Practical 1 : Bipolar / FET Amplifier Frequency Response
EERI 322, 2017

1. Aim

The aim of this practical is to design and demonstrate a multistage discrete BJT / MOSFET amplifier (as discussed in Chapter 7 - Frequency Response) with a specified gain and cutoff frequencies. This practical is based on Design Problem D7.80 in Microelectronics: Circuit Analysis and Design, Fourth Edition, by Donald Neamen.

2. Method

Design, simulate, construct, demonstrate and document an amplifier (BJT / MOSFET, multi-stage) according to requirements. Results must be documented in a report, giving the student an opportunity to improve his/her non-verbal communication skills as expected by the Engineering Council of South Africa (ECSA). From an ethical point of view, plagiarism must be avoided by all means. Any plagiarism will lead to disciplinary action against the guilty parties. This practical has the following objectives:

- Reviewing the relevant theoretical work (ELO 1)
- Gaining experience in using laboratory equipment (power supply, multimeter, breadboard)
- Gaining experience in conducting experiments and data analysis (ELO 4)
- Improving teamwork (ELO 8)
- Develop report writing skills (ELO 6 – Structure of technical report)
- Using a simulation package to verify results (ELO 5)

3. Requirements

The following requirements are applicable to the amplifier:

- The input signal shall be a 200 mV peak-to-peak sine wave generated by a standard laboratory signal generator
- The midband gain of the amplifier shall be 100
- The low 3 dB cut-off frequency shall be 50 Hz
- The high 3 dB cut-off frequency shall be 12 kHz
- The load resistance shall be 1 kΩ
- The supply voltage shall be ±15 V
- The input and output shall be ac coupled to the amplifier
- The BJTs used shall be KSP2222A (NPN) and KSP2907A (PNP)
- The MOSFETs used shall be 2N7000 (N-channel)
- No more than four transistors shall be used (includes all BJTs and MOSFETs)
- At least one NPN and one PNP transistor shall be used
- At least one N-channel MOSFET shall be used.

Students can work together in groups of two to design the amplifier and submit the group report on 9 August 2017 after demonstrating the amplifier. Each student will have to demonstrate competency by designing, simulating, constructing and demonstrating the circuit (with different parameters) on the mentioned date. In order to pass the practical, the circuit must work. During demonstration, the student shall demonstrate the gain, low cut-off frequency and high cut-off frequency of the circuit by displaying the input and output waveforms on the oscilloscope. After successful demonstration, the student shall hand in a report documenting the results. The report shall be formatted properly and special attention must be given to spelling and grammar.

4. Report

The report for this practical should include the following:

- **Cover page:** Number and name of practical, group member names and numbers. Please use the official template from the NWU.
- **Table of Contents:** Shows sections in report and corresponding page numbers.
- **Introduction:** Give a brief overview of the report. This section should be written last.
- **Aim:** Briefly state the aim of the practical. This must be stated in your own words and must not be copied from this document.
- **Literature:** Give a short theoretical overview of the circuit involved. Describe the operation of the circuit and give important design formulas. **Do not copy** work from the textbook!
- **Design:** Discuss the design of the circuit and explain the functions of the various sub-circuits. Hereafter, give details on the design of the various sub-circuits by showing calculations and giving final component values.
- **Simulations:** The simulation is done to verify the design before construction. Do a dc analysis and show all currents, voltages and power dissipation. Hereafter an ac analysis must be done to determine the frequency response of the circuits. In order to verify the amplification, a transient analysis can be done to show the input and output voltages. All simulations must be supported by thorough discussions.
- **Results:** Measure the dc currents and voltages as simulated (no input signal). Apply an ac signal and determine the frequency response of both circuits. Perform an ac sweep and capture the response on a digital oscilloscope.
- **Discussion:** Discuss your results and comment on the obtained responses. Explain discrepancies between the simulation and actual circuit.
- **References:** No report is complete without a reference list. State all sources used and avoid internet sources. List at least five sources, only one source can be an internet website.

Reports must be handed in on eFundi in pdf format and must be named “Group XX – PA1 – Frequency Response.pdf” where XX is the group number as allocated in class. The mark sheet to be used when assessing the reports is also attached and must be used to make sure the report is complete before submission.

5. Submission date

The **last day** for submission of reports is Wednesday 9 August 2017. The individual practical demonstrations will be assessed by the demonstrators and myself.