Title of the experiment

Analysis of Analog multiplier circuit using eSim.

Theory:

An analog multiplier is a device that produces an output voltage or current that is proportional to the product of two or more independent input voltage or current. The analog multiplier is designed using log and antilog amplifier. A log amplifier can be constructed using a bjt in the feedback to the opamp. The output of log amplifier is dependent on the saturation current which varies from transistor to transistor and also with temperature. Antilogarithmic or exponential amplifier does the exact opposite operation of a log amplifier.
In analog amplifier the two inputs are given in the form of voltages to log amplifier respectively. The output voltage from the log amplifier are added and inverted by the unity gain summing amplifier. Also, the voltage of 0.5653 is added to the summing amplifier. Output of summing amplifier is given to the antilog amplifier. The output at antilog amplifier is the multiplication of two inputs but it is in inverted form. So we are using an inverting amplifier to get the desired output. The final output is V0 = kV1*V2.

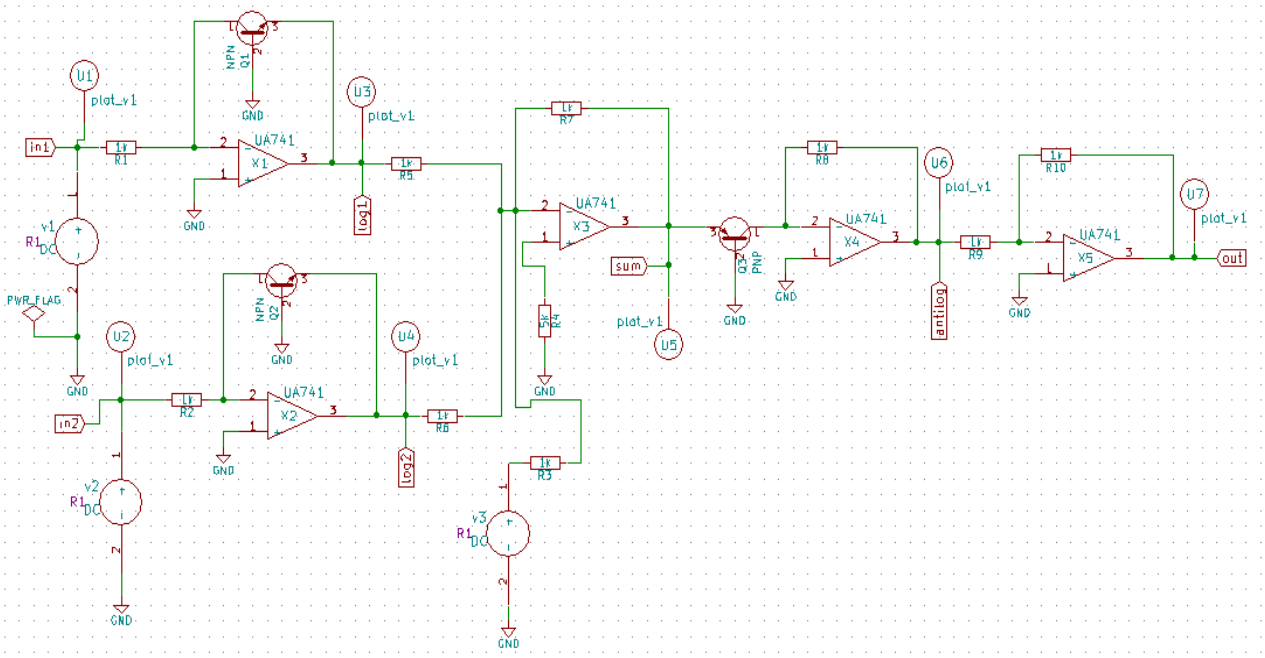

Figure 1: Analog Amplifier

Simulation results:

1. Ngspice plots:

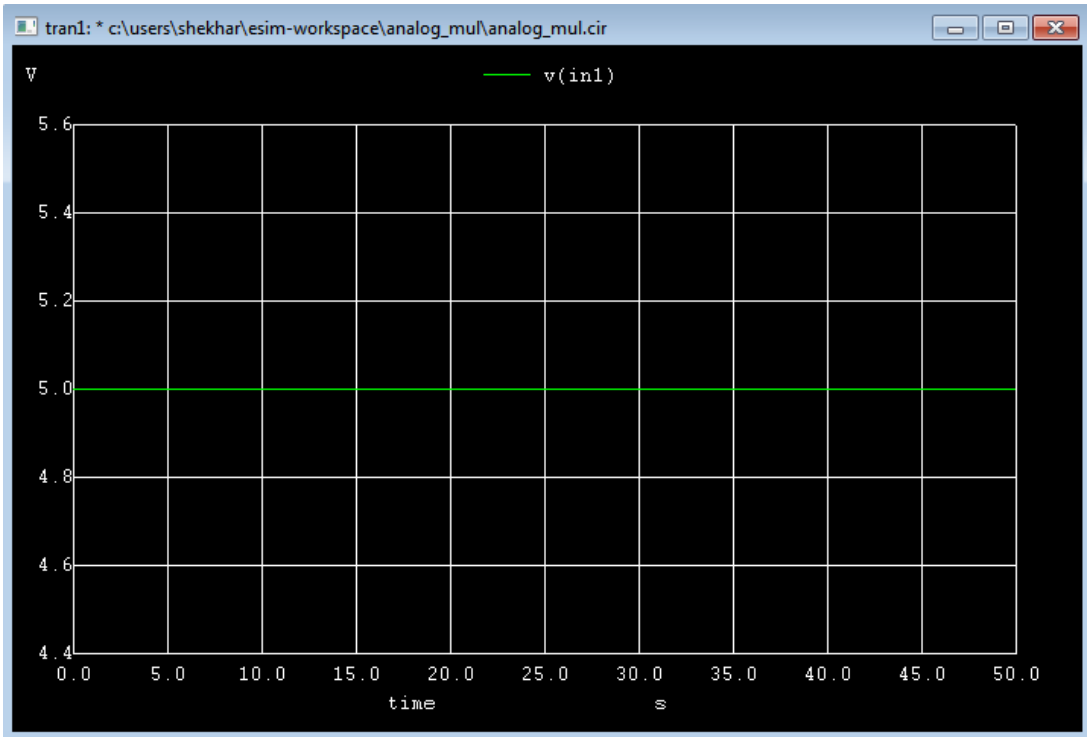

Figure 2: ngspice input 1 plot

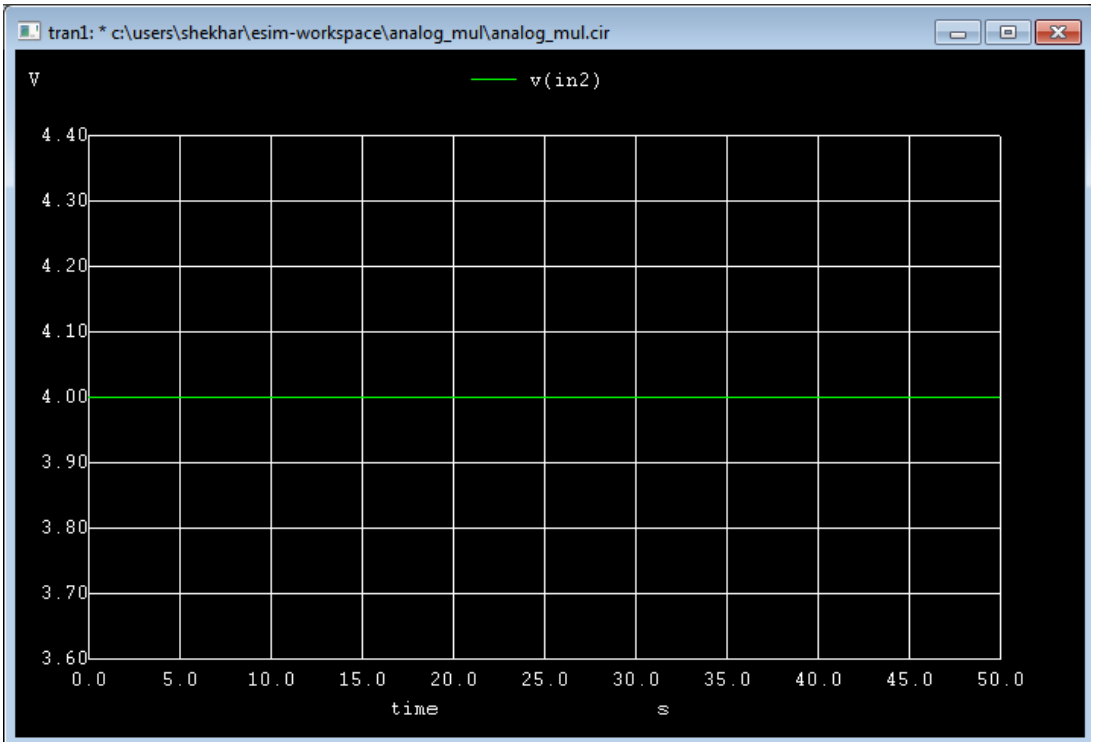

Figure 3: ngspice input 2 plot

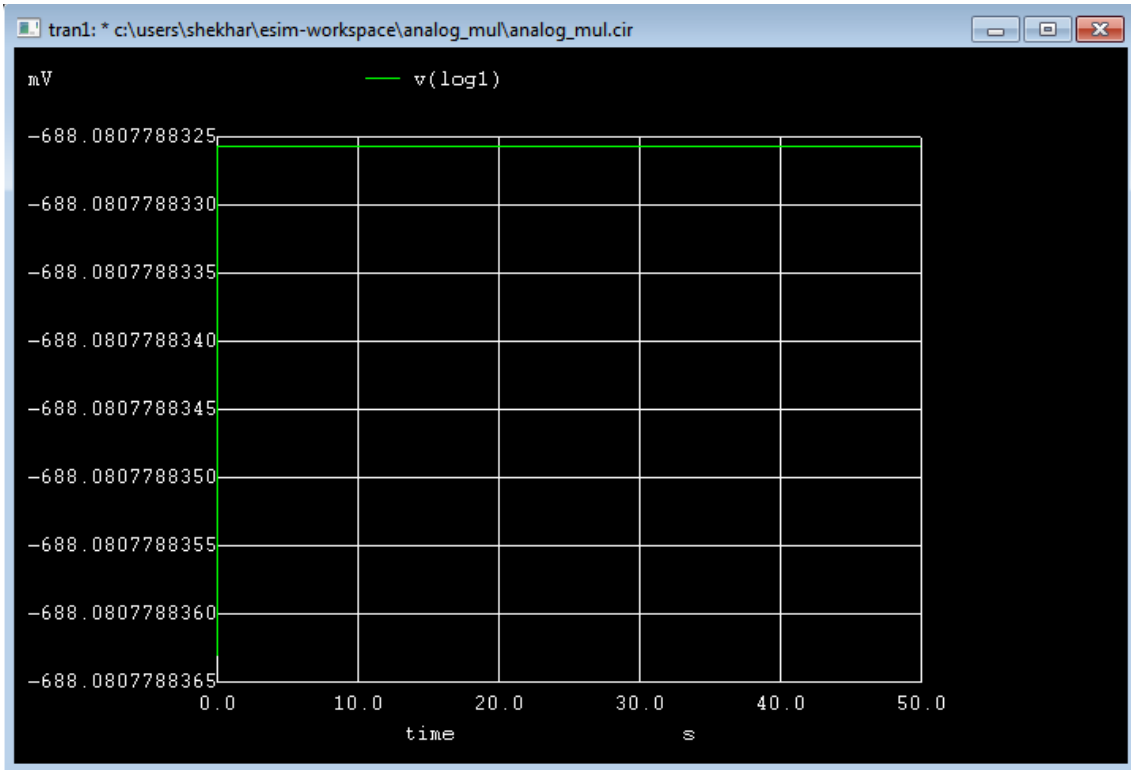

