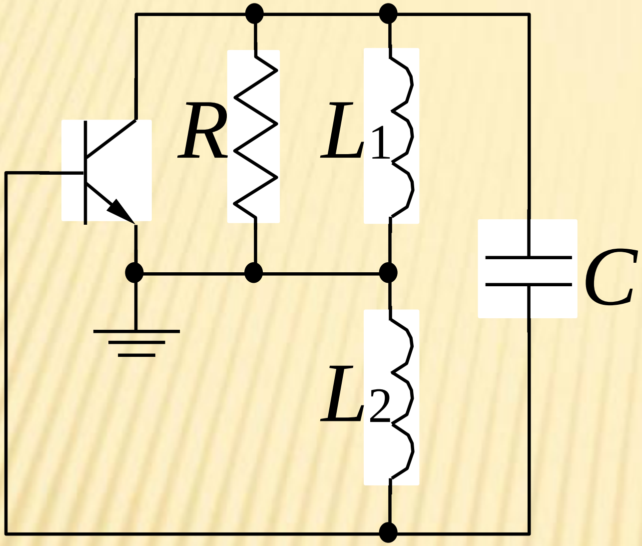
LECTURE 8 OSCILLATOR

- Introduction of Oscillator
- Linear Oscillator
  - LC Oscillator

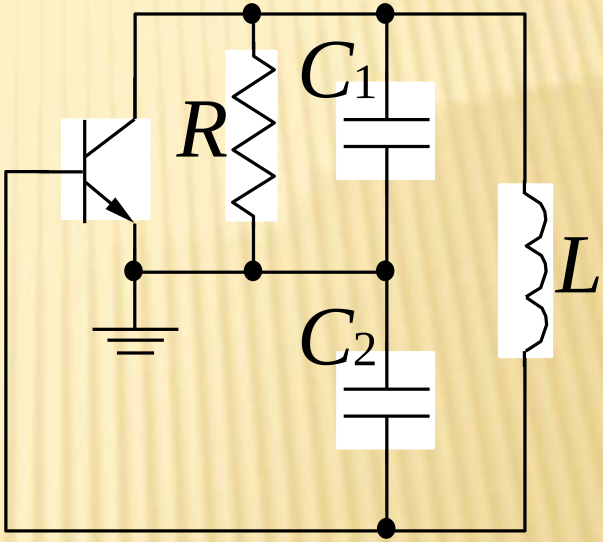
Hartley Oscillator



$$\omega_o = \frac{1}{\sqrt{(L_1 + L_2)C}}$$

$$g_m = \frac{L_1}{RL_2}$$

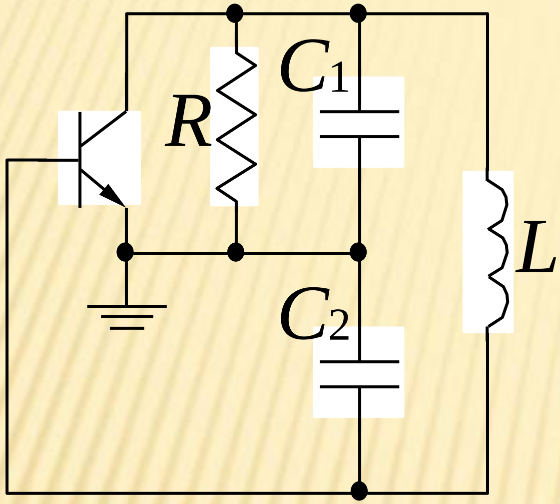
Colpitts Oscillator

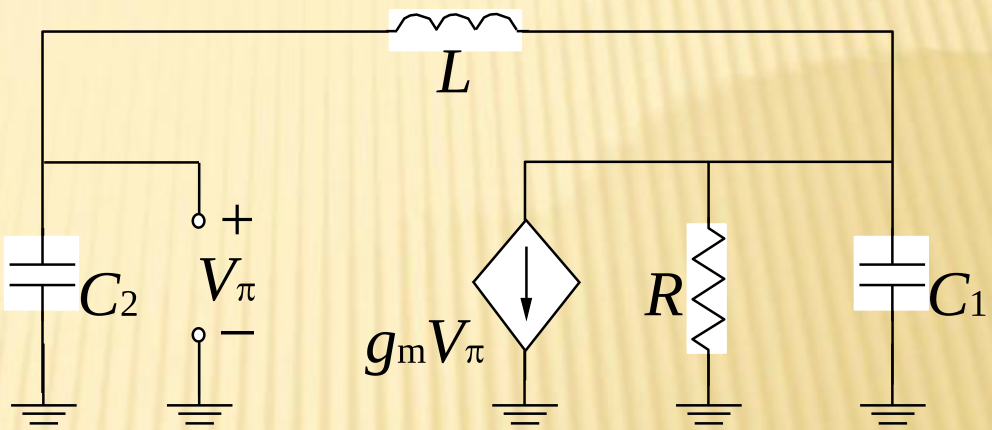


$$\omega_o = \frac{1}{\sqrt{LC_T}} \qquad C_T = \frac{C_1 C_2}{C_1 + C_2}$$

$$g_m = \frac{C_2}{RC_1}$$

COLPITTS OSCILLATOR





In the equivalent circuit, it is assumed that:

- Linear small signal model of transistor is used
- The transistor capacitances are neglected
- Input resistance of the transistor is large enough

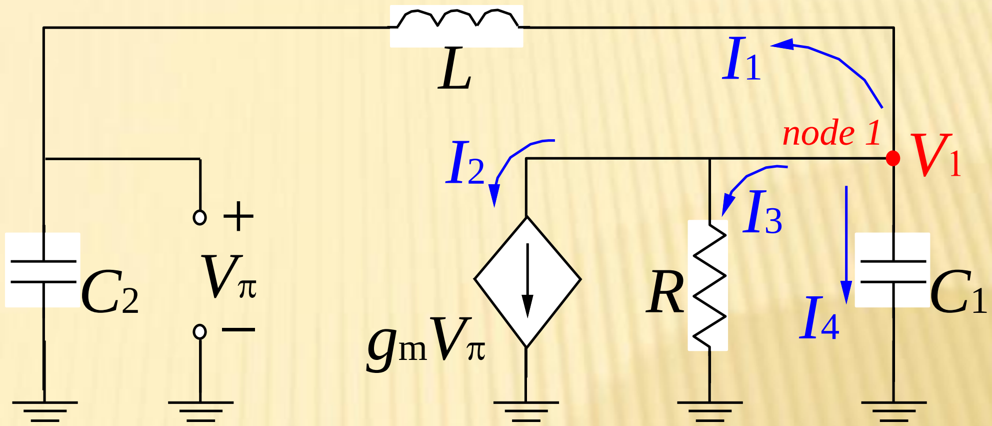
At node 1,

