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Answer to the Question No. (1)

Here,

$R_B = Id + 10\ k\Omega$

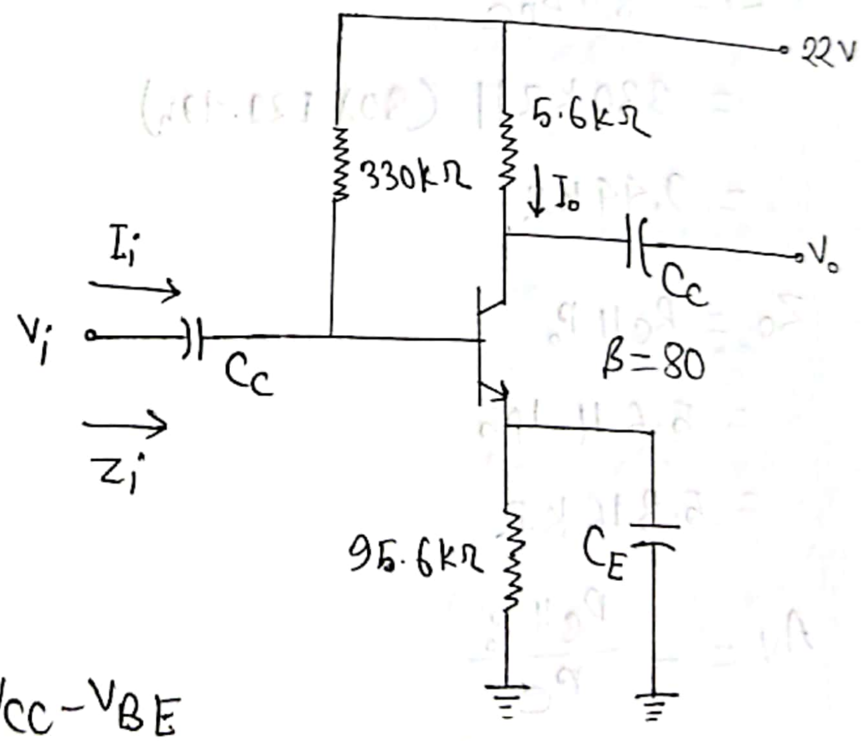
$= (95+10)\ k\Omega$

$= 105\ k\Omega$

$R_E = Id + 0.6\ k\Omega$

$= (95+0.6)\ k\Omega$

$= 95.6\ k\Omega$



For DC;

$$I_B = \frac{V_{CC} - V_{BE}}{R_B + (\beta+1) R_E}$$

$$= \frac{22 - 0.7}{330 + (80+1) \times 95.6}$$

$$= 2.64 \times 10^{-6}\ A$$

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Sub:

$I_E = (\beta+1) I_B$

$= (80+1) \times 2.64 \times 10^{-6}$

$= 0.214\ mA$

$r_e = \frac{26mV}{I_E}$

$= \frac{26}{0.214}$

$= 121.495\ \Omega$

$Z_i = R_B \| \beta r_e$

$= 330\ k\Omega \| (80 \times 121.495)$

$= 9.44\ K\Omega$

$Z_o = R_C \| r_o$

$= 5.6 \| 105$

$= 5.316\ K\Omega$

$A_V = -\frac{R_C \| r_o}{r_e}$

$= -\frac{5.6 \| 105}{121.495 \times 10^{-3}}$

$= -43.77$

(Answer)

Sub :