Figure 4: ngspice log 1 plot

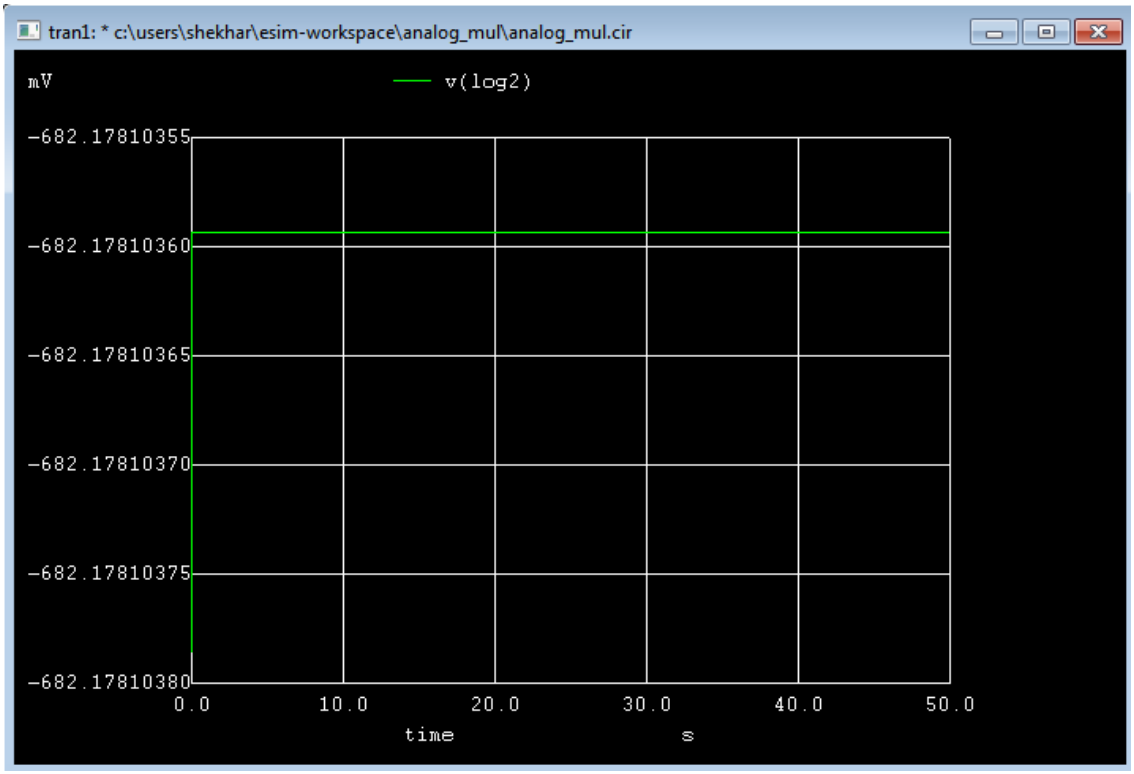

Figure 5: ngspice log 2 plot

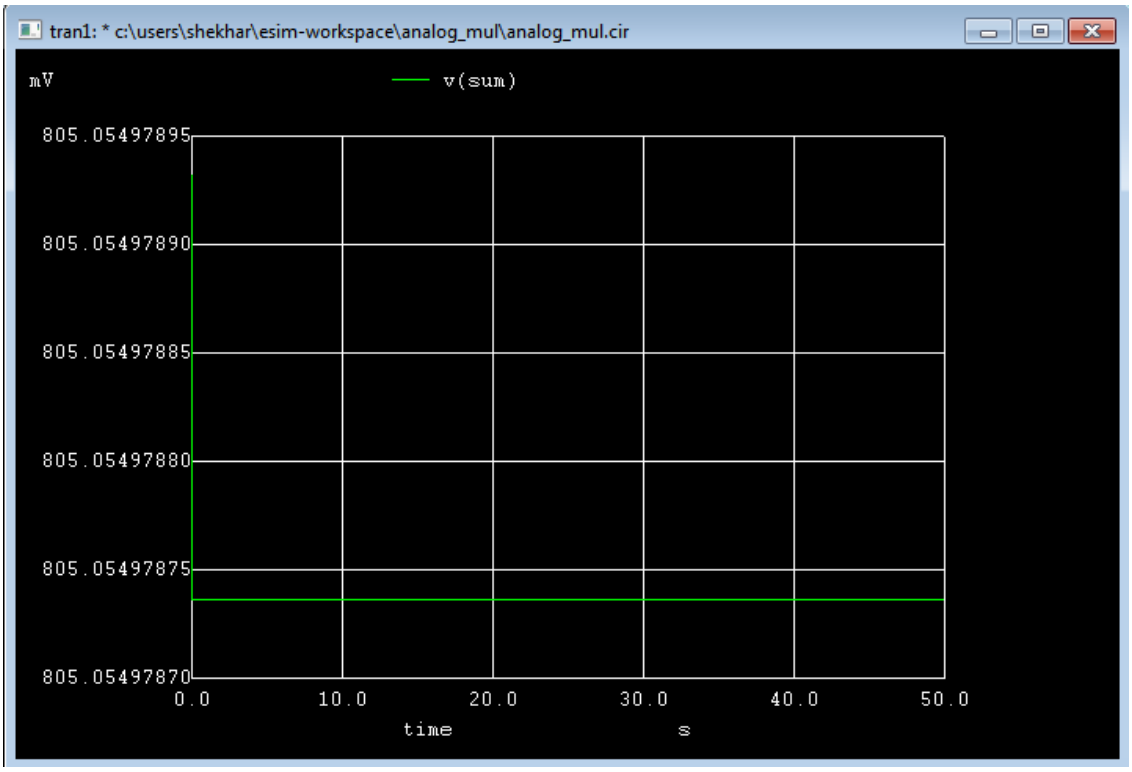

Figure 6: ngspice summing amplifier plot

