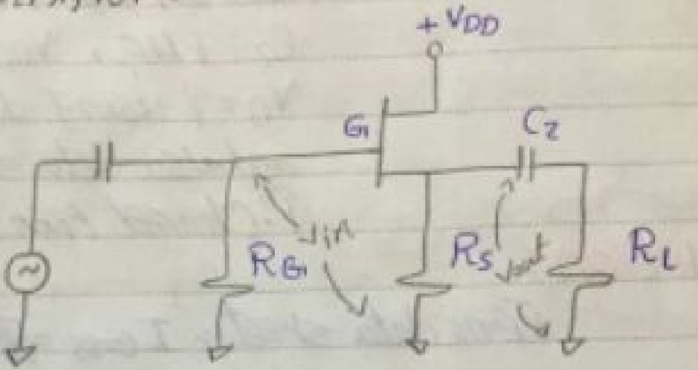
② Common Drain amplifier:



* we dont need R_D as it will connect to ground

* The input is in the gate and the output taken from the source

* Analysis of the circuit

$$A_v = \frac{V_{out}}{V_{in}} = \frac{I_D R_s'}{V_{gs} + I_D R_s'} \qquad R_s' = R_s \parallel R_L$$

$$= \frac{g_m R_s}{1 + g_m R_s} \simeq 1$$

* The output followed the input so it called source forward
 ↳ in amplifier

$$A_i = \frac{I_{out}}{I_{in}} > 1$$

* so common Drain use as current amplifier

$$R_{in} = R_G \parallel R_{in(gate)}$$

Ex3 in the circuit, $C_1 = 0.1\ \mu F$, $R_G = 10M$, $R_S = 1K\Omega$, $C_2 = 1\mu F$, $V_{DD} = 10V$, Determine $V_D = ?$ using data sheet information and also determine $R_{in} = ?$ of P-chanel transistor

Solution

From data sheet: $I_{GSS} = 50\ nA$ at $V_{gs} = 20V$

$$g_m = g_{m0}\left(1 - \frac{V_{gs}}{V_{gs(off)}}\right)^2, \quad g_{m0} = \frac{2 I_{DSS}}{|V_{GS(off)}|}$$

$$R_{in(gate)} = \frac{20}{50} = 0.4\ G\Omega = 400\ M\Omega$$

$$R_{in} \simeq R_G = 10M$$

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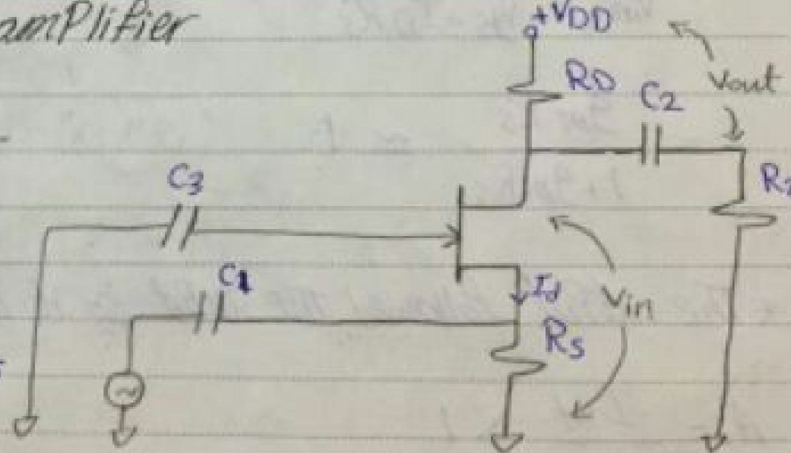
[3] Common Gate amplifier

$$A_V = \frac{V_{out}}{V_{in}} = \frac{I_D R_d}{V_{gs}}$$

$$= g_m R_d > 1$$

$$= \frac{I_D R_d}{I_D R_S}, \quad V_{gs} = I_D R_S$$



* من حيث التحكم على A_v هل هو أكبر من (1) الأسهل هو استخدام صيغة الكسر

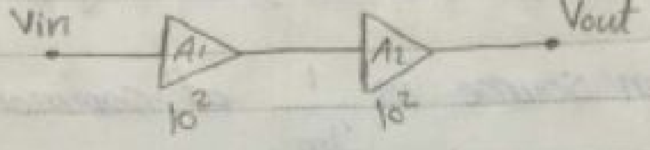
$$A_i = \frac{I_{out}}{I_{in}} \simeq 1, \quad \frac{I_D}{I_S}, \quad I_D \simeq I_S$$

$$R_{in} = \frac{V_{in}}{I_{in}} = \frac{V_{gs}}{I_d} = \frac{V_{gs}/g_m}{} = \frac{1}{g_m}$$

على source

* Low input resistance compare to common drain

* Cascade Amplifier :

