Tuesday, March 12, 2013
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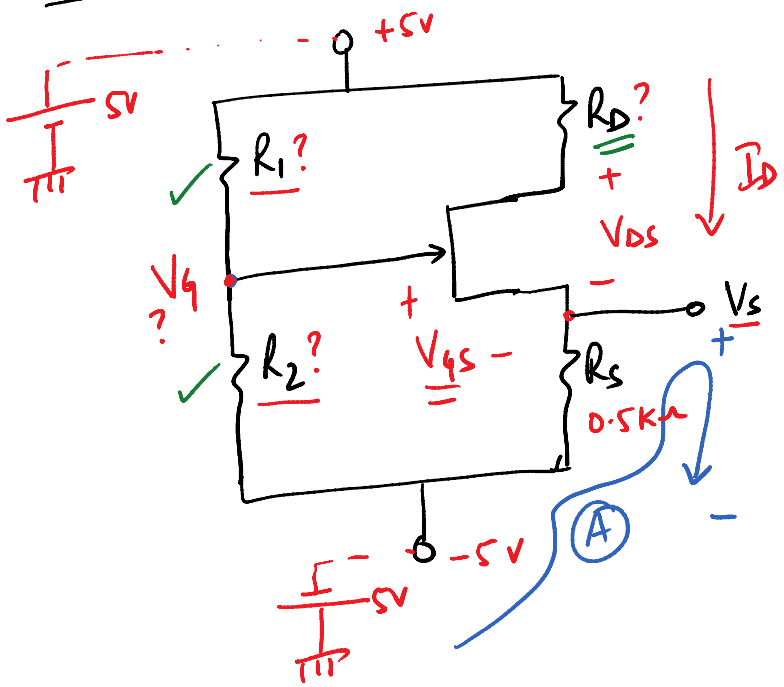
LECTURE - 35

VOLTAGE DIVIDER BIASING CIRCUIT



$I_{DSS} = 12mA$

$V_P = -3.5V$

$R_1 + R_2 = 100k\Omega$

$I_D = 5mA$

$V_{DS} = 5V$

DESIGN

ASSUME TRANSISTOR IS IN SAT.

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

$$5m = 12m\left(1 - \frac{V_{GS}}{-3.5}\right)^2$$

$$V_{GS} = -1.24V$$

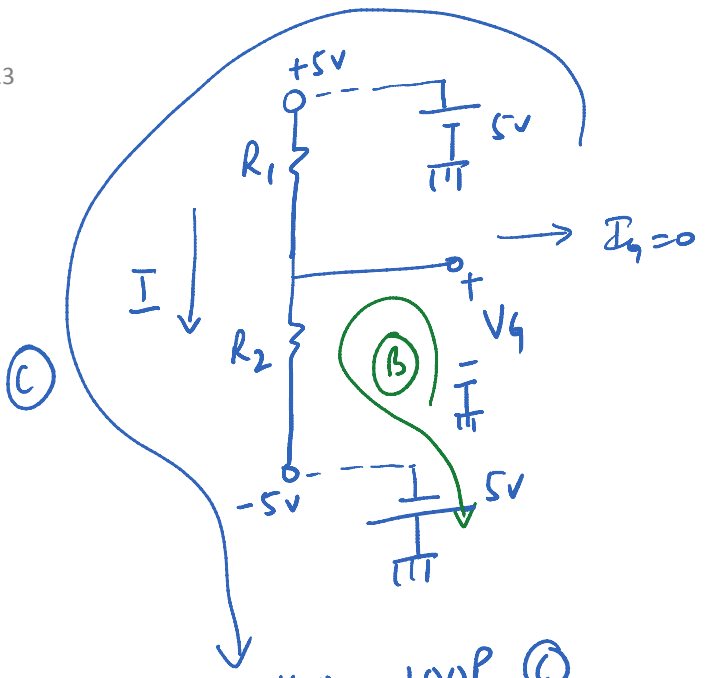
KVL loop (A)

$$5 - I_D R_S + V_S = 0$$

$$V_S = (5m)(0.5k) - 5 = -2.5V$$

$$V_{GS} = V_G - V_S$$

$$V_G = V_{GS} + V_S = -1.24 - 2.5 = -3.74V$$



KVL LOOP (C)

$$-5 + I(R_1 + R_2) - 5 = 0$$

$$I = \frac{10}{R_1 + R_2}$$

KVL LOOP (B)

$$5 - I R_2 + V_g = 0$$

$$V_g = I R_2 - 5$$

$$V_g = \left(\frac{10}{R_1 + R_2}\right) R_2 - 5$$

$$-3.74 = \frac{10}{100K} R_2 - 5 \Rightarrow R_2 = 12.6K\Omega$$

$$R_1 = 87.4K\Omega$$

KVL D-S LOOP

$$-5 + I_D R_D + V_{DS} + I_D R_S - 5 = 0$$

$$R_D = \frac{10 - V_{DS} - I_D R_S}{I_D} = \frac{10 - 5 - (5m)(0.5K)}{5m}$$

I_D sm

$R_D = 0.5\,k\Omega$

$V_{DS(SAT)} = V_{GS} - V_P = -1.24 - (-3.5) = 2.26V$

$V_{DS} = V_{DS(SAT)}$ ∴ TR. IS IN SAT.