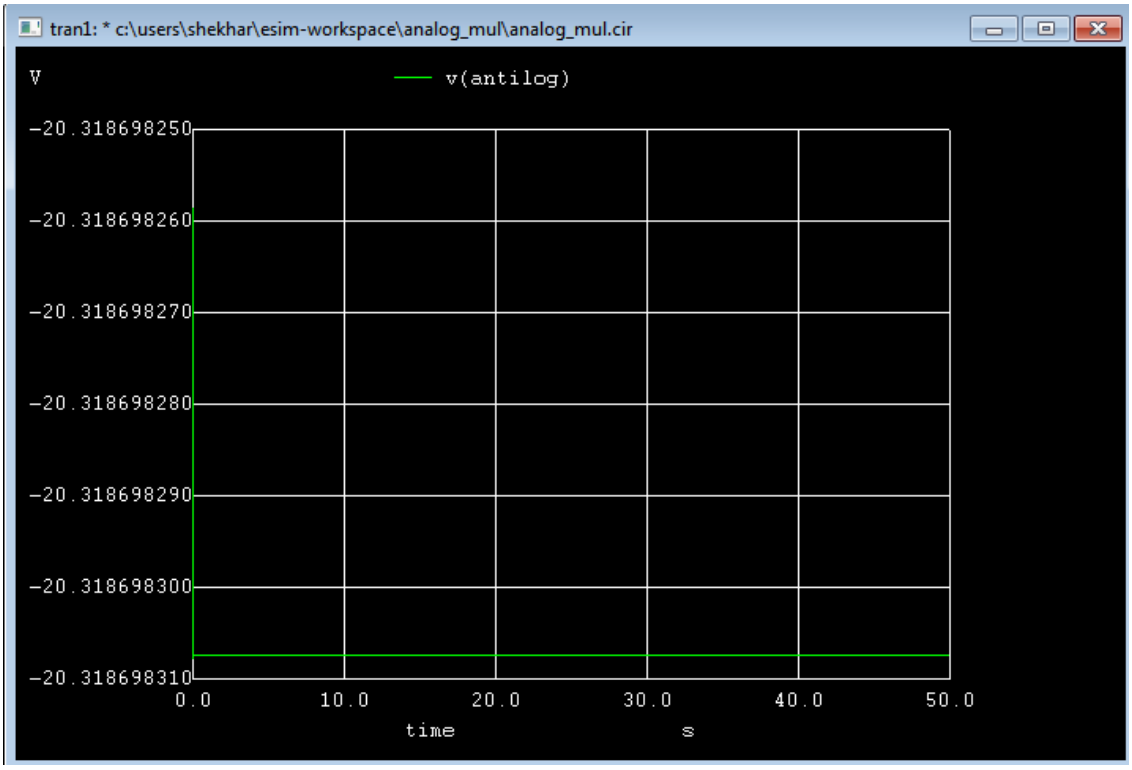

Figure 7: ngspice antilog plot

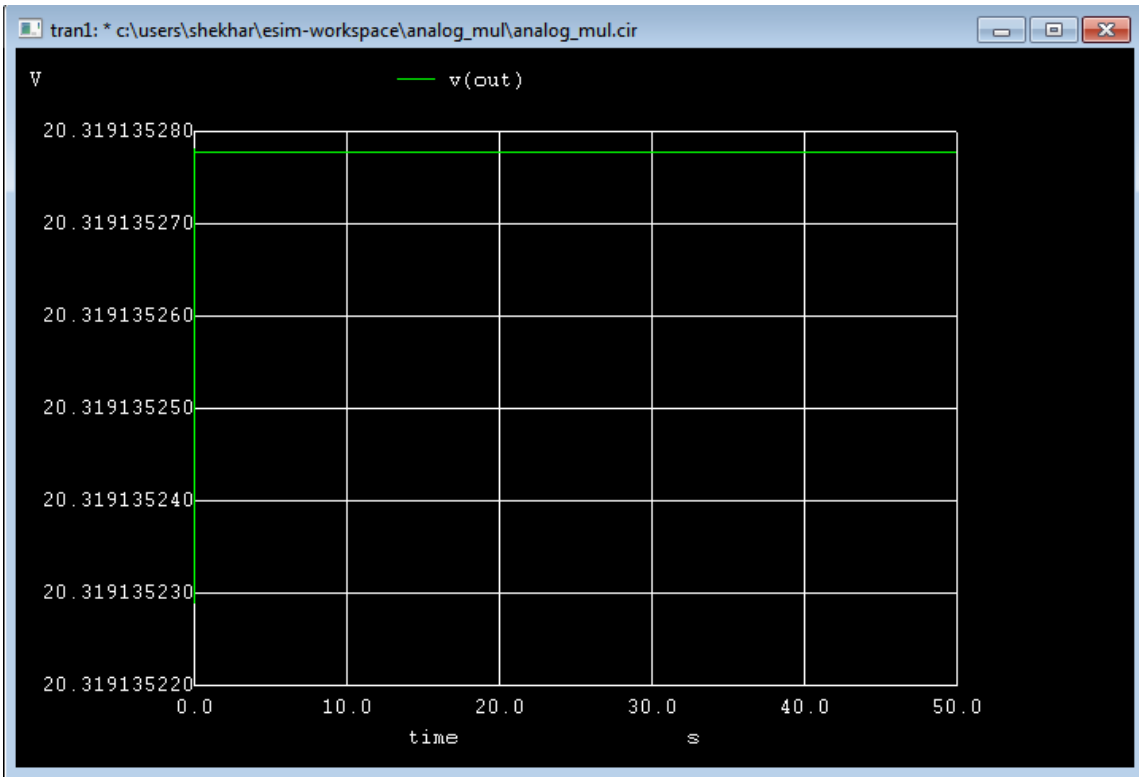

Figure 8: ngspice output plot

2. Python plot :

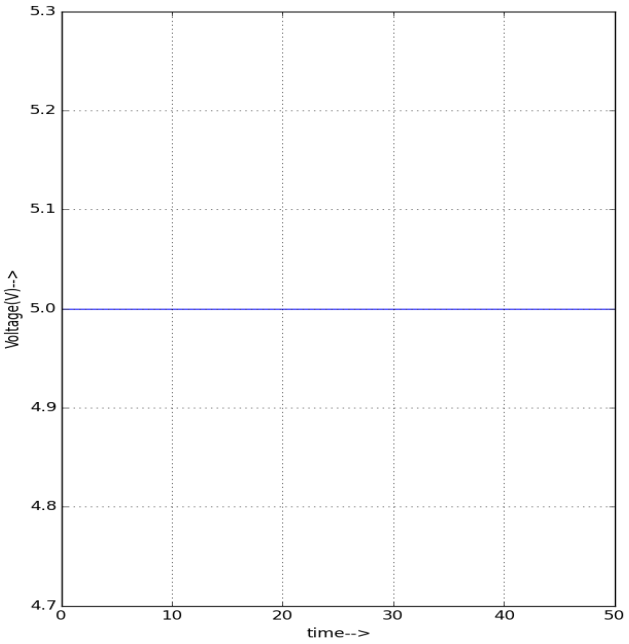

