جامعة بيرزيت

BIRZEIT UNIVERSITY

Faculty of Engineering and Technology
Department of Electrical and Computer Engineering

ENEE 2103

CIRCUITS AND ELECTRONICS LABORATORY

Experiment #11, Pre-Lab #7

Zener Diodes and Voltage Regulators

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Section: 1

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Date: 1/11/2020

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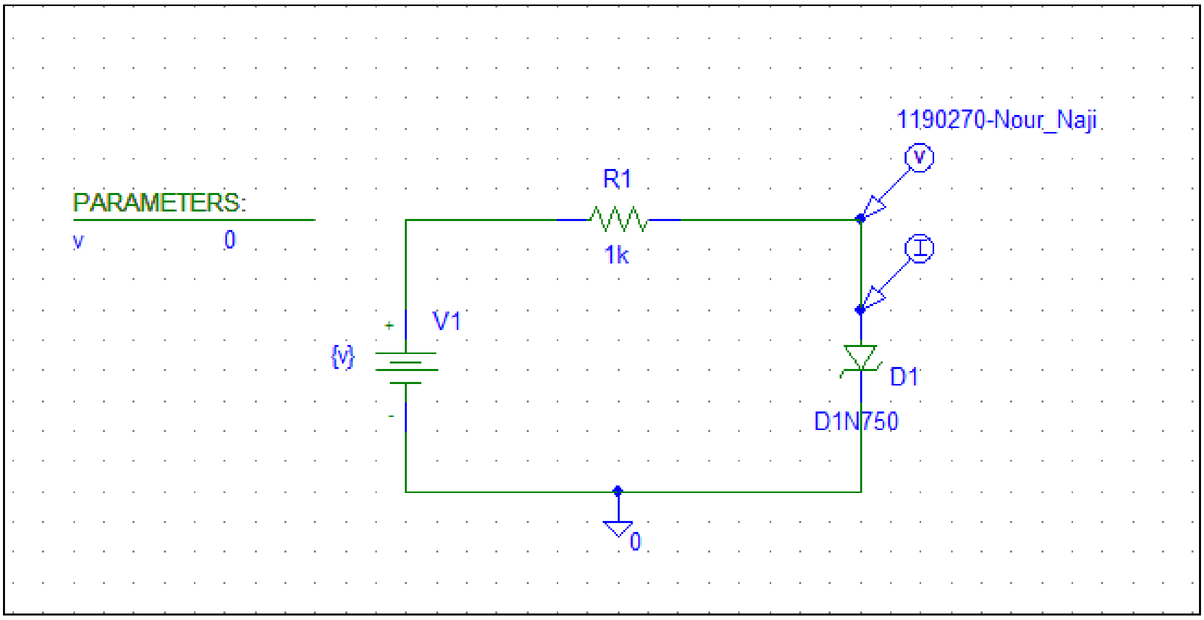
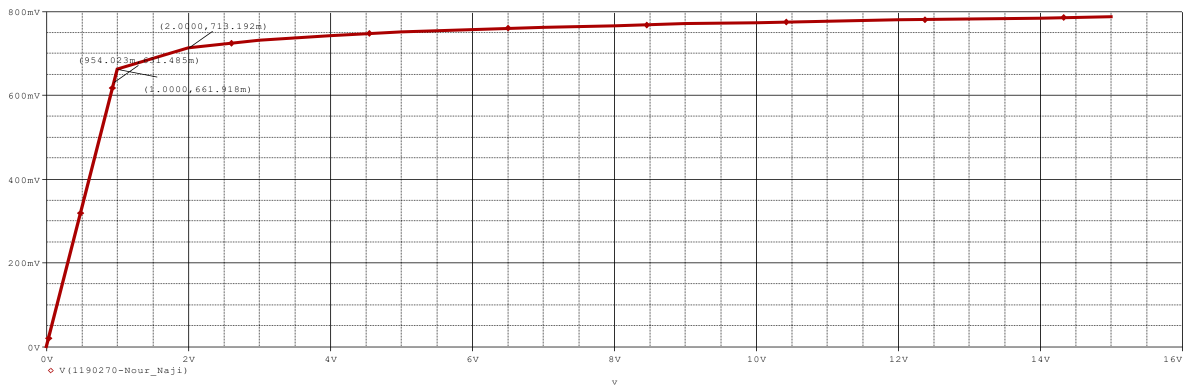
1.1 Zener diode with 1 kΩ resistor

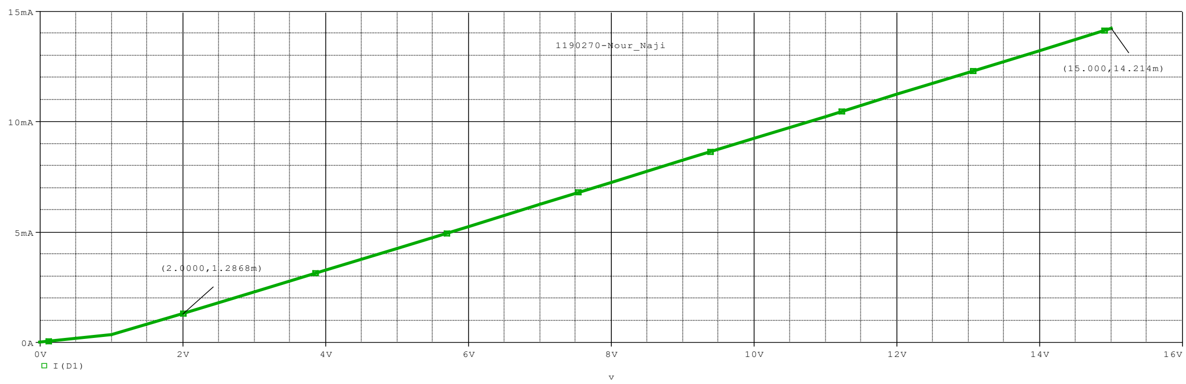
➔ Circuit using PSpice:



- Zener voltage (Vo) :

