Friday, February 08, 2013
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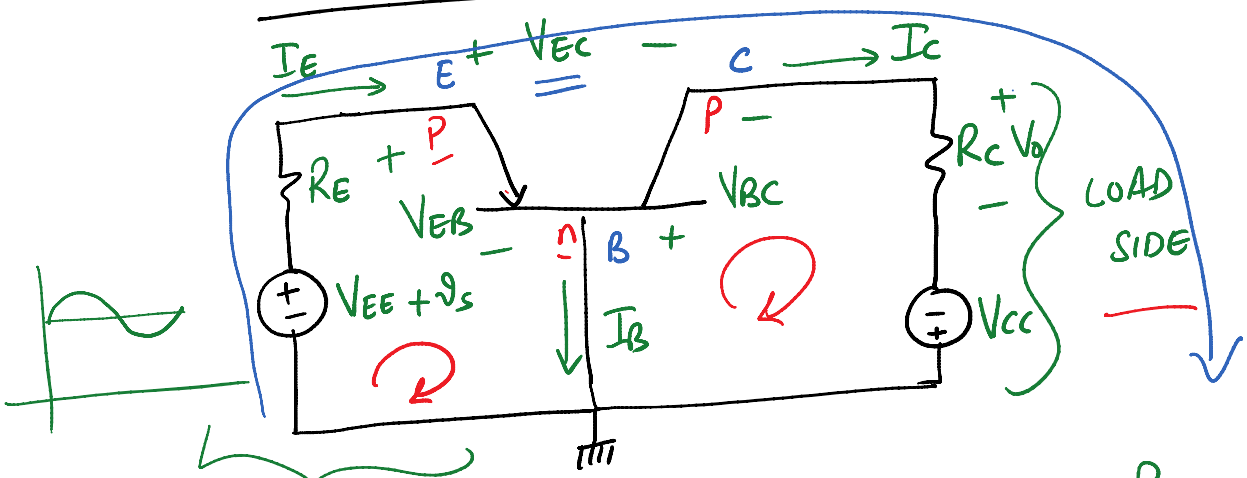
LECTURE – 25

COMMON BASE BJT CIRCUIT ANALYSIS



DC ANALYSIS TO FIND OPERATING POINT (V_{EC}, I_C)

KVL EMITTER BASE (EB) LOOP

$\vartheta_s = 0$
NO AC
ONLY DC

$$-V_{EE} + I_E R_E + V_{EB} = 0$$

$$I_E = \frac{V_{EE} - V_{EB}}{R_E}$$

IF $V_{EB} = V_{to}$

$$\therefore \quad I_E = \frac{V_{EE} - V_{to}}{R_E}$$

$\beta \leftarrow$ GIVEN
↳ FROM DATA SHEET

$$I_B = \frac{I_C}{\beta}$$

$$I_C = \alpha I_E \qquad \frac{I_C}{I_E} = \alpha$$

KVL EC LOOP

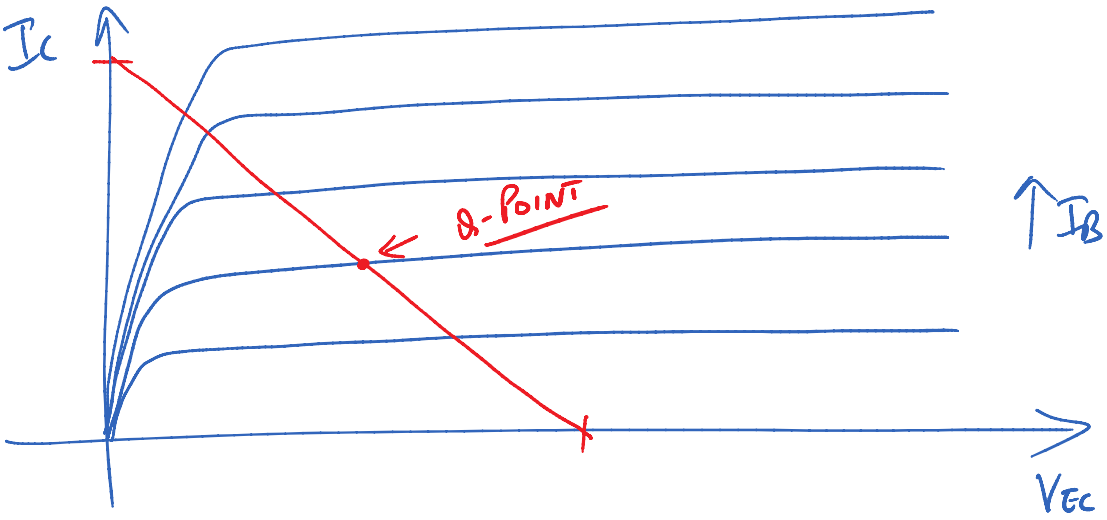
$$V_{EC} + I_E R_E + V_{EE} + I_C R_C - V_{CC} = 0$$