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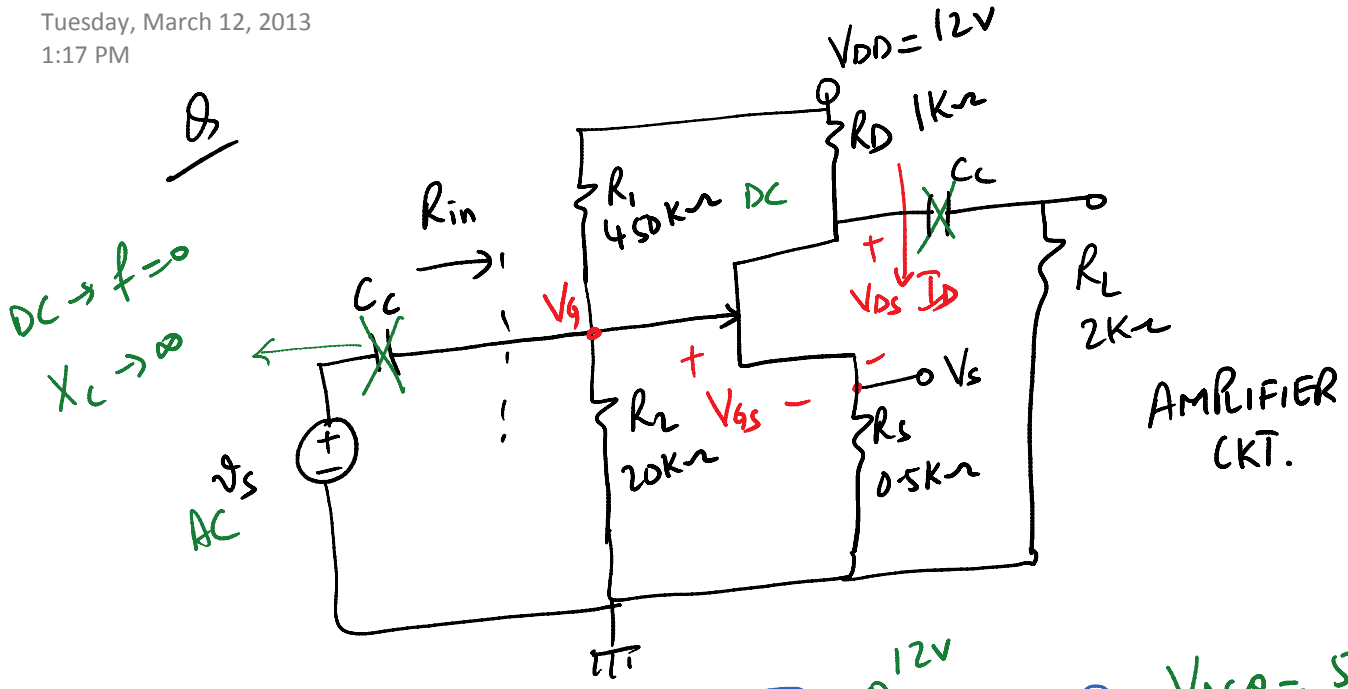
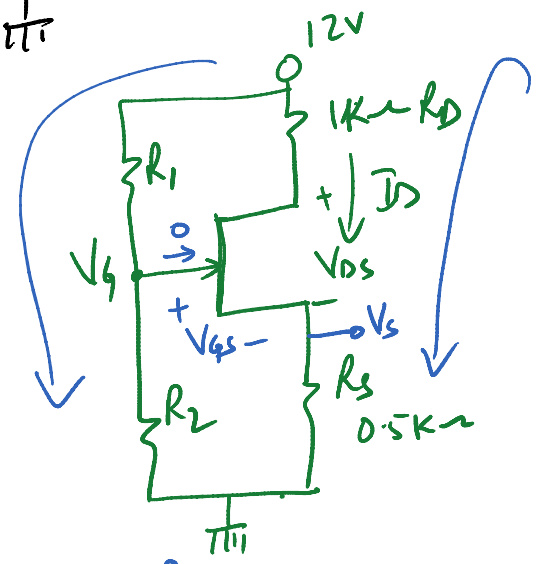
Q3





$V_{DSQ} = 5V$

$I_{DSS} = 10mA$

V_P ?

KVL DS Loop

$$V_{DD} = I_D R_D + V_{DS} + I_D R_S$$

$$I_D = \frac{V_{DD} - V_{DS}}{R_D + R_S} = \frac{12 - 5}{1K + 0.5K} = 4.67mA$$

$$\rightarrow V_S = I_D R_S = (4.67m)(0.5k) = 2.33V$$

$$\rightarrow V_G = V_{DD}\left(\frac{R_2}{R_1 + R_2}\right) = \frac{12\ (20k)}{450k + 20k} = 0.511V$$

$$V_{GS} = V_G - V_S = 0.511 - 2.33 = \underline{\underline{-1.82V}}$$

$$V_{GS} = V_G - V_S = 0.511 - 2.33 = \underline{\underline{-1.82V}}$$

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

$$4.65m = 10m\left(1 - \frac{(-1.82)}{V_P}\right)^2$$

$$V_P = -5.75V$$