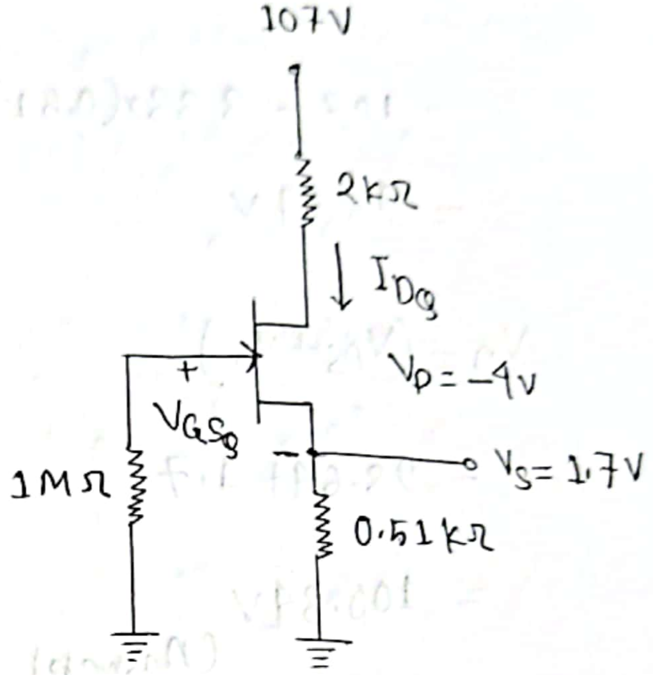
Answer to the Question No.(2)

Here,

$V_{DD} = 10+12\ V$

$= (95+12)V$

$= 107V$



$I_D = \frac{V_S}{R_S}$

$= \frac{1.7V}{0.51k\Omega}$

$= 3.3mA$

We know, $I_D = \frac{I_{DSS}}{2}$

$\Rightarrow I_{DSS} = 2 \times I_D$

$= 2 \times 3.33$

$= 6.66$

$V_{GS} = -I_D R_S$

$= -(3.33mA \times 0.51k\Omega)$

$= -1.698\ V$

$I_{DQ} = 1.7mA$

$V_{GSQ} = -1.7V$

Sub :

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Figure:-

$$V_{DS} = V_{DD} - I_D (R_S + R_D)$$

$$= 107 - 3.33 \times (0.51 * 2)$$

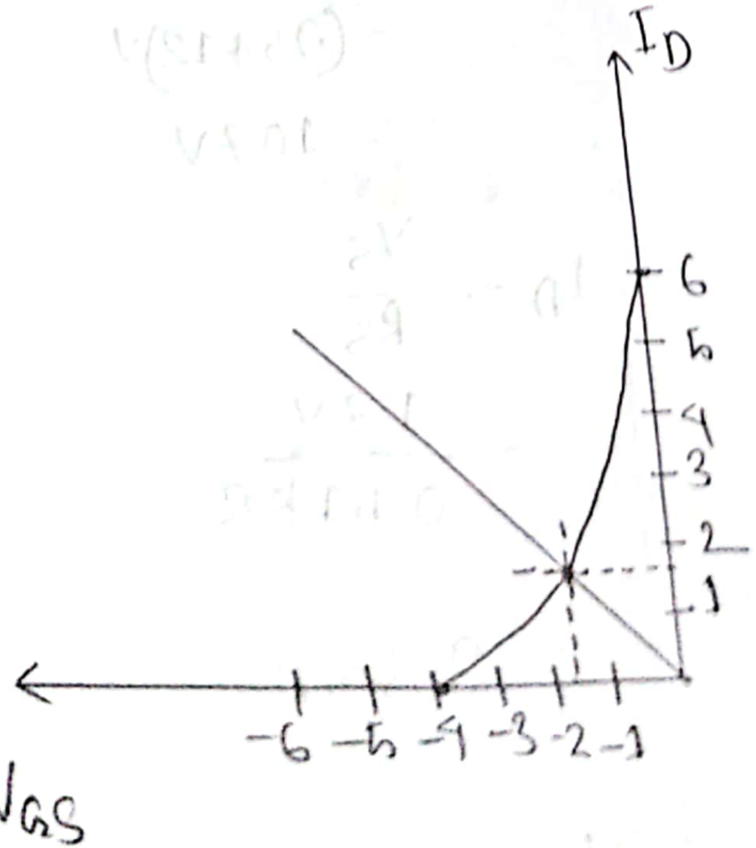
$$= 98.64\ V$$

$$V_D = (V_{DS} + V_S)$$

$$= 98.64 + 1.7$$

$$= 100.34\ V$$

(Answer)



