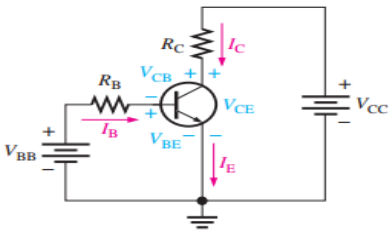
Addis Ababa University Addis Ababa Institute of Technology School of Electrical and Computer Engineering	Applied Electronics I: Project 1 Regulated DC Power Supply Design

INTRODUCTION

Almost all electronic devices, whether they are handheld devices (Mobile phones, Tablets, Laptops, GPS navigator devices…) or customer electronics (TVs, Radios, Audio system ….) internally operate using DC voltages. Although we connect them to AC supplies/outlets/ to give them power, they don't operate on the AC. This shows us that they all have a power module inside the package that is responsible for the conversion of this AC to regulated DC. This power module is made to deliver various level of DC voltages (commonly 3.3V, 5V, 6V, 12V, 24V…).

Basically, there are two well-known configurations of power supplies. **Linear Mode Power Supply (LMPS),** which can be implemented using diodes and/or transistors working in its linear region, and **Switched Mode Power Supply (SMPS)**, which can be implemented using diodes and transistors operating/switching at high frequencies. In fact, most recent regulators are based on SMPS configuration due to its good power conversion efficiency, which is about 98%.

Here, you are expected to **design a linearly regulated DC power supply** to bias a transistor amplifier shown below (you will learn about transistor amplifier and biasing in subsequent classes).



Where: V_{CC} =12V and I_C=6mA, and

V_{BB} = 5V and I_B = 40uA

TASK

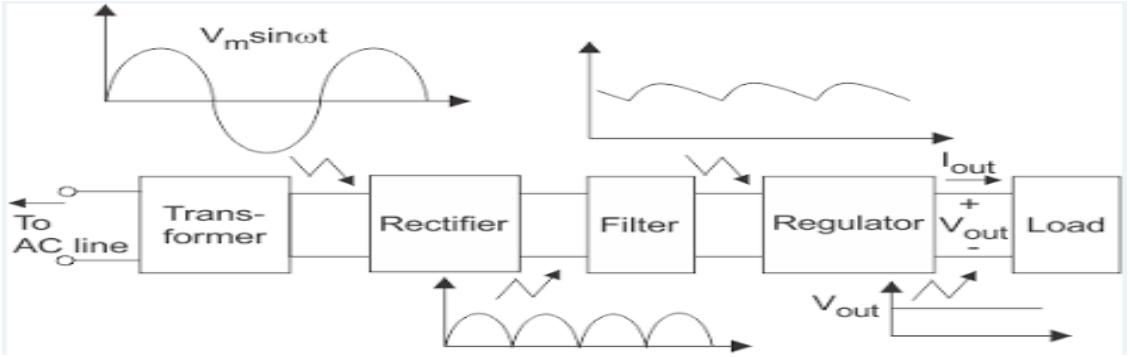
1. **Design a regulated DC power supply** that can deliver 6mA (I_C) at 12V (V_{CC}) to bias an npn BJT amplifier when a resister load (R_C) is connected (Assuming R_C is constant).
2. (**Bonus**) modify the above design so that it can deliver the amplifier both 6mA (I_C) at 12V (V_{CC}) and 40uA (I_B) at 5V (V_{BB}).

DELIVERABLES

1. The full design report that shows all the steps you took.
2. The simulation file (using LTSpice)

DESIGN PROCEDURES

A typical regulated DC power supply has the following structure.

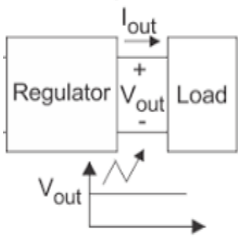


ASSUMPTIONS AND APPROXIMATIONS

You can use reasonable assumptions and approximations whenever deemed appropriate stating the reason. (Write them where visible).

REQUIREMENTS

The regulator

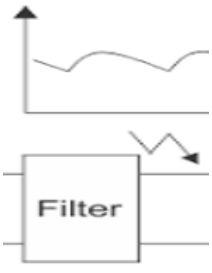


Output: $V_L=V_{out}=12V$, $I_L=I_C=6mA$,

Input: DC value of the filter out put plus its ripple ($V_{CDC}+ V_{CRIPPLE}$), make sure that this voltage is in the range to make the Zener diode ON.

Hint: check I_{ZM} of 12V Zener and assume I_Z to be around half of its maximum.

The smoothing filter

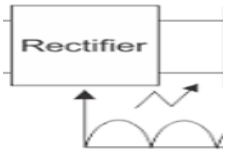


Input: Rectified voltage,

Output: filtered voltage with a maximum ripple voltage of $V_{Rpp}=2V$

- You can use any type of low pass filter.
- Output of the filter should meet the requirement for the input voltage of the regulator.

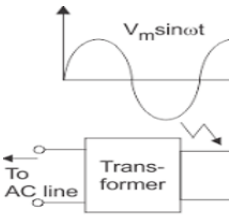
The rectifier



The rectifier should deliver the sum of all voltage drop on the circuit elements to its right.

Use Bridge configured full wave rectifier.

The transformer



Input: Assume EEPCO's AC supply at our home, (V_{rms}=220V at 50Hz)

Output: define the turn ratio of the transformer in order to get the voltage you need at the input of rectifier.

Note:

- It is to be done in a group of maximum three students.
- There will be zero tolerance for plagiarism.
- All of you should submit the design report in hard copy and your simulation file through the corresponding email addresses of your instructors.
    - Section A: ermias.telahun@aait.edu.et
    - Section B: daveepat@gmail.com
- You will defend your work at a future date to be announced when you submit your work. (i.e. all group members should be present)

Submission date

December 21, 2021