

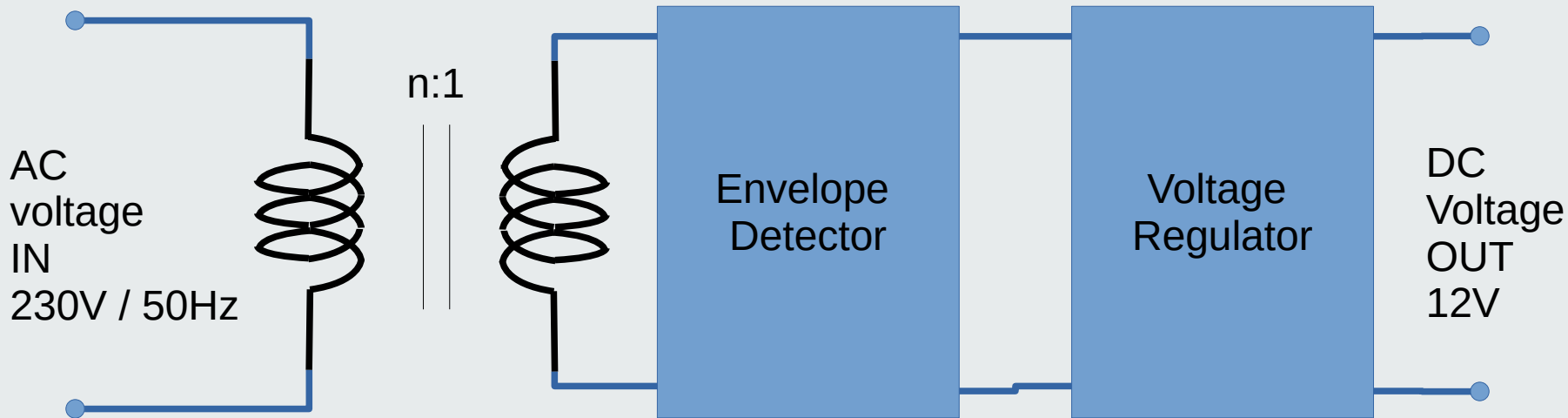
Circuit Theory and Electronics Fundamentals

Lab 3:



Converter

AC/DC converter circuit



Based on Lecture 14, you are free to choose the architecture of the Envelope Detector and Voltage Regulator circuits

The **Merit** of your work is given by $M = \text{Quality} / \text{Cost}$

Quality = $1/\text{ripple}(v_o) + 1/\text{average}(v_o - 12)$

Cost = cost of resistors + cost of capacitors + cost of diodes

Cost of resistors = 1 monetary unit (MU) per kOhm

Cost of capacitors = 1 MU/ μF

Cost of diodes = 0.1 MU per diode

Simulation Analysis

- 1) Write an Ngspice script to simulate the AC/DC converter for 10 periods. Use the default diode model.
- 2) Measure the output voltage level using Ngspice's average function on at least 1000 points (should be 12V ideally)
- 3) Measure the output voltage ripple using Ngspice's min and max functions: $\text{ripple}(v_o) = \max(v_o) - \min(v_o)$
- 4) Plot the voltages at the output of the Envelope Detector and Voltage Regulator circuits
- 5) Plot $(v_o - 12)$ (output AC component + DC deviation)

Suggestion: start simple and get it to work! Then think of simple changes/additions that significantly improve the figure of merit.

Theoretical Analysis

- 1) Use a suitable theoretical model able to predict the output of the Envelope Detector and Voltage Regulator circuits
- 2) Produce the same plots as in simulation by theoretical analysis
- 3) Compute the output DC level and the voltage ripple

Lab report

- 1) Produce all tables and plots required in the simulation and analysis sections
- 2) Compare Octave and Ngspice results side by side looking for accuracy or discrepancy, and explaining both. Read the repository's README file.
- 3) The results of interest are, obviously,
 - the output DC level deviation
 - the output voltage ripple
 - the cost of the components used

Evaluation criteria

- 1) The instructor should *git pull* your repo, and run *make flawlessly*
- 2) The report should not have obvious mistakes in figures, tables, formulae, section titles or main sentences
- 3) 1 bonus point (mark can be 5 offsetting previous grade losses) for the 5% best merit figures
 - if your work is in the top 5%, expect a more thorough review