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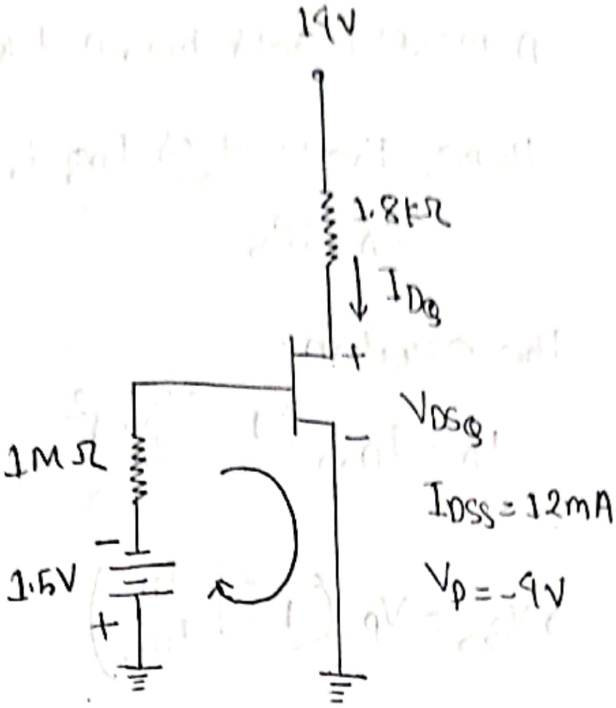
Answer to the Question No.(3)

Here,



Applying KVL,

$-V_{GG} - V_{GSQ} = 0$

$\Rightarrow V_{GSQ} = -V_{GG}$

$= -1.5V$

We know,

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

$= 12mA \times \left(1 - \frac{(-1.5)}{(-4V)}\right)^2$

$= 4.6875 mA$

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

$= 14 - (4.6875 \times 1.8)$

$= 5.5625V$

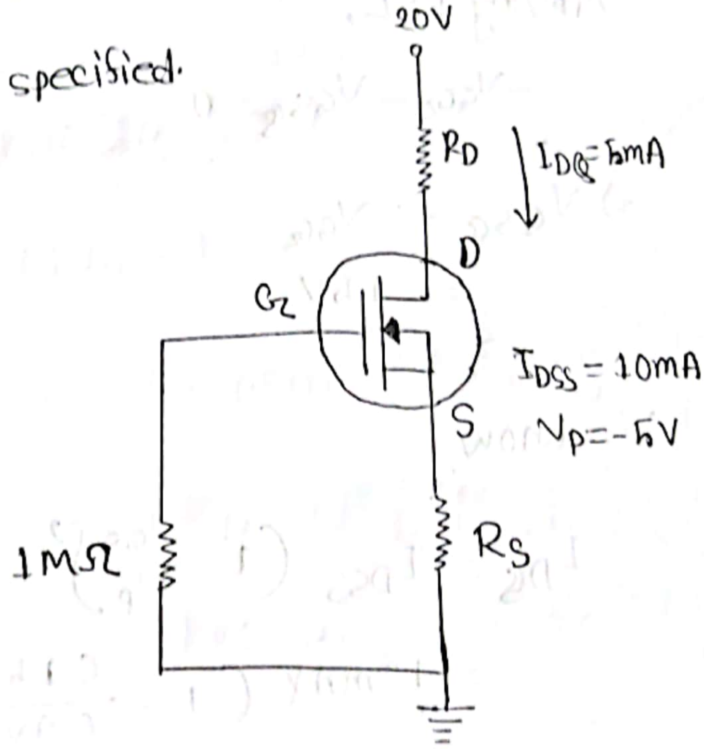
(Answer)

Answer to the Question No.(4)

D-MOSFET self-bias network:

Here, the level of I_{DQ} is specified.