$$V_1 = V_\pi + i_1(j\omega L)$$

where,

$$i_1 = j\omega C_2 V_\pi$$

$$\Rightarrow \; V_1 = V_\pi(1-\omega^2 LC_2)$$



Apply KCL at node 1, we have

$$j\omega C_2 V_\pi + g_m V_\pi + \frac{V_1}{R} + j\omega C_1 V_1 = 0$$

$$j\omega C_2 V_\pi + g_m V_\pi + V_\pi(1-\omega^2 LC_2)\left(\frac{1}{R} + j\omega C_1\right) = 0$$

For Oscillator V_π must not be zero, therefore it enforces,

$$\left(g_m + \frac{1}{R} - \frac{\omega^2 LC_2}{R}\right) + j\left[\omega(C_1 + C_2) - \omega^3 LC_1C_2\right] = 0$$

$$\left(g_m + \frac{1}{R} - \frac{\omega^2 LC_2}{R}\right) + j\left[\omega(C_1 + C_2) - \omega^3 LC_1C_2\right] = 0$$

Imaginary part = 0, we have

$$\omega_o = \frac{1}{\sqrt{LC_T}} \qquad C_T = \frac{C_1C_2}{C_1 + C_2}$$

Real part = 0, yields

$$g_m = \frac{C_2}{RC_1}$$