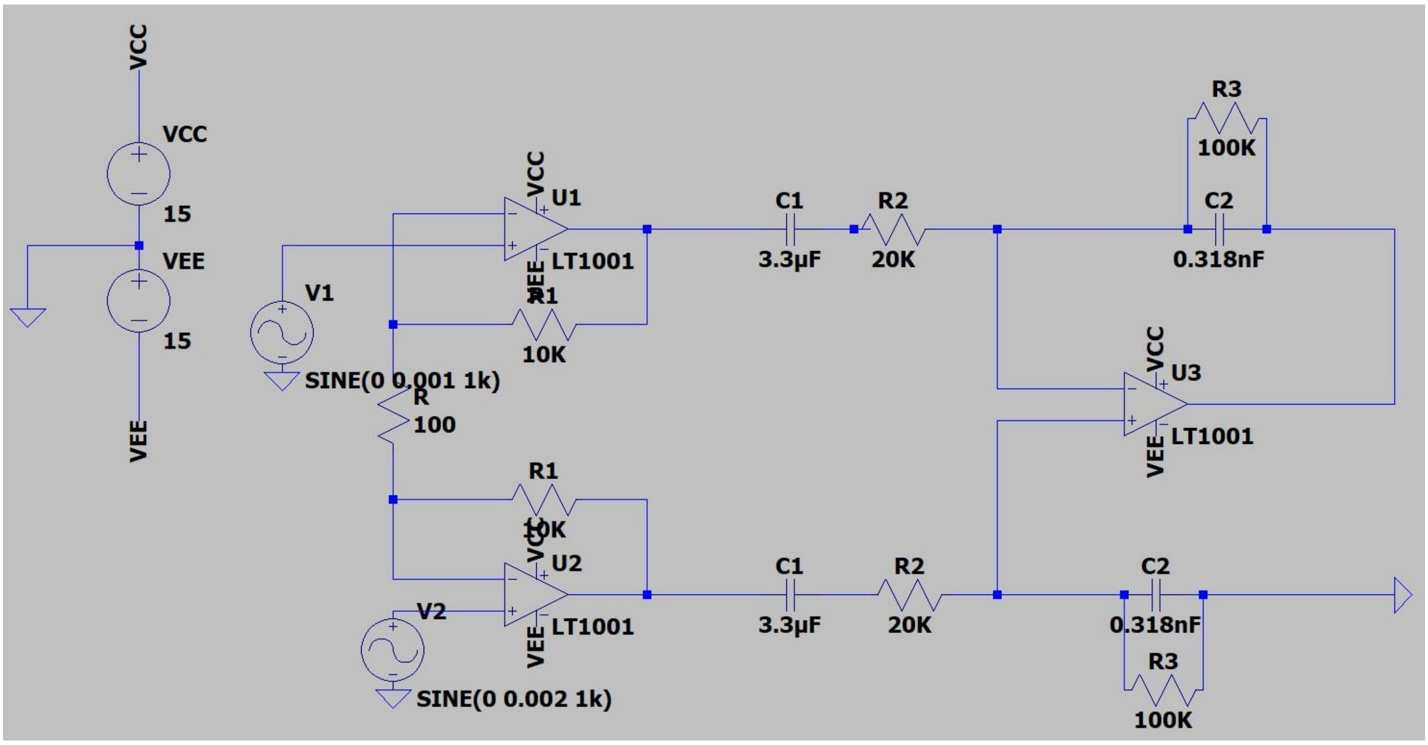
A High Gain and High CMRR Instrumentation Amplifier for Biomedical Applications

CIRCUIT DIAGRAM



DESIGN:

$$G = \left(1 + \frac{2R1}{Rg}\right)\left(\frac{R3}{R2}\right)$$

For Gain of **1000**,

Choose the resistor values as **R1 =10k*Ω*, R2 =20K*Ω*, R3=100K*Ω*, Rg=100*Ω***

(By changing Rg, we can achieve desired Gain)

- Gain of First , 2 opamplifiers (act like buffer)

$$A_v = \left(1 + \frac{2R1}{R2}\right) = 201$$

- **<u>C1:</u> C1** blocks the dc offset at the input act as a short circuit (Forms a High pass Filter (**HPF)**)

