Department of ECE

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Subject :– Analog circuit.
(EC- 2nd yr, 4th sem)

Query Time :→ 03:00 pm – 04:00 pm.

Wien Bridge oscillator (RC oscillator) (64)

→ A Wien bridge oscillator is a electronic oscillator that generates sine waves.

→ it is developed by Max Wien in 1891 for the measurement of impedence.

→ This oscillator is also ~~an~~ RC oscillator which uses ~~ween~~ wien bridge circuit as a feedback network.

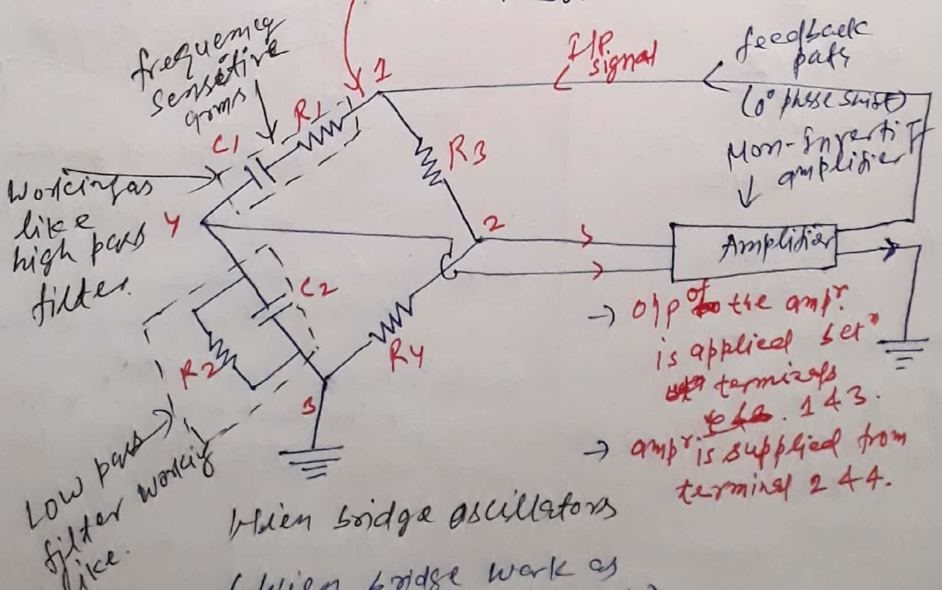
→ The bridge circuit does not introduce any phase shift. or [0° phase shift].

→ The bridge ckt consists four resistors & Two capacitors.

→ Therefore, the amplifier that we are using in This oscillator is [non- inverting] amplifier which does not introduce any phase shift. ~~0° phase shift.~~

wien bridge → feedback n/w ckt

0° or 360°



Wien bridge oscillators

(Wien bridge work as as a feedback network)

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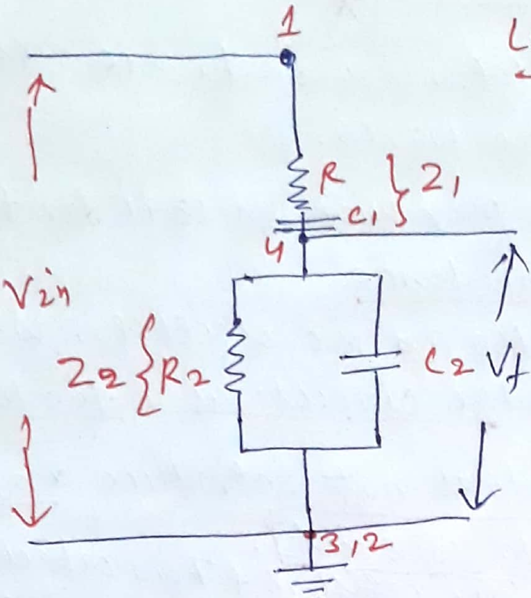
Lead-Lag Network



$$Z_1 = R_1 + \frac{1}{j\omega C_1}$$

| $Z_1 \to$ impedence

$$Z_1 = \frac{1 + j\omega R_1 C_1}{j\omega C_1}$$

&

$$Z_2 = \frac{R_2 \times \frac{1}{j\omega C_2}}{R_2 + \frac{1}{j\omega C_2}} = \frac{R_2}{1 + j\omega R_2 C_2}$$

$$f = \frac{1}{2\pi\sqrt{R_1R_2C_1C_2}}$$

if $R_1 = R_2 = R$ & $C_1 = C_2 = C$ then

$$f = \frac{1}{2\pi\sqrt{R \cdot R \cdot C \cdot C}}$$

$$\boxed{f = \frac{1}{2\pi RC}\ Hz}$$ Proved.

$$I = \frac{V_{in}}{Z_1 + Z_2} = \frac{V_{in}}{Z}$$

| $V = IR$
$\therefore I = \frac{V}{R} = \frac{V}{Z}$
| $Z_1 + Z_2 = Z$.

$$\therefore V_f = I \times Z_2$$

$$= \frac{V_{in}}{Z_1 + Z_2} \times Z_2$$

$$v_f = \frac{Z_2}{Z_1 + Z_2} \cdot V_{in}$$

we know that

$$v_f = \beta V_{in}$$

$$\therefore \beta = \frac{v_f}{V_{in}}$$

| $V_f = \beta V_o$ $\downarrow$ V_{in}

$$\beta = \frac{\frac{Z_2}{Z_1 + Z_2} \cdot \cancel{V_{in}}}{\cancel{V_{in}}} = \frac{Z_2}{Z_1 + Z_2}$$

$$\beta = \frac{Z_2}{Z_1 + Z_2} = \frac{\frac{R_2}{1 + j\omega R_1 C_1}}{\frac{1 + j\omega R_1 C_1}{j\omega C_1} + \frac{R_2}{1 + j\omega R_2 C_2}}$$

$$\therefore \beta = \frac{j\omega R_2 C_1}{1 - \omega^2 R_1 R_2 C_1 C_2 + \cancel{j\omega R_1 C_1} + j\omega(R_1C_1 + R_2C_2 + R_2C_1)}$$

after ~~rationalization~~, rationalizing and simplifying.

$$\beta = \frac{\omega^2 C_1 R_2 (R_1C_1 + R_2C_2 + C_1R_2) + j\omega C_1 R_2 (1 - \omega^2 R_1R_2C_1C_2)}{(1 - \omega^2 R_1R_2C_1C_2) + \omega^2 (R_1C_1 + R_2C_2 + C_1R_2)^2}$$

$$\boxed{\frac{1}{a-b} \times \frac{a+b}{a+b}}$$ rationalizing form.

for $0°$ phase, imaginary part $= 0$,
$\omega \neq 0$,

$$C_1 R_2 \omega (1 - \omega^2 R_1R_2C_1C_2) = 0$$

$$\omega (1 - \omega^2 R_1R_2C_1C_2) = 0$$

$$\cancel{\omega} = \omega^2 R_1R_2C_1C_2$$

$$\omega^2 = \frac{1}{R_1R_2C_1C_2}$$

$$\therefore \omega = \frac{1}{\sqrt{R_1R_2C_1C_2}}$$

$$2\pi f = \frac{1}{\sqrt{R_1R_2C_1C_2}}$$

$$\therefore f = \frac{1}{2\pi\sqrt{R_1R_2C_1C_2}}$$