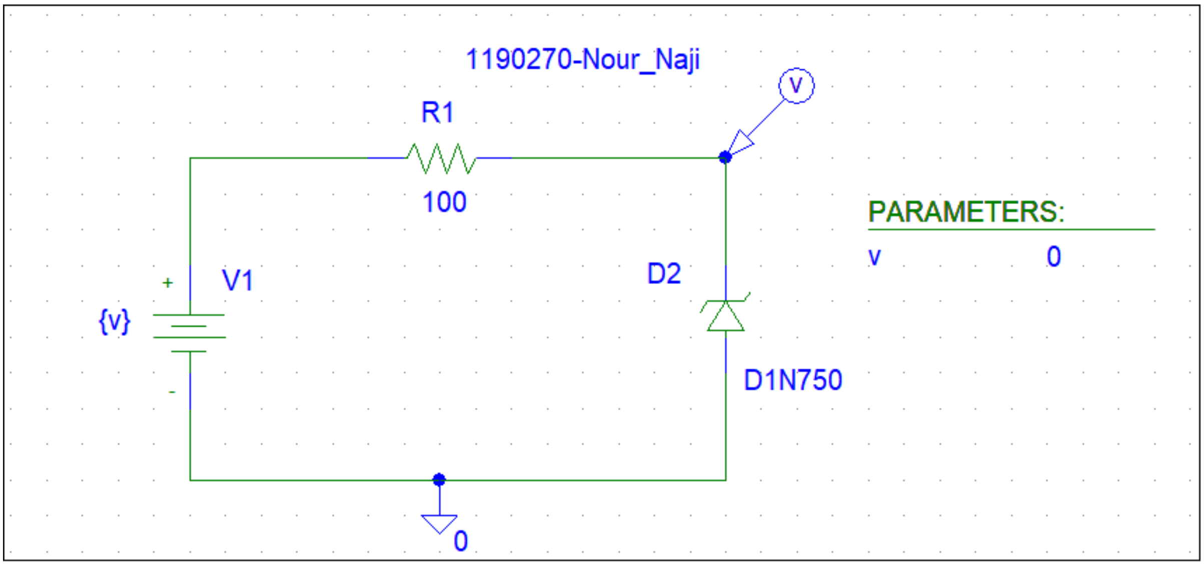


- Current in the circuit: (Iz) :

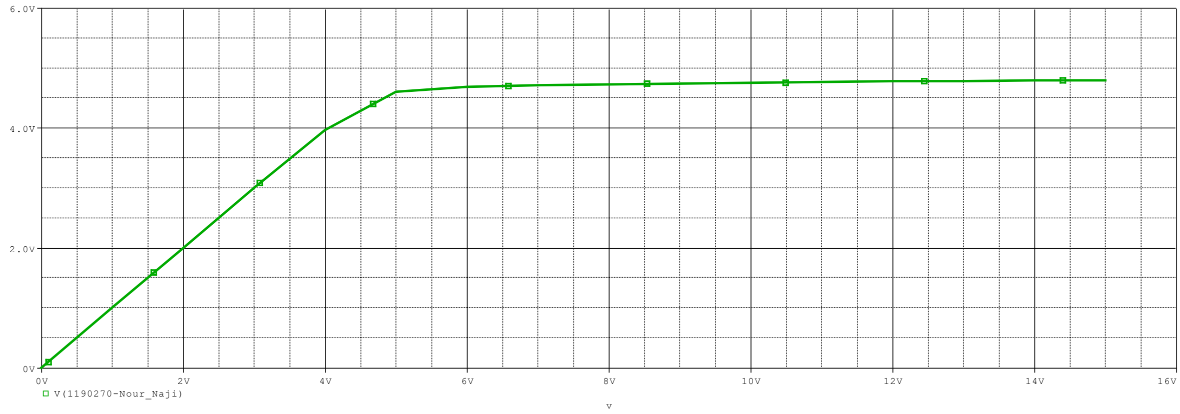


1.2 Zener diode with 100 Ω resistor

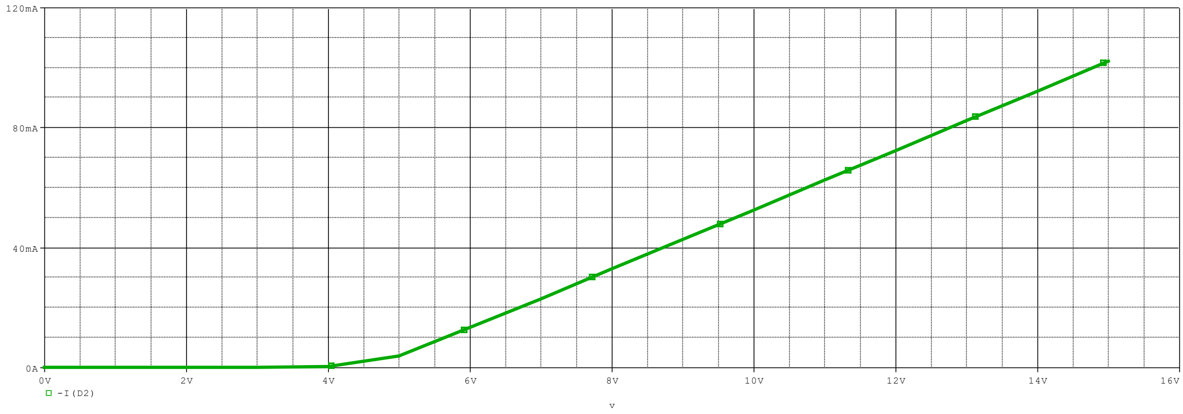
➔ Circuit using PSpice:



- Zener voltage (Vo) :

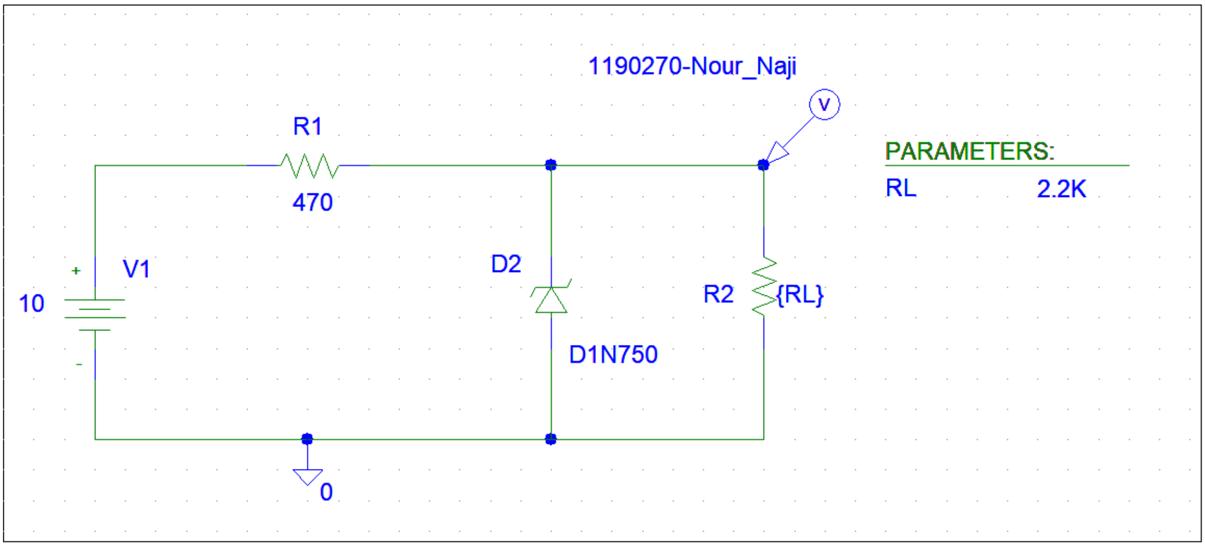


- Current in the circuit: (Iz) :

