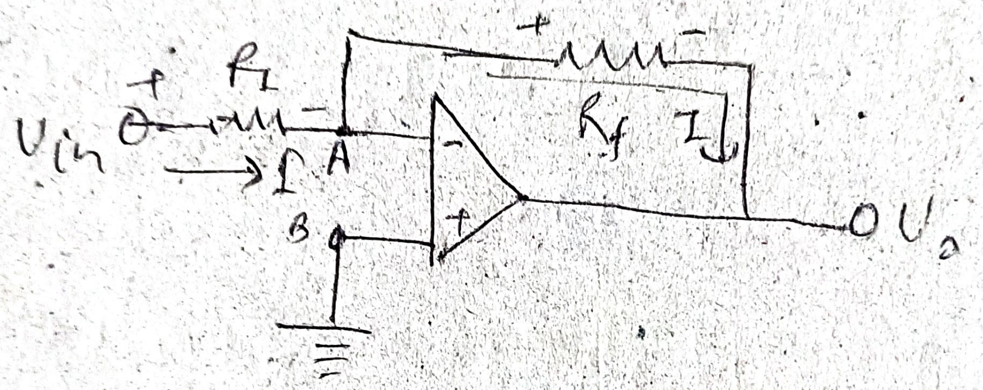


ii) non-inverting



Que. In ideal differential amplifier. find the i) differential gain (Ad) ii) Common mode gain (Ac)

i) Inverting Amplifier:



$V_B = 0$

$V_A = V_B = 0$ (by virtual ground effect)

$V_{in} - IR_1 - \cancel{V_A} = 0$

$\boxed{V_{in} = IR_1}$

$\cancel{V_A} - IR_f - V_o = 0$

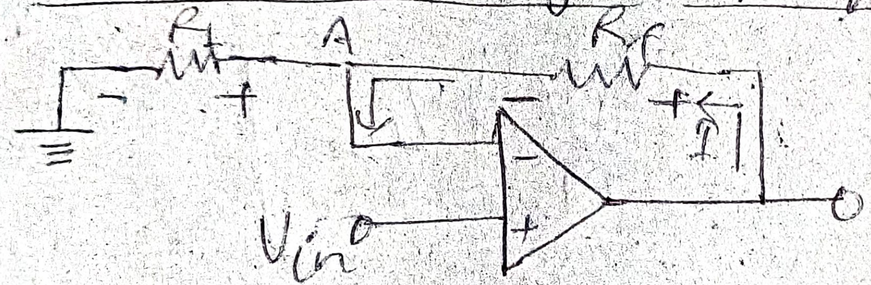
$\boxed{V_o = -IR_f}$

$$\text{Gain} = \frac{V_o}{V_{in}} = \frac{-IR_f}{IR_1}$$

$$\text{Gain} = \frac{V_o}{V_{in}} = \frac{-R_f}{R_1}$$

$$\boxed{V_o = \frac{-R_f}{R_1}(V_{in})}$$

ii) <u>Non-Inverting amplifier:</u>



$$V_B = V_{in}$$

$$V_A = V_B = V_{in}$$

$$V_A + IR_f - V_o = 0$$

$$V_o = V_A + IR_f = V_{in} + IR_f \quad (i)$$

$$V_A - IR_1 = 0$$

$$V_A = IR_1 \Rightarrow \boxed{V_{in} = IR_1} \quad (ii)$$

$$\text{Gain} = \frac{V_o}{V_{in}} = \frac{V_{in} + IR_f}{IR_f}$$

$$= \frac{IR_1 + IR_f}{IR_1}$$

$$\boxed{\text{Gain} = 1 + \frac{R_f}{R_1}}$$

$$\boxed{V_o = \left(1 + \frac{R_f}{R_1}\right) V_{in}}$$