$$-V_{EE} + I_E R_E + V_{EC} + I_C R_C - V_{CC} = 0$$

$$V_{EC} = V_{CC} + V_{EE} - I_E R_E - I_C R_C$$

→ LOAD LINE EQUATION

IV CURVE



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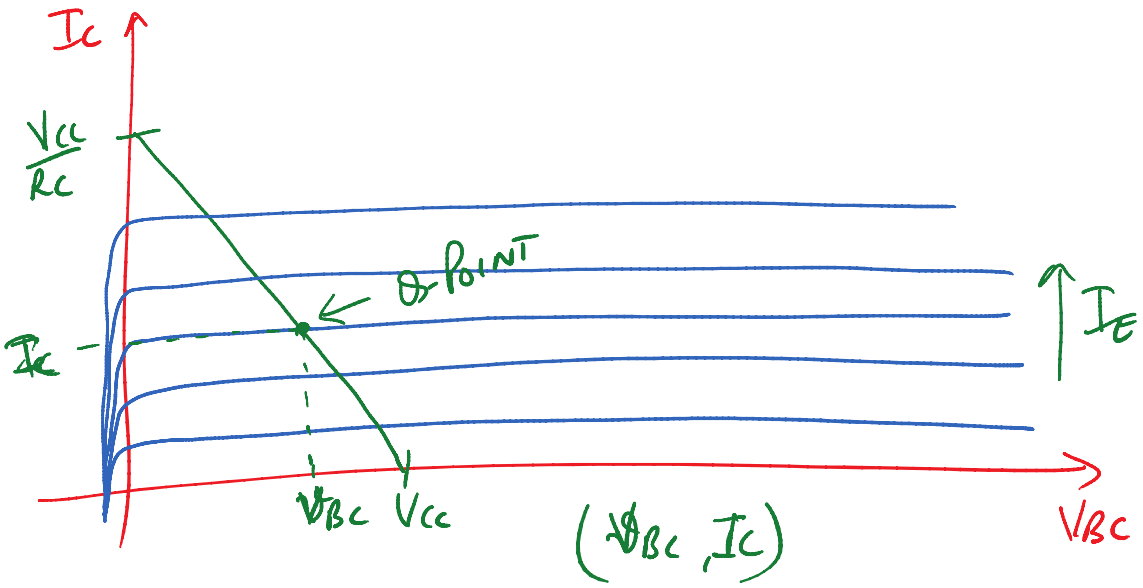
KVL BC LOOP