Figure 9: python input 1 plot

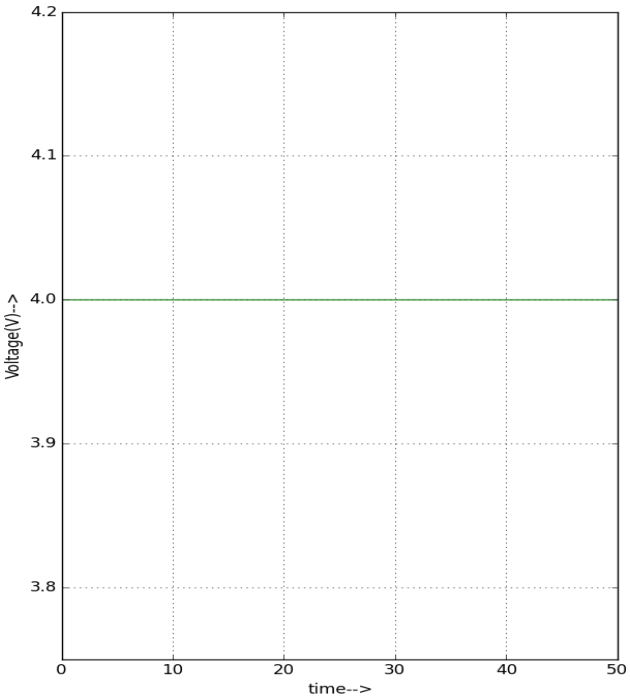

Figure 10: python input 2 plot

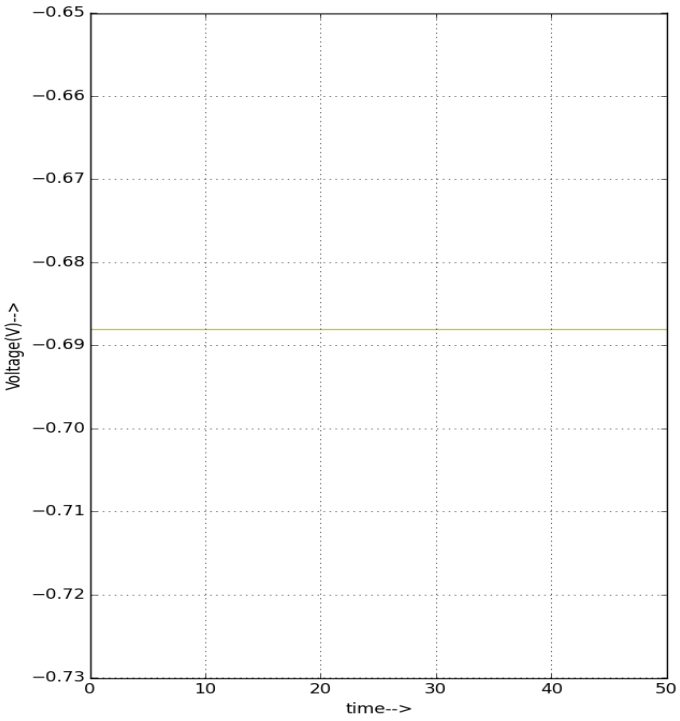

Figure 11: python log 1 plot