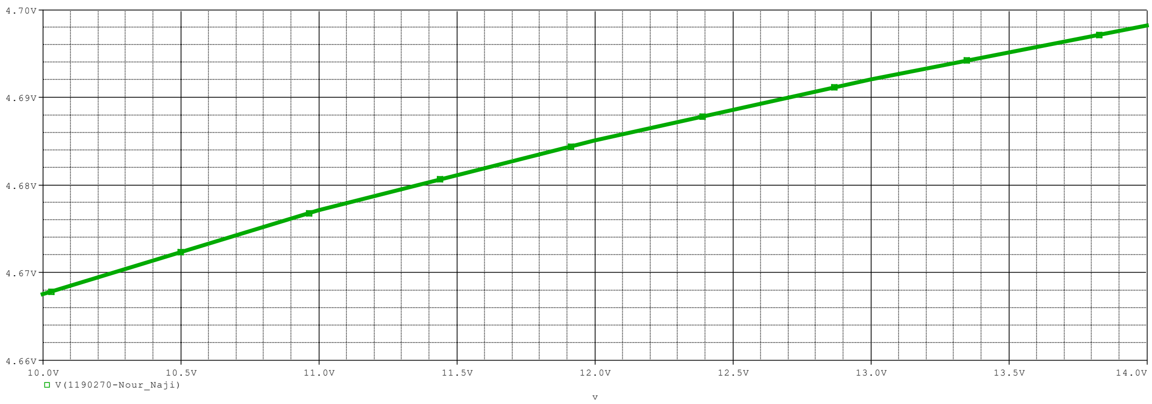


1.3 Zener diode with load resistor

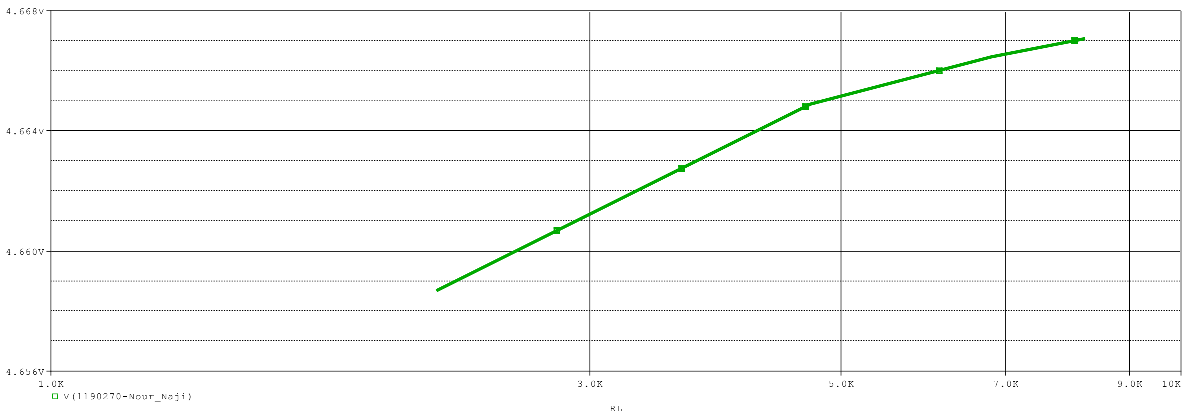
➔ Circuit using PSpice:



- Voltage across the load resistor:



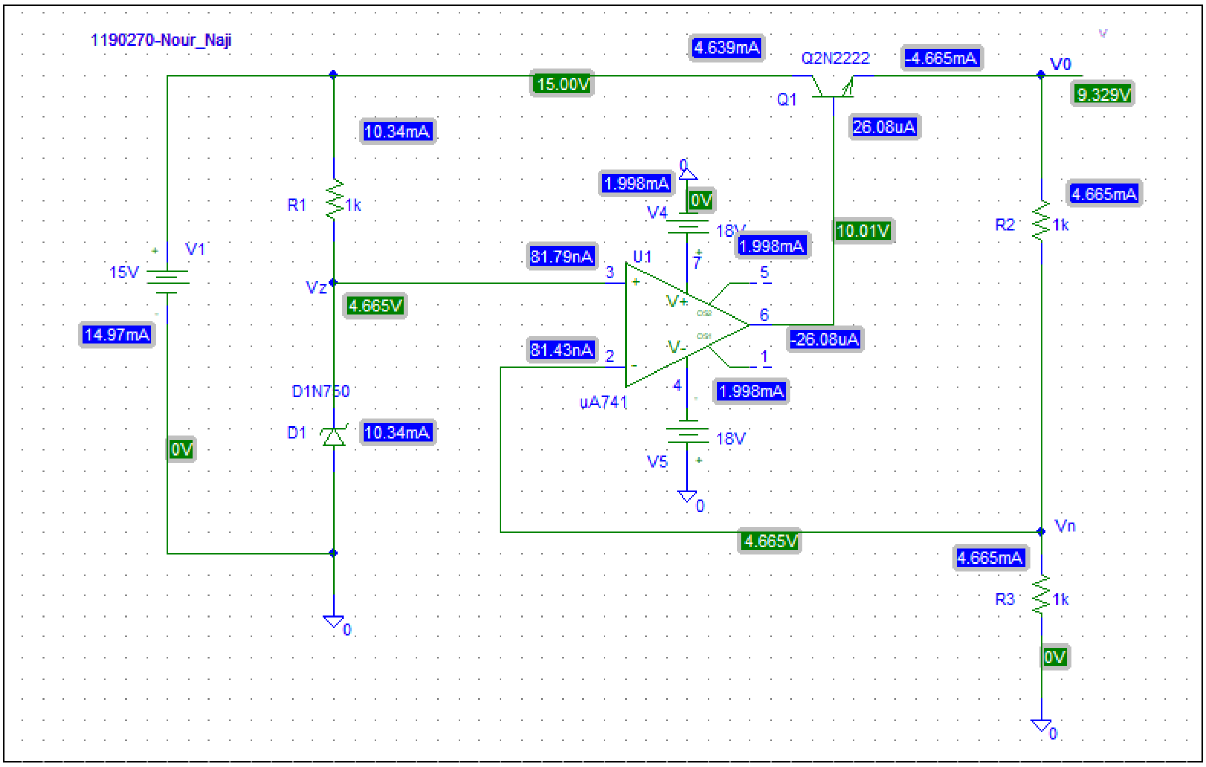
- Voltage across RL after applying DC sweep for it, and the input voltage is 10 V:



2. THE VOLTAGE REGULATED POWER SUPPLY.

2.1 Opamp series voltage regulator

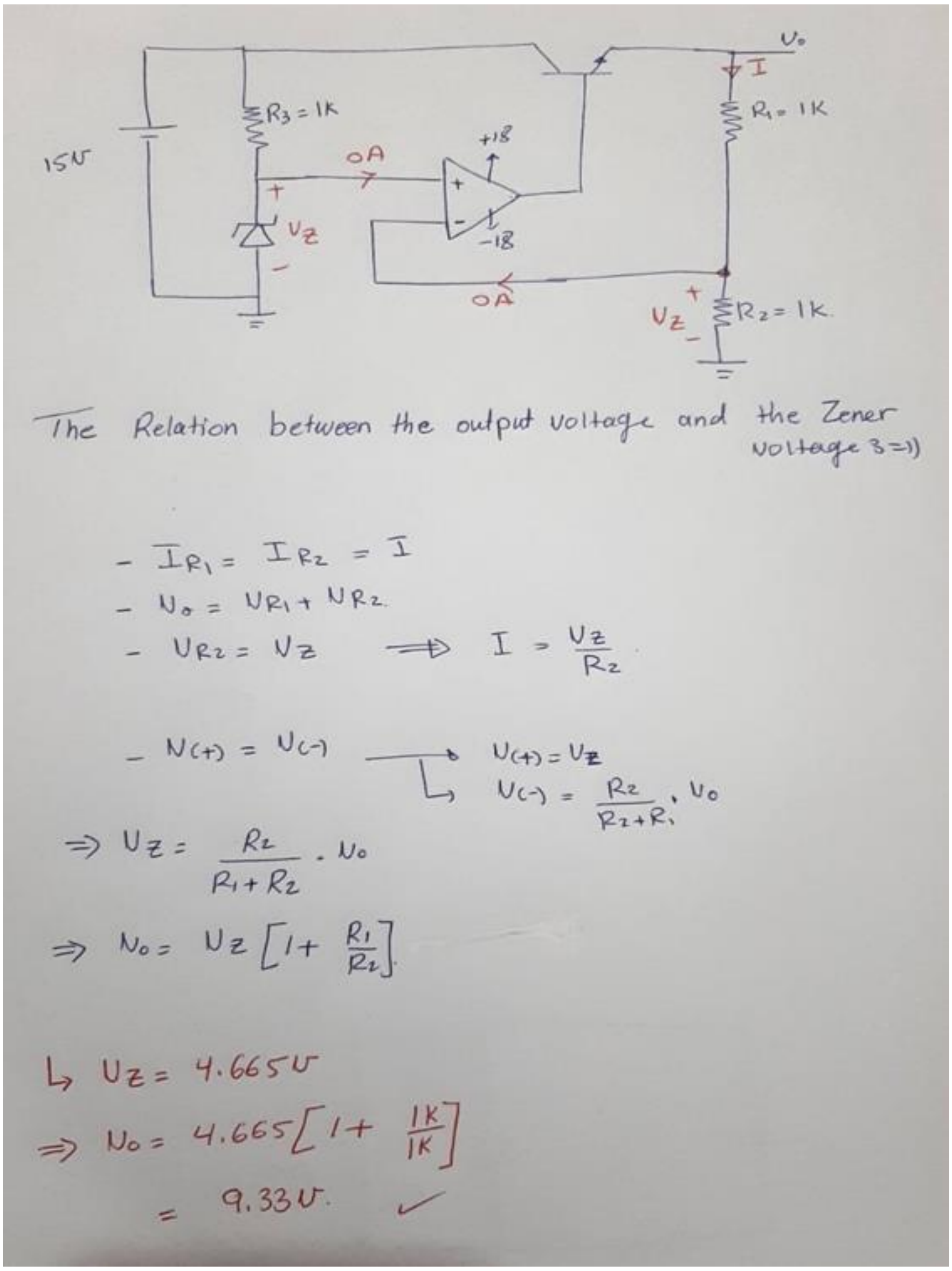
- Circuit using PSpice and Bias point analysis



From the bias point analysis of the circuit:

- V_o = 9.329v
- V_z = 4.665v

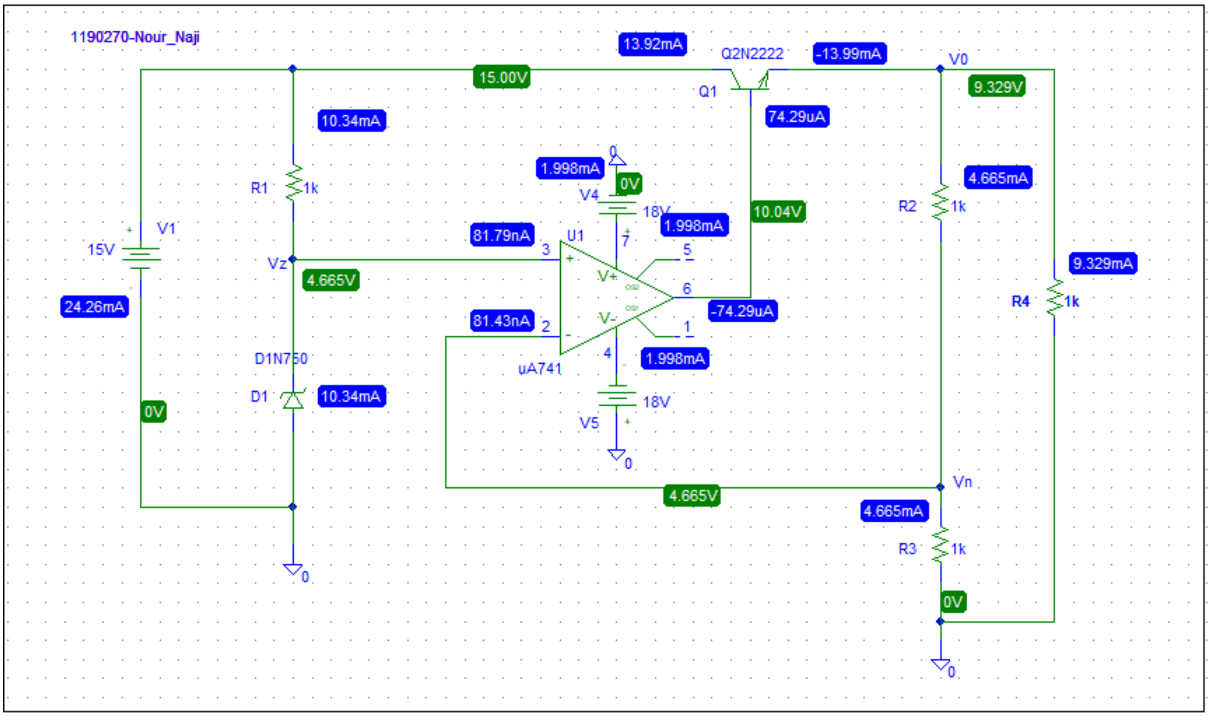
How V_o and V_z are related to each other?



- From this equation $V_o = V_z\, [1 + \frac{R2}{R3}]$,we conclude that Vo voltage is directly proportional to the Zener voltage. As far as the Zener voltage remains stable, Vo also remains stable.
- Vo, is not possible to exceed V1. It can be almost as much high as V1 when T1 saturates, but no more than this. Vo could not also be lower than Vz. That's why $V_Z < V_o < V1$.

