Skill Experiment-4: VOLTAGE SERIES FEEDBACK AMPLIFIER

AIM:

To design, construct, and analyse the behaviour of a **Voltage Series Feedback Amplifier**, and to observe the effect of feedback on gain, input impedance, and output impedance.

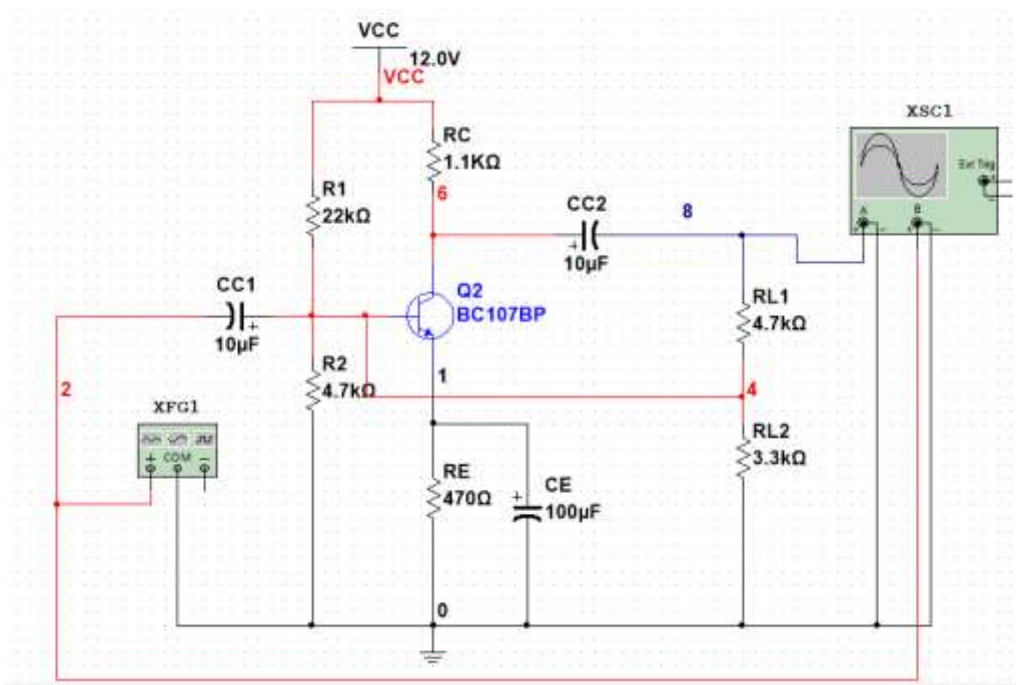
Apparatus Requirement:

S.No	Apparatus/Component	Specification	Quantity
1	Transistor	BC107 or similar	1
2	Resistors	Various (as per design)	As required
3	Capacitors	10 µF, 100 µF, 0.1 µF	As required

PRE-LAB QUESTIONS:

1. What is feedback in amplifiers?
2. Define voltage series feedback.
3. How does voltage series feedback affect the gain of an amplifier?
4. What are the advantages of using negative feedback in amplifiers?
5. How does feedback influence input and output impedances?

Circuit Diagram



Procedure:

1. Open Multisim and place the components as per the given circuit: one BC107 transistor (Q2), resistors R1 = 22 kΩ, R2 = 4.7 kΩ, RC = 1.1 kΩ, RE = 470 Ω, RL1 = 4.7 kΩ, RL2 = 3.3 kΩ, capacitors CC1 = 10 μF, CC2 = 10 μF, CE = 100 μF, and a signal generator XFG1 for input.
2. Connect a dual-trace oscilloscope XSC1 at the output node through CC2 and load resistors.
3. Give a DC supply of 12 V for VCC. First, run the circuit as it is with the bypass capacitor CE connected across RE.
4. This represents the amplifier without feedback because the AC signal at the emitter is bypassed and not fed back to the input.
5. Use the oscilloscope to check the amplified output waveform for a sinusoidal input of 20 mV peak at 1 kHz.
6. Then perform an AC analysis sweep from 10 Hz to 1 GHz to plot the frequency response curve and note the midband gain, lower cutoff frequency, and higher cutoff frequency.
7. Next, add 2 resistors in series at the load RL1 and RL2 and tap it between both the resistors to get feedback connected to the base of the transistor.
8. This introduces voltage series (negative) feedback into the amplifier.
9. Now rerun the circuit with the same sinusoidal input and observe the output waveform on the oscilloscope.
10. Again perform an AC sweep analysis from 10 Hz to 1 GHz to plot the new frequency response with feedback.
11. Now Keep RL2 = 3.3 kΩ as given in the circuit. This resistor provides the feedback path.
12. Go to Simulate → Analyses → Parameter Sweep. In the dialog, select "Add Sweep Variable" and choose the component RL2 (resistor).
13. Set the sweep type to "List of Values" (not linear or logarithmic). Enter two values: first value = 3.3 kΩ (normal case, feedback present), second value = a very high resistance (for example 1 GΩ) which effectively acts as an open circuit and removes the feedback.
14. Inside the same dialog, add an AC Analysis as the sub-analysis. Set AC Analysis sweep from 10 Hz to 1 MHz, logarithmic scale, with at least 100 points per decade for smooth response. The output should be the voltage at the output node (after CC2 across RL1).