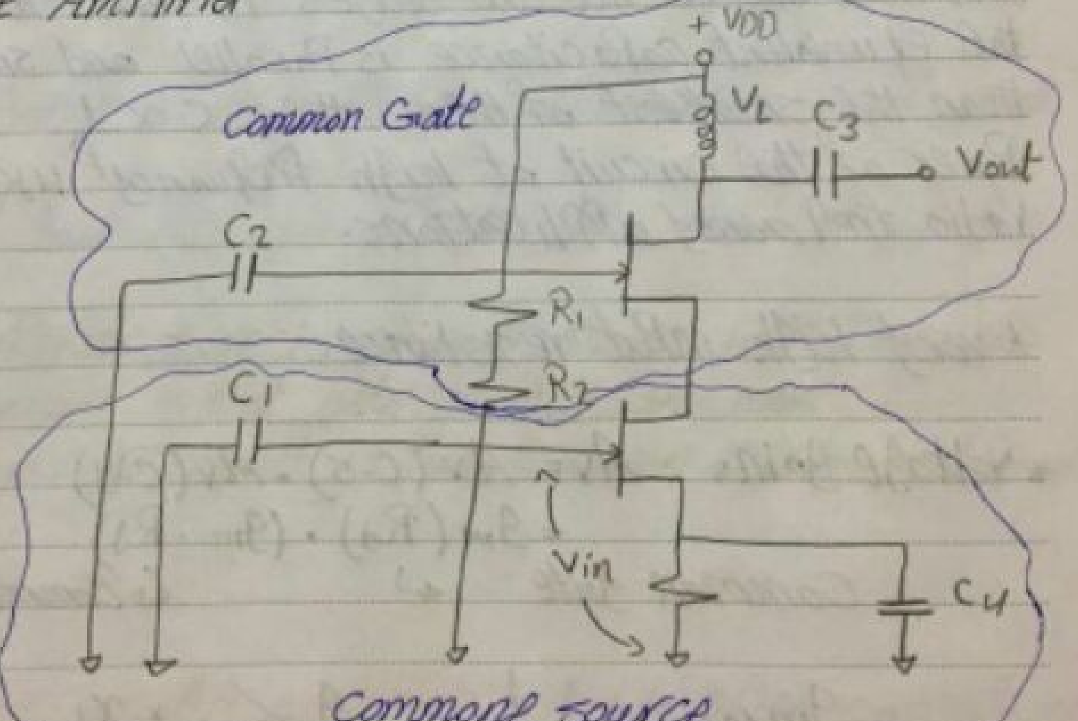


* multistage amplifier

$$A_V = A_{V_1} A_{V_2} = 10^4$$

* Take the output of stage 1 as an input of stage 2

* Cascode Amplifier



* It is a circuit consist of two stages, the first common gate (the output on it) the second is common source (the input on it)

Voltage devider is عبارة عن common gate * تغذية دائرة الدخل R_1, R_2

R_D to common source is $\frac{1}{g_m}$ of common gate

★ The importance of the circuit

Very high voltage gain as it consist of 2 stages and used in radio frequancy applications, very high frequancy and that due to the two stages is series and then the equivalent capacitance is parallel and smaller than the smallest of them, then $C \alpha \frac{1}{f}$ Power of the circuit at high frequancy like radio frequency applications.

* very high input resistance

* Voltage gain: $A_v = A_v(C.S) \cdot A_v(C.g)$

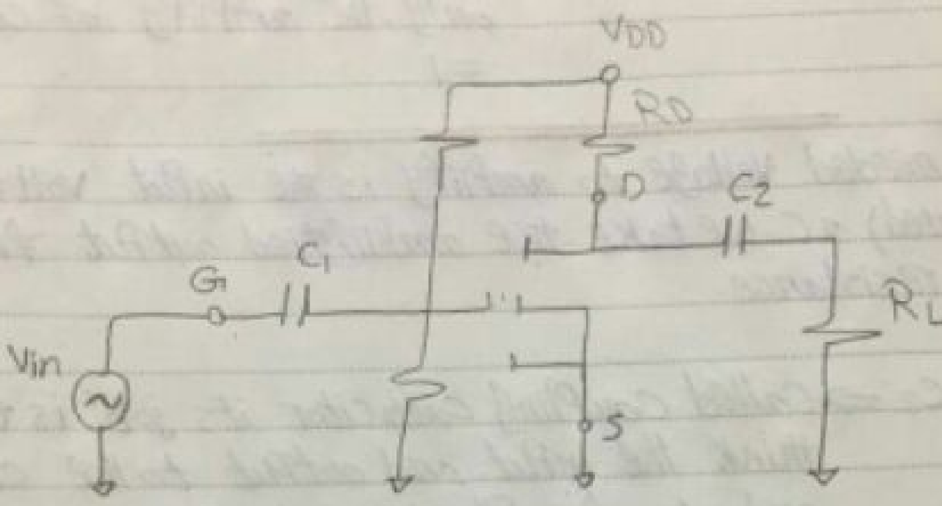
$$= g_m(R_d) \cdot (g_m \cdot R_d)$$

Common gate ↲ ↳ Common source

$$= g_{m(C.S)} \cdot \frac{1}{g_{m(C.g)}} \cdot g_{m(C.G)} * X_L$$

$$A_v = g_{m(C.S)} * X_L$$

FET amplifier



• signal stage amplifier circuit

* The amplifier may be voltage or current or Power

* Voltage gain " voltage ~~amplifier~~ amplification coefficient" A_V

* current gain A_i * Power gain A_P

* the amplifier here is common source FET so the input circuit is that between gate and ~~sour~~ source and the output circuit is that Between Drain and source

There is:

* common Emitter amplifier: it amplified current and voltage

* common collector amplifiers: it amplify current only the amplify of the voltage =1

* common Base amplifier: It amplify source Voltage only, the amplify of current = 1

* The needed Voltage to amplify is the input voltage (alternated) ac, we take the amplified output from a load resistance.

* C_1, C_2 ⇒ called coupling capacitor its job is to think the input and output to the circuit and also for blocking to DC current

* any amplifier circuit we need to determine

A_v, A_i, A_p, input and output impedance.

⇒ to determine the Q point in the amplifier circuit we must do DC analysis

we also calculate the input and output impedance Z_i, Z_o, R_{input}, R_{output}