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| **Electronic Circuits Lab (1064134) Report Sheet** | | | | | | | |
| Instructor: **Eng. Nuha Odeh** | | | Experiment #: **10** | | | | |
| Academic Year: **2024 / 2025** | | | Experiment Name: **Multistage Amplifier** | | | | |
| Semester: **1st semester (2nd Period)** | | | Submitted on: **15/12/2024** | | | | |
| **Students** | | | | | | | |
| **1- نصار براهمه** | | | **2- ابراهيم مشاقي** | | | | |
|  | | |  | | | | |
| **Report’s Outcomes** | | | | | | | |
| ILO \_2\_ = (50) % | ILO \_3\_ = (25) % | ILO \_5\_ = (25) % | | ILO = () % | | ILO = () % | |
| **Evaluation Criterion** | | | | | **Grade** | | **Points** |
| **Abstract**  answers of the questions: “What did you do? How did you do it? What did you find?” | | | | |  | |  |
| **Introduction**  Sufficient, clear and complete statement of objectives. | | | | |  | |  |
| **Theory**  Presents sufficiently the theoretical basis. | | | | |  | |  |
| **Apparatus**/ **Procedure**  Apparatus sufficiently described to enable another experimenter to identify the equipment needed to conduct the experiment. Procedure sufficiently  described. | | | | |  | |  |
| **Experimental Results and Calculations**  Results analyzed correctly. Experimental findings adequately and specifically summarized, in graphical, tabular, and/or written form. | | | | | 4 | |  |
| **Discussion**  Crisp explanation of experimental results. Comparison of theoretical predictions to experimental results, including discussion of accuracy and error analysis in some cases. | | | | | 3 | |  |
| **Conclusions and Recommendations**  Conclusions summarize the major findings from the experimental results with adequate specificity. Recommendations appropriate in light of conclusions. Correct grammar. | | | | | 1 | |  |
| **References**  Complete and consistent bibliographic information that would enable the reader to find the reference of interest. | | | | |  | |  |
| **Appendices**  Appropriate information, organized and annotated. Includes all calculations  and raw data Sheet. | | | | |  | |  |
| **Appearance**  Title page is complete, page numbers applied, content is well organized,  correct spelling, fonts are consistent, good visual appeal. | | | | | 2 | |  |
| **Total** | | | | | 10 | |  |

* **Objectives**
* Measure the curves for input – and output voltages, the partial voltage amplification factors, total voltage amplification factor and the limiting frequencies for a two-stage AC voltage amplifier.
* Measure the partial voltage amplification factors.
* Determine the total voltage amplification factor and the limiting frequencies for a two-stage AC voltage amplifier.
* **Apparatus**
* Breadboard 5. Multimeters
* Power supply 6. Oscilloscope
* Eclipses 7. Capacitors
* Resistances
* **Theory**

**Multistage circuit**

A **multistage circuit** consists of multiple circuit stages, each performing a specific function, such as amplification, filtering, or switching. The output of one stage is connected to the input of the next, forming a cascading structure.

**Types of multistage circuits:**

**Amplifiers:**

* **Cascaded Amplifiers:** Used to achieve high overall gain, often employing different transistor configurations (e.g., common emitter, common base).
* **Multistage Operational Amplifiers (Op-Amps):** Combine multiple stages for high gain and low distortion.

**Filters:**

* Active or passive filters that combine multiple stages to achieve steeper roll-off and better selectivity.

**Signal Processing Circuits:**

* Multistage signal conditioning circuits prepare signals for analog-to-digital conversion.

**Digital Logic Circuits:**

* Complex logic circuits often consist of multiple stages of gates or flip-flops.

**Gain**

The ratio of the output \*electrical quantity to the input one of the amplifier is called its gain. The gain of a multistage amplifier is equal to the product of gains of individual stages. For instance, if G1, G2 and G3 are the individual voltage gains of a three-stage amplifier, then total voltage gain G is given by:

\*G = G1 × G2 × G3



It is worthwhile to mention here that in practice, total gain G is less than G1 × G2 × G3 due to the loading effect of next stages.

**Frequency response**

The voltage gain of an amplifier varies with signal frequency. It is because reactance of the capacitors in the circuit changes with signal frequency and hence affects the output voltage. The curve between voltage gain and signal frequency of an amplifier is known as frequency response. Figure 3 shows the frequency response of a typical amplifier. The gain of the amplifier increases as the frequency increases from zero till it becomes maximum at fr, called resonant frequency. If the frequency of signal increases beyond fr the gain decreases.



**Bandwidth**

The range of frequency over which the voltage gain is equal to or greater than \*70.7% of the maximum gain is known as bandwidth. The voltage gain of an amplifier changes with frequency. Referring to the frequency response in Figure 4, it is clear that for any frequency lying between f1 and f2, the gain is equal to or greater than 70.7% of the maximum gain. Therefore, f 1 − f 2 is the bandwidth. It may be seen that f1 and f2 are the limiting frequencies. The former (f) is called lower cut-off frequency and the latter (f2) is known as upper cut-off frequency. For distortionless amplification, it is important that signal frequency range must be within the bandwidth of the amplifier.



*Figure 3: Frequency vs Gain (2)*

* **Procedures**
* **Two-Stage AC Voltage Amplifier**
* **Circuit**



*Figure 4: Two-Stage AC Voltage Amplifier*

* **Readings**

|  |  |  |
| --- | --- | --- |
| V1 | V2 | V ges |
| 110 | 63.63 | 7000 |

*Table : voltage gain*

|  |  |
| --- | --- |
| **FL** | **F**H |
| **43HZ** | **23kHZ** |

*Table 2: cutoff frequency*

* **Discussion**
* **the cutoff frequency** is the point where the circuit's output falls to (½)^0.5​ (approximately 70.7%) of its maximum value, we got two frequencies:

**1-Upper frequency**

**2-Lower frequency**

* **The Voltage gain** is the ratio of output voltage to input voltage Av=Vout/Vin.
* **Snapshots**
* **First stage input and output waves**



*Figure 5: first stage*

* **second stage input and output waves**



*Figure 6: second stage*

* **Questions in the manual**

**What is the phase shift between UE and UA1?**

180 degrees.

**What is the phase shift between UE and UA2?** 0 degrees.

**What is the interrelation between the single amplification factor and the total amplification factor?**

Total factor = amplification factor1 \* amplification factor2

Vges = V1 \* V2.

**What is the lower limiting frequency?**

FL=52HZ.

**What is the upper limiting frequency?**

FH=50kHZ.

* **Conclusion**

In this experiment, we have studied how the multistage amplifier can be used to increase extremely weak signals to utilizable levels and how its flexibility within input & output impedance and higher gain, and determined how this circuit is really important for amplification because usually, a single amplifier cannot achieve the required amplification factor and the required bandwidth. At present, any electronic device can process digital or radio electrical signals by including a multistage amplifier.

* **References**
* Electronic Circuits Lab (1064134) manual
* Eng. Nuha Odeh Lectures