15. Run the parameter sweep simulation. You will now get two Bode plots on the same graph: one for RL2 = 3.3 kΩ (with feedback) and another for RL2 = 1 GΩ (open circuit → without feedback). This way, both frequency responses can be compared simultaneously.

16. From the results, compare the frequency response graphs. Without feedback, the gain is higher but the bandwidth is limited, and distortion may be more visible. With feedback, the gain reduces, but the bandwidth improves, the lower cutoff frequency shifts to a lower value, the higher cutoff frequency shifts higher, and the overall frequency response becomes flatter. The output waveform also shows reduced distortion and improved linearity.

Expected Graphs:

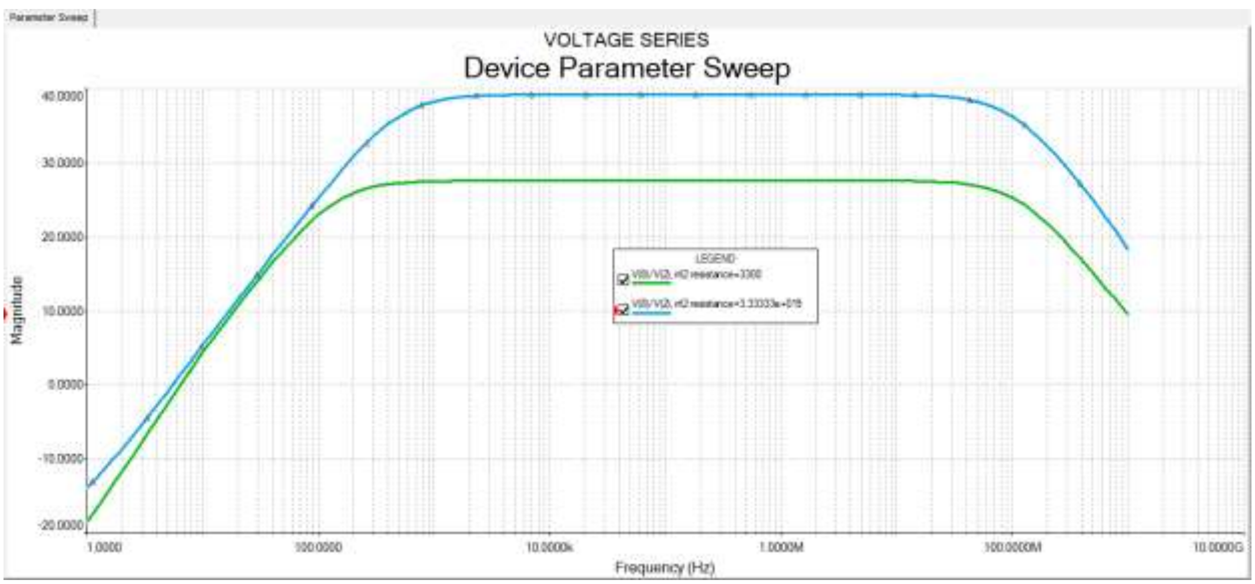


Fig: Frequency response of the amplifier with and with out feedback for voltage series feedback amplifier

Inference and Analysis:

1. Voltage series feedback in the amplifier stabilizes the gain, increases bandwidth, reduces distortion, and improves linearity, though it decreases the overall gain compared to the case without feedback.

2. Without feedback (RL2 = open), the gain is higher but the bandwidth is limited, with lower fL and higher fH being closer, resulting in a narrower passband.

3. With feedback (RL2 = 3.3 kΩ), the midband gain decreases significantly, but the bandwidth improves (both fL decreases and fH increases), making the amplifier more stable over frequency.

4. The frequency response curve with feedback is flatter, showing reduced variation in gain with frequency, which indicates improved fidelity.

5. The input and output waveform distortion is also reduced in the feedback case, improving linearity of the amplifier.

6. Overall, the trade-off is clear: gain drops with feedback, but stability, bandwidth, and quality of amplification improve.

POST LAB TASKS:

- Calculate the theoretical gain with and without feedback.
- Compare experimental gain with theoretical values.
- Analyze the impact of feedback on signal distortion and stability.
- Prepare a detailed report with circuit diagrams, tables, and observations.

VIVA QUESTIONS:

1. What is the difference between positive and negative feedback?
2. Why is negative feedback preferred in amplifier circuits?
3. What is the main characteristic of a voltage series feedback amplifier?
4. How does negative feedback affect gain stability?
5. What happens to bandwidth when negative feedback is applied?

Evaluator Remark (if Any):	**Marks Secured: _____out of 50**
	Signature of the Evaluator with Date