$$V_{BC} + I_C R_C - V_{CC} = 0$$

$$V_{BC} = V_{CC} - I_C R_C \longrightarrow \text{LOAD LINE EQUATION}$$



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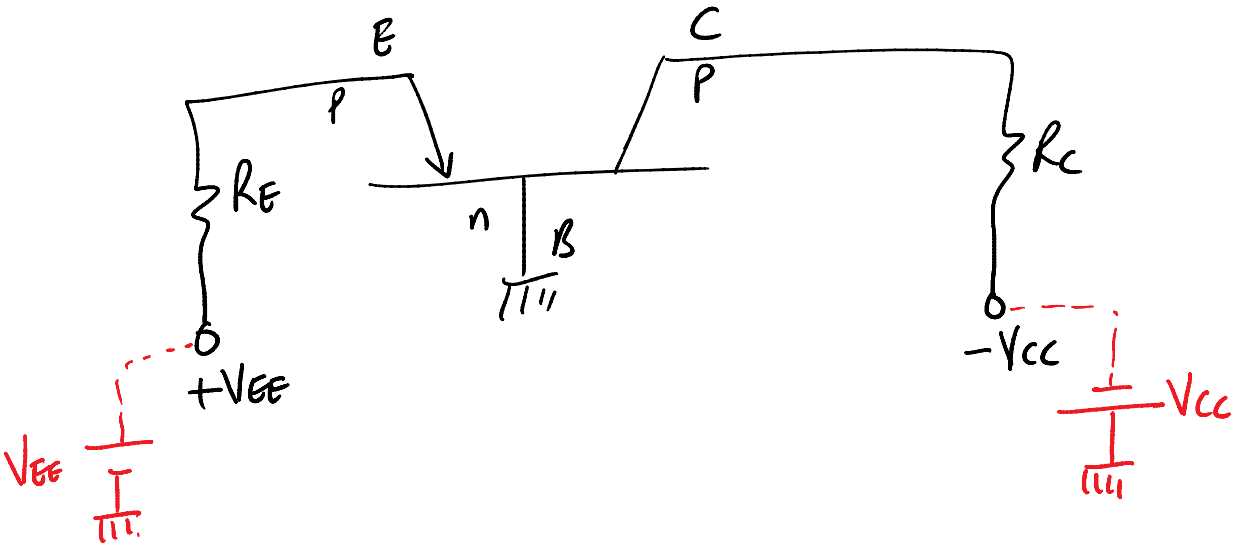
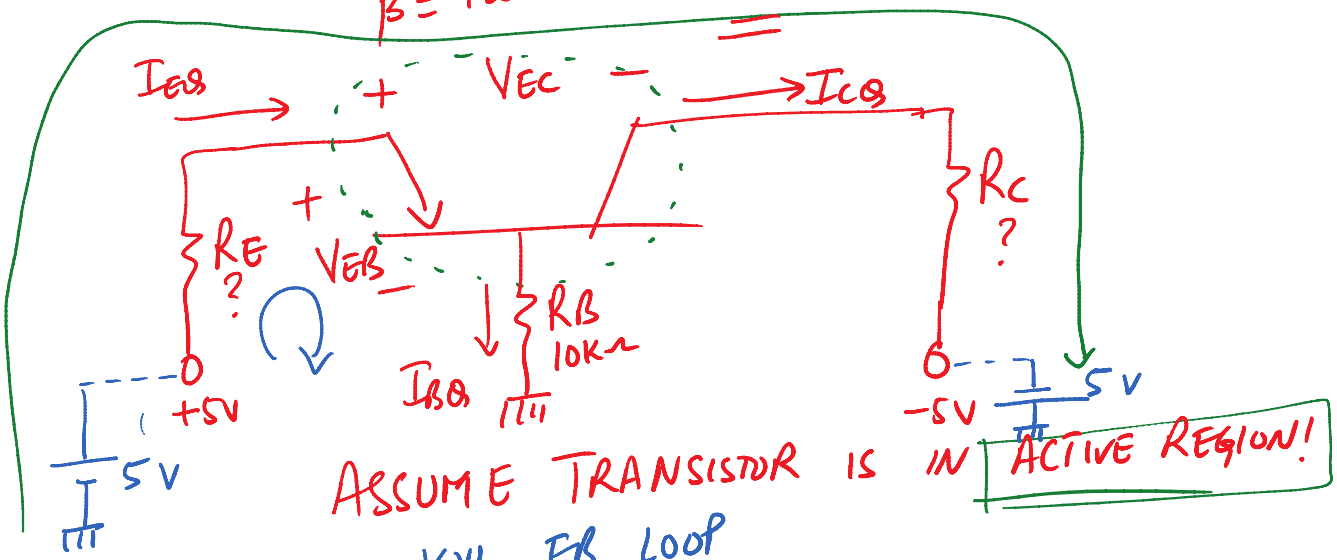


Ex

DESIGN A CB CIRCUIT

$I_{EQ} = 0.5mA$ $\quad V_{ECQ} = 4V > V_{EC(SAT)}$ 0.2-0.3V

$\beta = 120$ $\quad V_{EB(ON)} = 0.7V$



ASSUME TRANSISTOR IS IN ACTIVE REGION!

KVL EB LOOP

$$-5 + I_{EQ}R_E + V_{EB} + I_{BQ}R_B = 0 \quad \cdots (1)$$

KCL TRANSISTOR NODE

$$-I_{EQ} + I_{BQ} + I_{CQ} = 0$$

$I_{CQ} = \beta I_{BQ}$

ONLY VALID IN ACTIVE REGION

$$-I_{EQ} + I_{BQ} + \beta I_{BQ} = 0$$

$$I_{BQ} = \frac{I_{EQ}}{1+\beta} \quad - (2)$$

SUBSTITUTE (2) IN (1)

$$5 = I_{EQ}R_E + V_{EB} + \frac{I_{EQ}}{1+\beta}R_B$$

$$= (0.5m)R_E + 0.7 + \left(\frac{0.5m}{}\right)(10K)$$

(121)

$\therefore R_E = 8.52\,k\Omega$

$I_{CQ} = \alpha I_{EQ}$ $\qquad \alpha = \frac{\beta}{1+\beta}$

KCL TRANSISTOR NODE

$I_{EQ} = I_{BQ} + I_{CQ}$

$= \frac{I_{CQ}}{\beta} + I_{CQ} = I_{CQ}\left(\frac{1}{\beta} + 1\right)$

$\therefore \boxed{I_{CQ} = \frac{\beta}{1+\beta} I_{EQ}} = \frac{120}{121}(0.5m)$

$= 0.496mA$

KVL EC LOOP

$-5 + I_{EQ} R_E + V_{ECQ} + R_C I_{CQ} - 5 = 0$

$-5 + (0.5m)(8.52K) + 4 + R_C(0.496mA) - 5 = 0$

$\therefore R_C = 3.51\,k\Omega$