$R_D = 3R_S$



The equation:

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

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

$$= -5 \times \left(1 - \sqrt{\frac{5}{10}}\right)$$

$$= -1.4645 V$$

So, $R_S = \dfrac{V_{GS}}{-I_D}$

$$= \frac{-1.4645}{-5}$$

$$= 0.2929 k\Omega$$

$R_D = 3R_S$

$= 3 \times 0.2929$

$= 0.8787 k\Omega$ (Answer)

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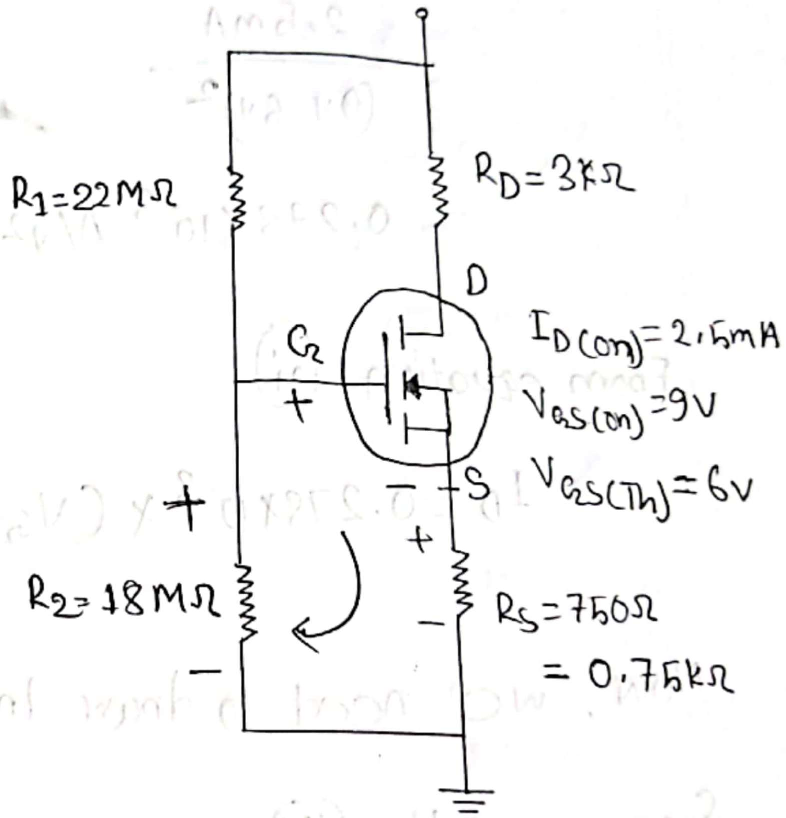
Answer to the Question No.(5)

E-MOSFET Voltage Divider configuration:-



Here,

$V_{DD} = ID + 12\ V$

$= (95+12)\ V$

$= 107V$

$$V_G = \frac{R_2 \times V_{DD}}{R_1 + R_2}$$

$$= \frac{18 \times 107}{(22+18) M\Omega}$$

$= 48.15\ V$

Applying KVL,

$+V_G - V_{GS} - I_D R_S = 0$

$\Rightarrow V_{GS} = V_G - I_D R_S$

$\Rightarrow V_{GS} = V_G - I_D(0.75k\Omega)$ ....(i)

We know, $I_D = k(V_{GS} - V_T)^2$

$\therefore I_D = k(V_{GS} - 6V)^2$ ....(ii)

Now, $k = \frac{I_{D(on)}}{(V_{GS(on)} - V_T)^2}$

$= \frac{2.5mA}{(9V-6V)^2}$

$= 0.278 \times 10^{-3}\ A/V^2$

From equation (ii)

$I_D = 0.278 \times 10^{-3} \times (V_{GS} - 6V)^2$ ----- (iii)

Now, we need to draw transfer characteristics curve

from equation (iii)