Attach a 1k load resistor to the output

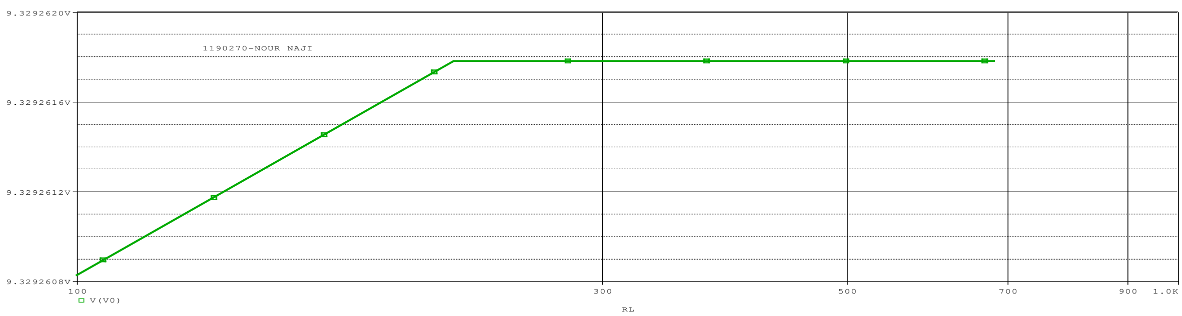
⇨ Circuit using PSpice :



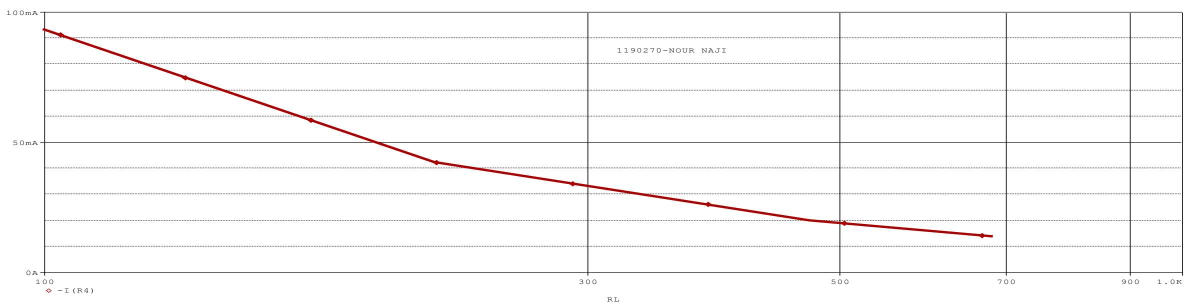
- V_o = 9.329 v
- I_o= 9.329 mA ➔ which is obtained from the relation $I_o = \frac{Vo}{R4} = \frac{9.329}{1K}$

➢ Applying DC sweep for the Load Resistor (RL):

Vo:

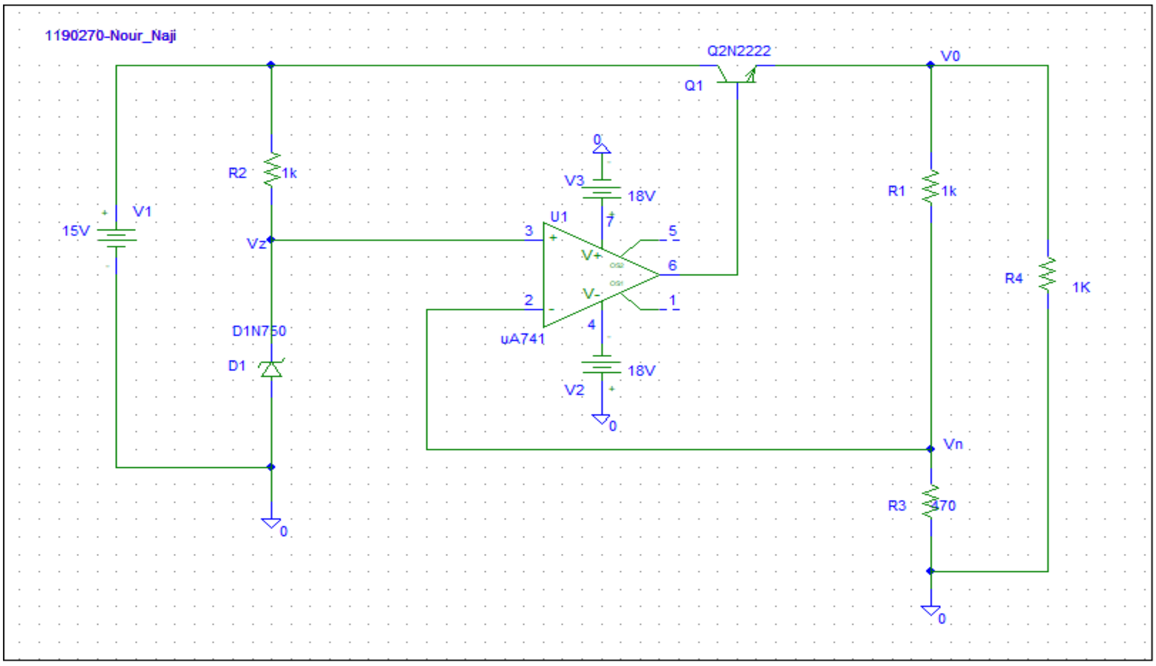


Io:

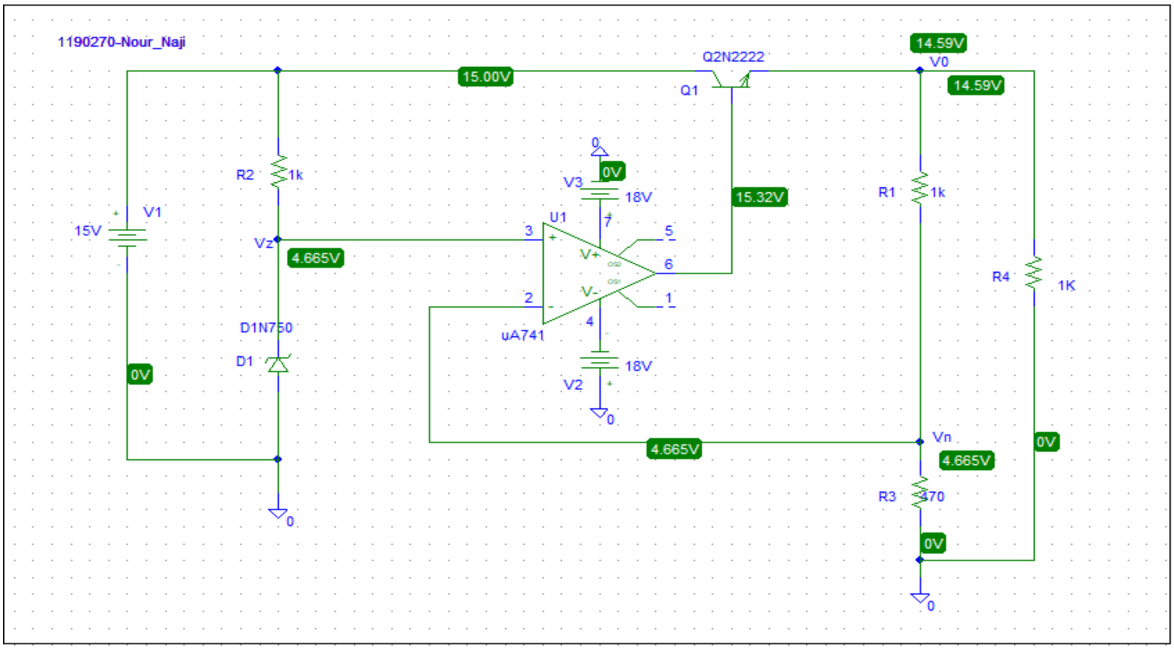


- RL = 1 kΩ, R3 = 470 Ω:

⇨ Circuit using PSpice



- Bias point analysis:

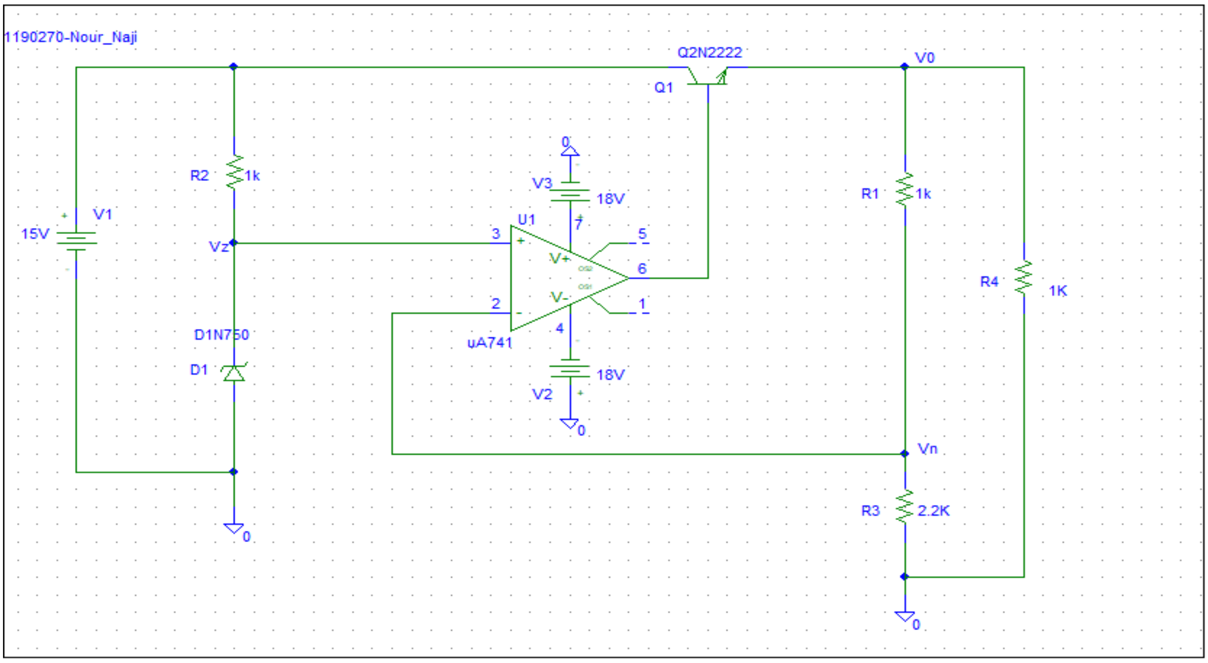


⇨ The output voltage (Vo) = 14.59 V, and the voltage across the Zener (Vz)= 4.665 V.

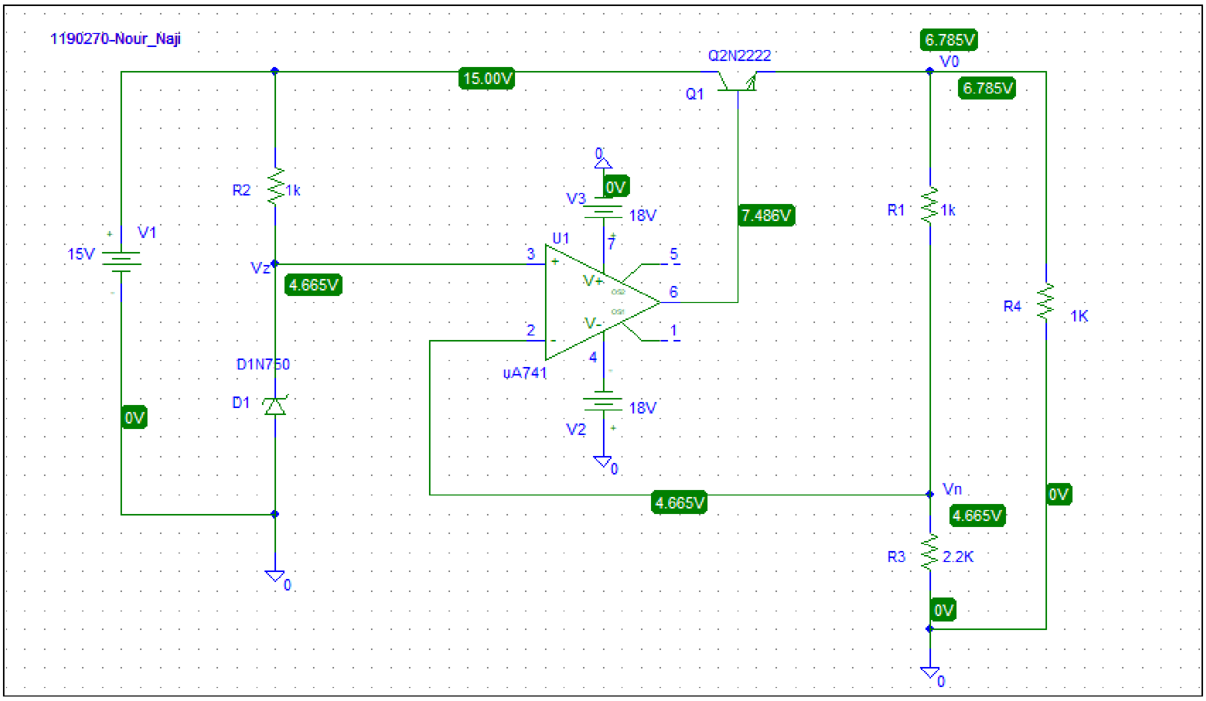
⇨ $V_o = V_z\,[1 + \frac{R2}{R3}]$ = $V_o = 4.665\,[1 + \frac{1K\Omega}{470\Omega}]$ = 14.59V.