To allow low frequency AC signal impedance of capacitance C1,

$$\mathbf{Z_{c1} \leq 0.01R1 = 0.01*(10K) = 100\ \Omega}$$

$$C1 = \frac{1}{2\pi f Z_{C1}} = \frac{1}{2\pi(1k*100)} = 3.3\mu F$$

- **<u>C2:</u> C2** supresses the noise at high frequency (In this case **5kHz**)

$$C2 = \frac{1}{2\pi f R3} = \frac{1}{2\pi(5k*100k)} = 0.318nF$$

<u>CMRR</u>

$$CMRR = 20\ log\frac{A_d}{A_{cm}} = 20log\frac{1000}{0.001} = 120dB$$

<u>ADVANTAGES</u>

High CMRR: Rejects noise from power lines and other interference sources, critical for biomedical signals.

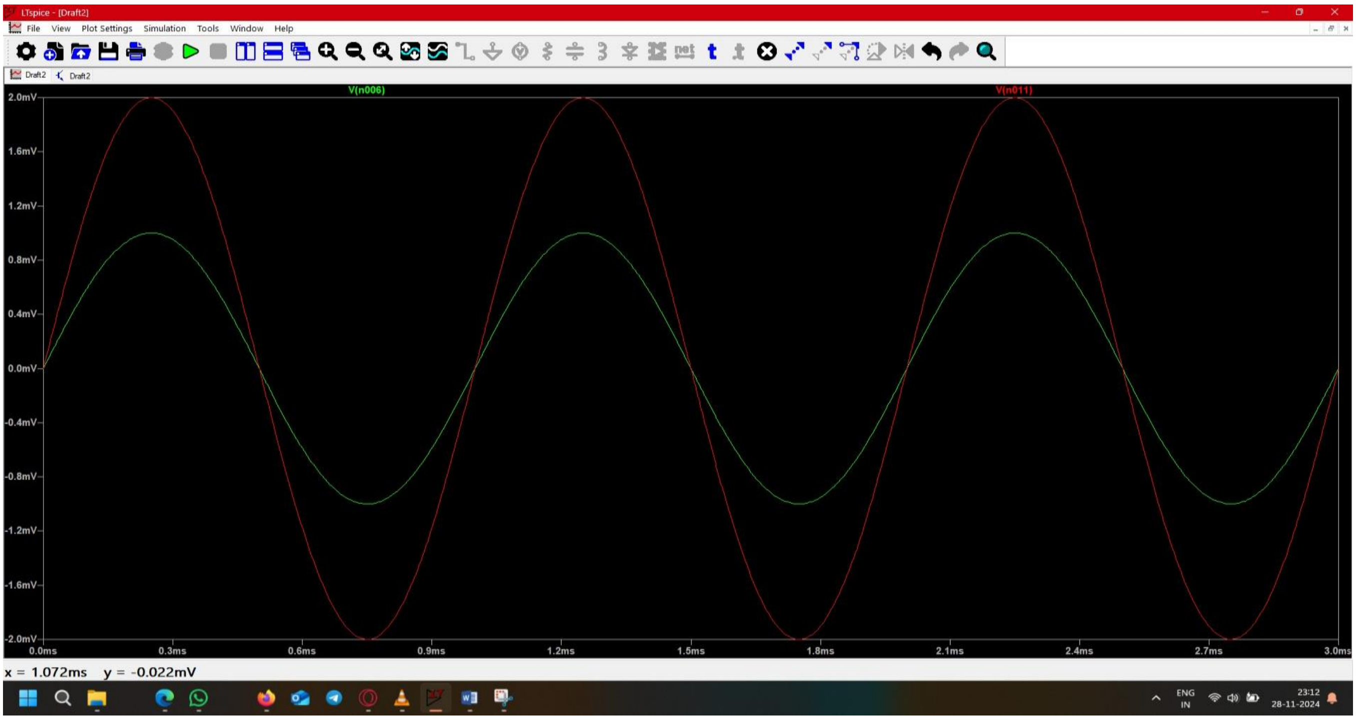
High Gain: Amplifies weak biomedical signals like ECG or EEG.

Offset Elimination: Input capacitors block DC offsets, maintaining signal integrity.

Stability: Feedback capacitors improve high-frequency stability and reduce noise.

<u>SIMULATION RESULTS</u>

<u>Input Wave forms (V1 , V2)</u>



$V_{out:}$ Wave Form