From equation (iii)

let $V_{GS} = 10V$

$I_D = 0.278 \times 10^{-3} \times (10V - 6V)^2 = 4.4mA$

let $V_{GS} = 15V$

$I_D = 0.278 \times 10^{-3} \times (15V - 6V)^2 = 22.5mA$

let $V_{GS} = 20V$

$I_D = 0.278 \times 10^{-3} \times (22V - 6V)^2 = 54.4mA$

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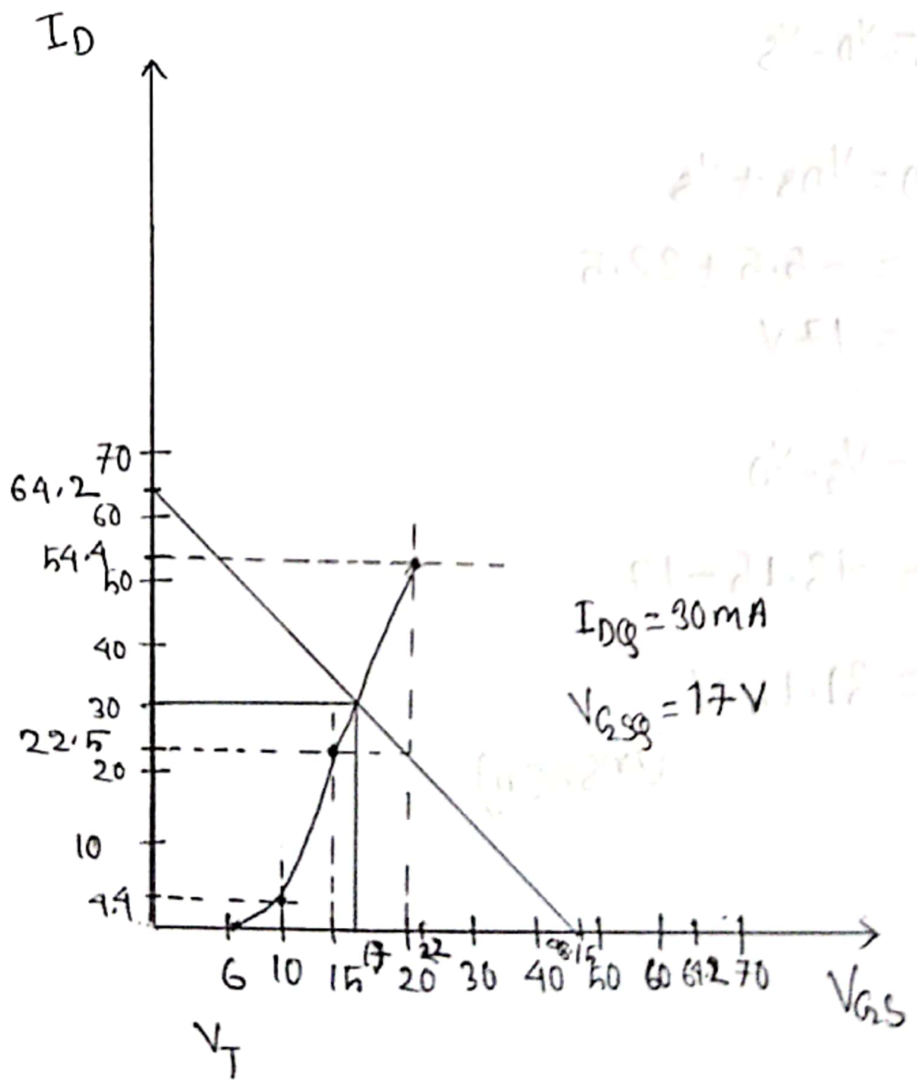
Now, from equation (i)

$$V_{GS} = 48.15\,V - I_D(0.75\,k\Omega)$$

let, $I_D = 0\,A$, $\therefore V_{GS} = 48.15\,V$

let, $V_{GS} = 0\,V$, $\therefore I_D = \dfrac{48.15}{0.75}$

$= 64.2\,mA$



$V_{DS} = V_{DD} - I_D(R_D + R_S)$

$= 107 - 30\,(3 + 0.75)$

$= -5.5\,V$

$V_S = I_D R_S$

$= 30\,mA \times 0.75\,k\Omega$

$= 22.5\,V$

$V_{DS} = V_D - V_S$

$\Rightarrow V_D = V_{DS} + V_S$

$= -5.5 + 22.5$

$= 17\,V$

$V_{GD} = V_G - V_D$

$= 48.15 - 17$

$= 31.15\,V$

(Answer)