- RL = 1 kΩ, R3 = 2.2 kΩ:

⇨ Circuit using PSpice



- Bias point analysis:

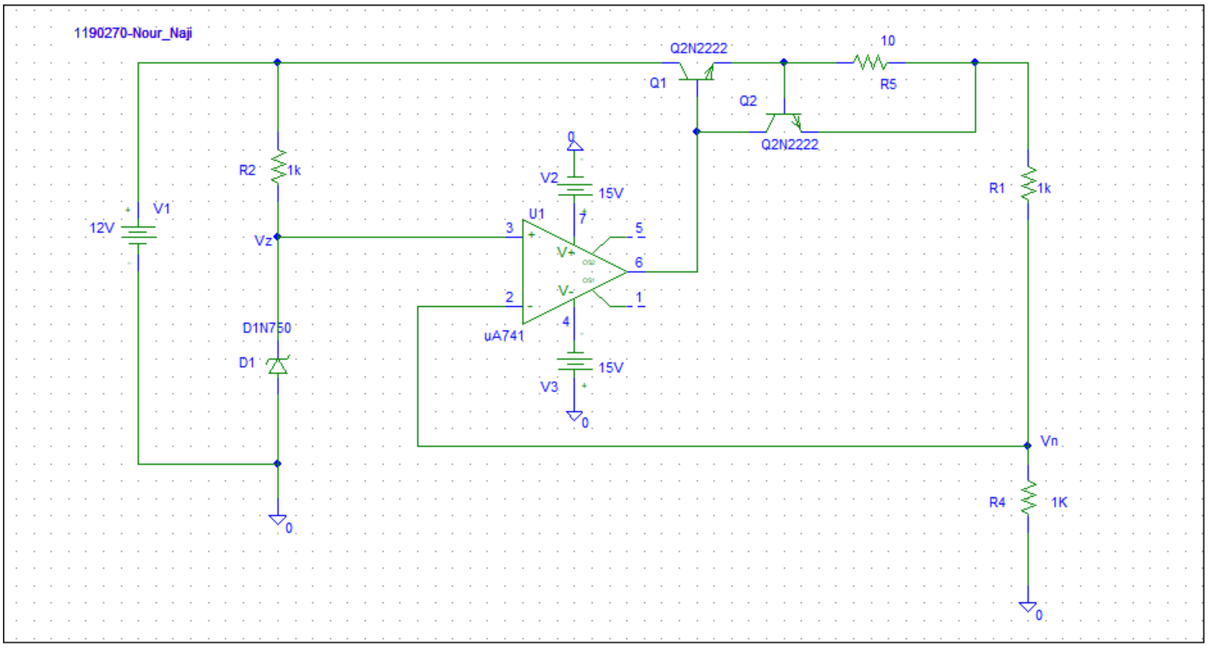


⇨ The output voltage (Vo) = 6.785V, and the voltage across the Zener (Vz)= 4.665 V.

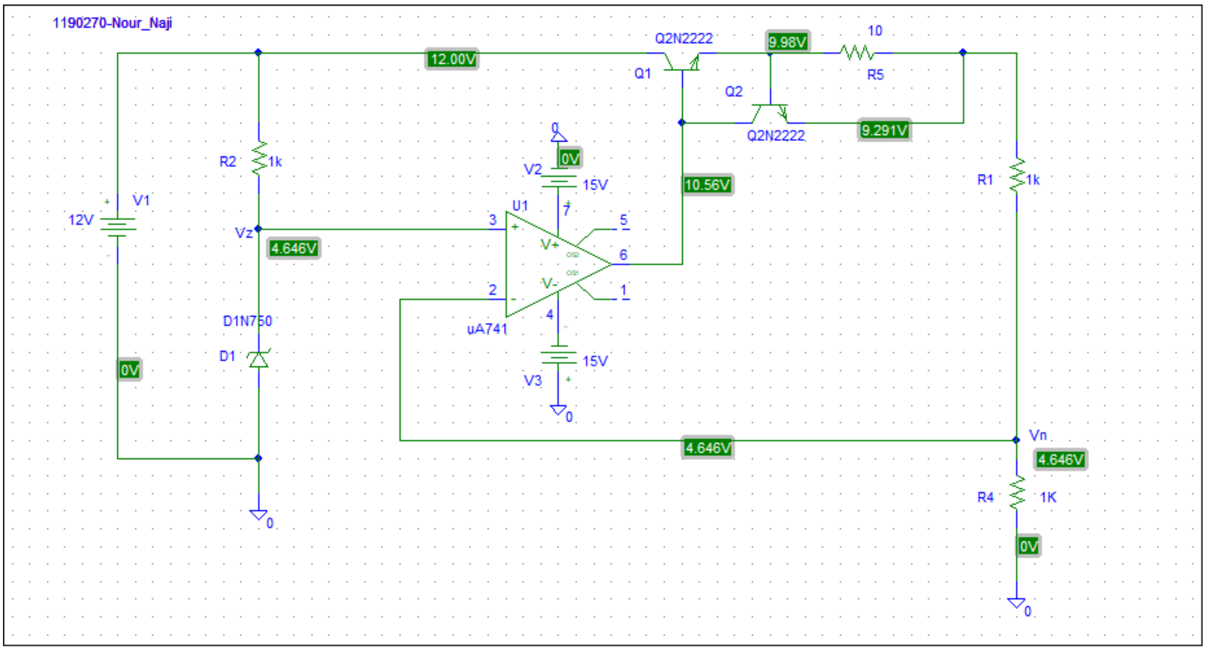
⇨ $V_o = V_z\,[1 + \frac{R2}{R3}]$ $= V_o = 4.665\,[1 + \frac{1K\Omega}{2.2K\Omega}]$ $= 6.7854.$

2.2 Opamp series voltage regulator with current limit

- Circuit using PSpice:



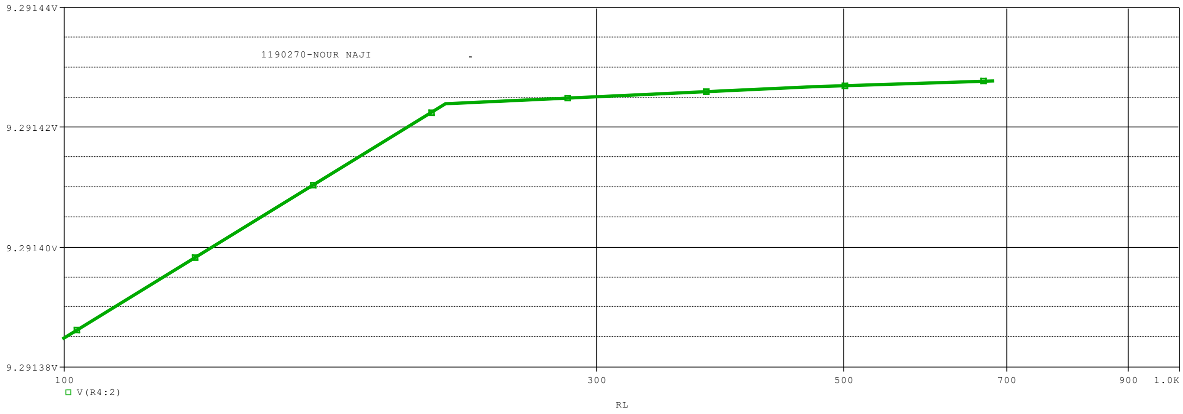
- Bias point analysis:



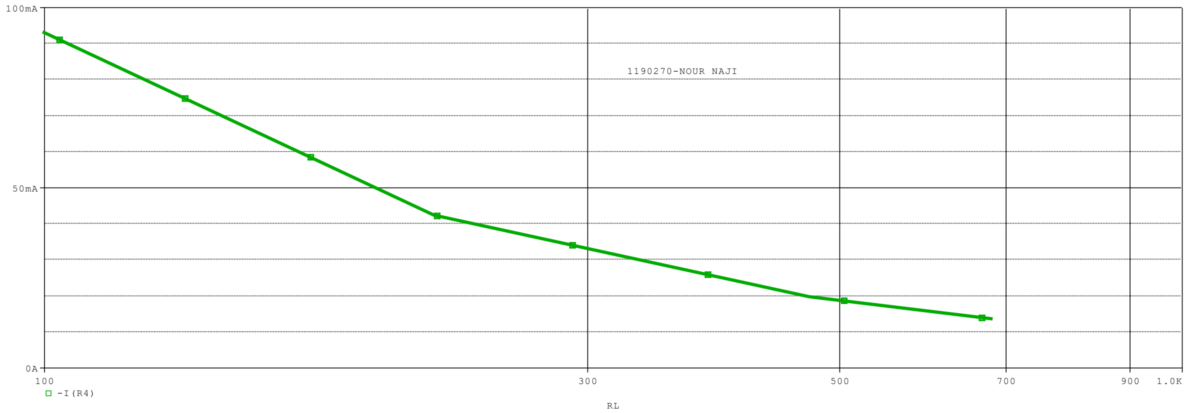
⇨ The output voltage (Vo) = 9.291 V

- Applying DC sweep for Load Resistor (RL):

Vo:

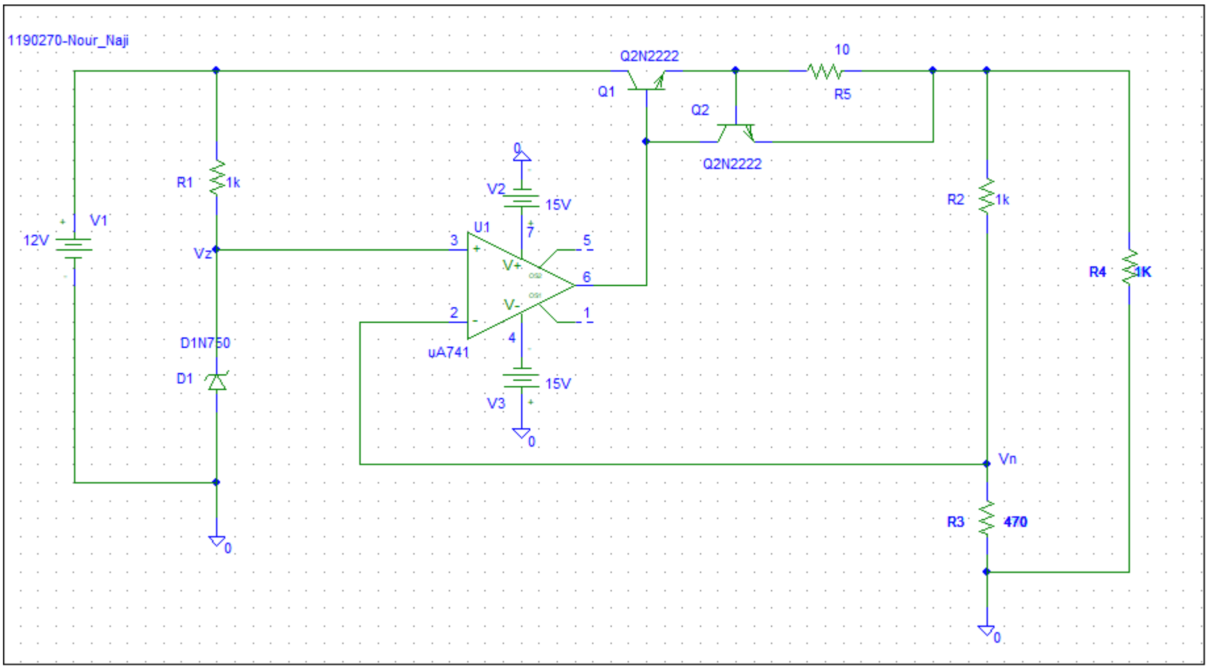


Io:

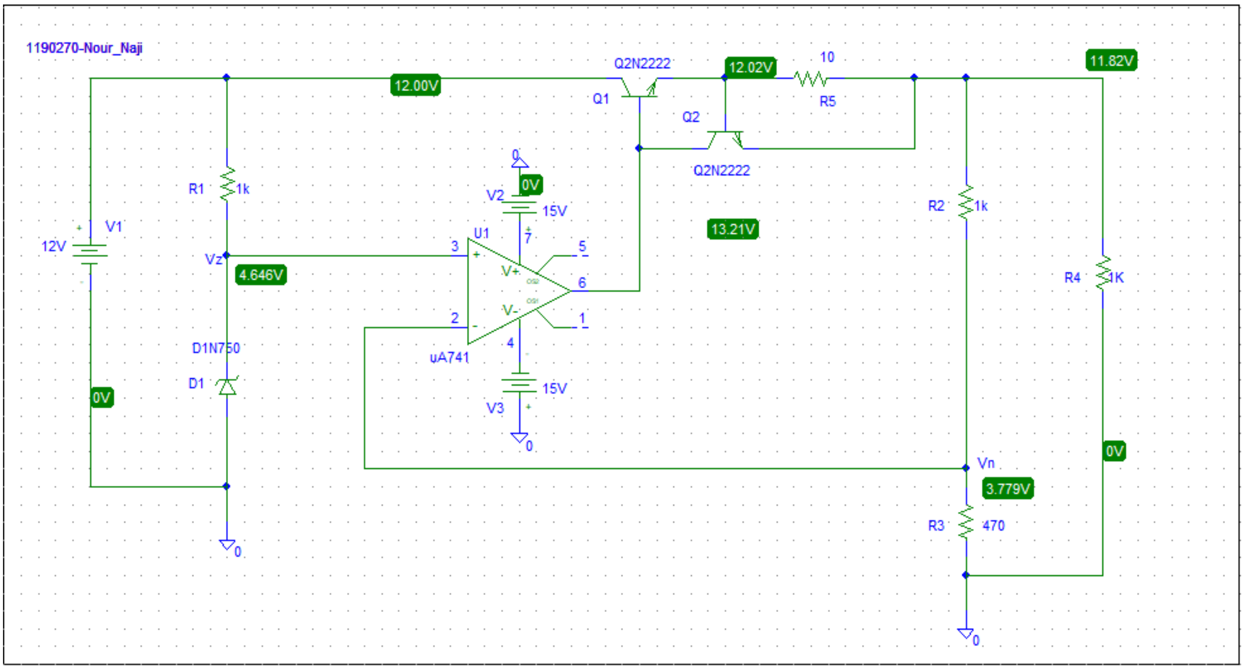


- RL = 1 kΩ, R3 = 470 Ω:

  - Circuit using PSpice:



- Bias point analysis:



⇨ The output voltage (Vo) = 11.82 V