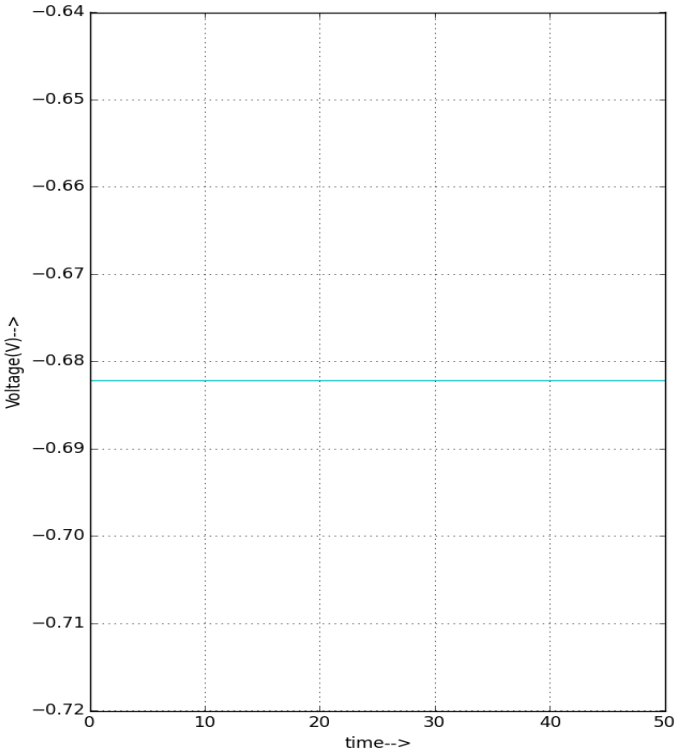

Figure 12: python log 2 plot

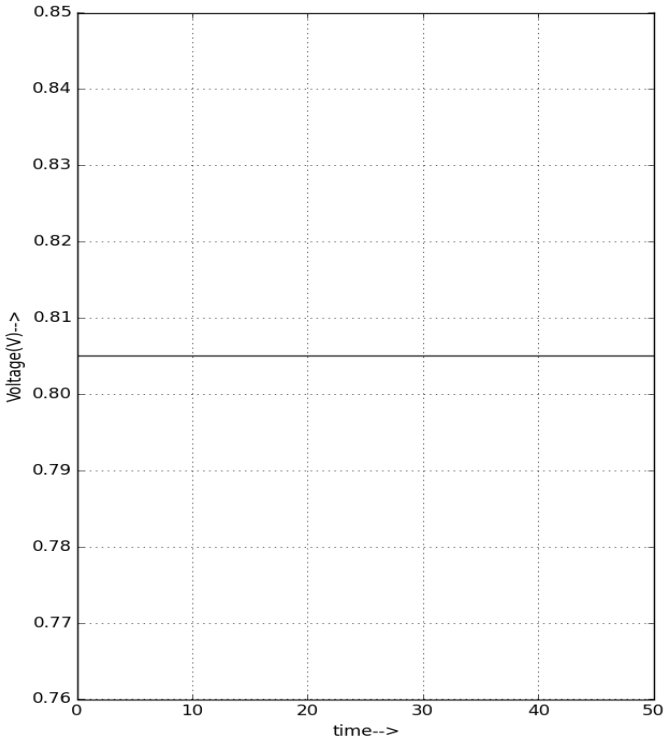

Figure 13: python summing amplifier plot

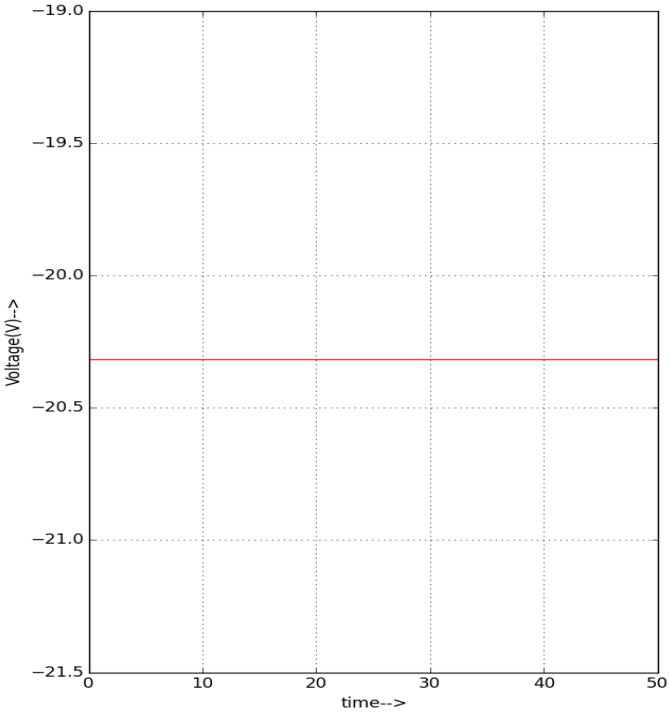

