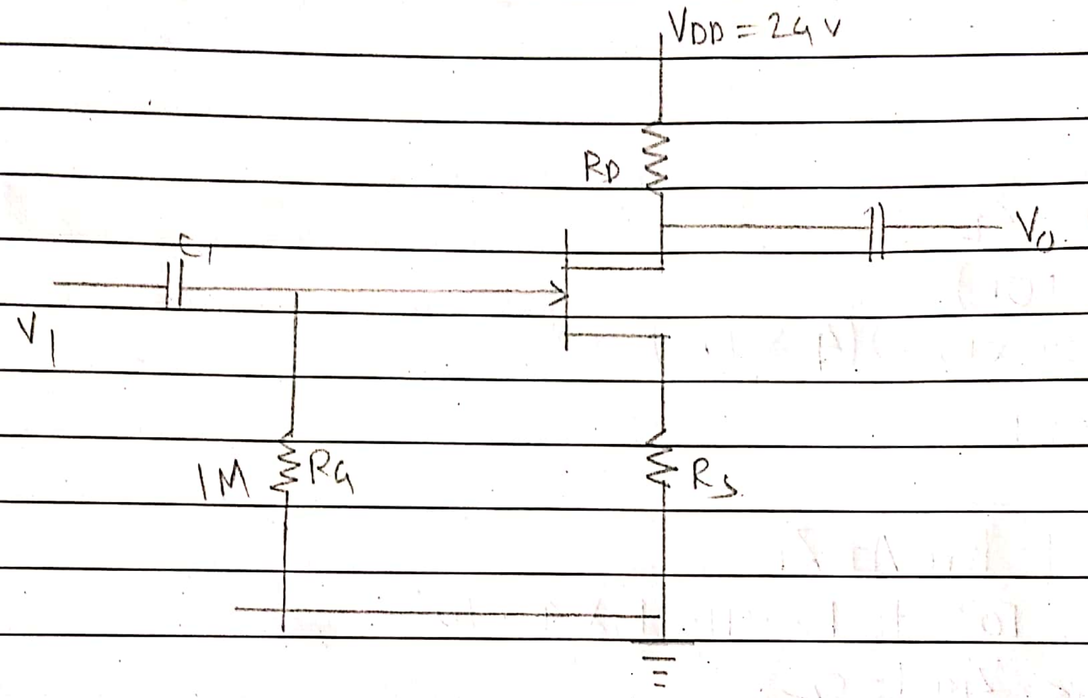
Q.8] It is desired to bias the JFET in the given ckt for $I_D = 0.8$ milliamp, $I_{DSS} = 1.65$ milliamp, $V_{GS off} = -2V$ find V_{GS}, g_m, R_S. What is the maximum transconductance possible and at what V_{GS}. State what is the type of amplifier shown and type of biasing used?



→ Type of Amplifier → n-channel JFET
Type of Biasing → Self-bias.

Given: $I_D = 0.8\,mA$, $I_{DSS} = 1.65\,mA$
$V_{GSoff} = 2V$

Find: V_{GS}, g_m, R_S

$V_{GS} = V_{GA} - V_{GS}$

$= 0 - (I_D R_S)$

$\boxed{V_G = -I_D R_S}$ ——— (1)

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

Put (1) in (2),

$$I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_{GSoff}}\right)^2 \quad \text{—— 3}$$

$$= I_{DSS}\left(1 + \frac{I_D R_S}{V_{GSoff}}\right)^2$$

$$\frac{0.8 \times 10^{-3}}{1.65 \times 10^{-3}} = \left(1 + \frac{(0.8) \times 10^{-3} \times R_S}{-2}\right)^2$$

$$\sqrt{0.48484} = 1 - \frac{0.8 \times 10^{-3} \times R_S}{2}$$

$$0.69631 = 1 - 0.4 \times 10^{-3} \times R_S$$

$$R_S = \frac{1 - 0.69631}{0.4 \times 10^{-3}}$$

$$\boxed{R_S = 759.225\ \Omega}$$

Now, from (1),

$$V_{GS} = -[0.8 \times 10^{-3} \times 759.225]$$

$$V_{GS} = -0.60738\ V$$

and $g_m = \frac{-2 I_{DSS}}{V_{GSoff}}\left(1 - \frac{V_{GS}}{V_{GSoff}}\right)$ —— (3)

$$g_m = \frac{(-2) \times 1.65 \times 10^{-3}}{(-2)}\left(1 + \frac{0.60738}{(-2)}\right)$$

$$= 1.65 \times 10^{-3}(1 - 0.30368)$$

$$g_m = 1.14891 \times 10^{-3}$$

from eq^n, $g_m = g_{mo}\left[1 - \frac{V_{GS}}{V_{GSoff}}\right)$

So iff $V_{GS} = 0$

$g_m = g_{mo}$ — Max Transconduction

At $V_{GS} = 0$, g_m is maximum.