Figure 14: python antilog plot

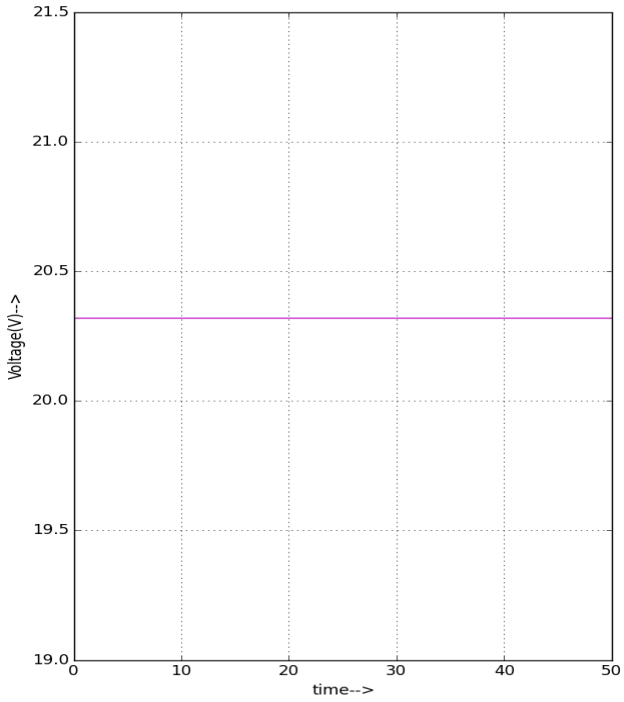

Figure 15: python output plot

Conclusion :

Thus, we have studied the Analog multiplier using operational amplifier in eSim and we got the appropriate waveform and amplitude swing output.

References:

1. https://www.electronicshub.org/operational-amplifier-applications/
2. https://en.wikibooks.org/wiki/Electronics/Analog_multipliers