11. Design and analysis of Emergency Lamp

Course: ECE1008 – Electronic Hardware Troubleshooting LAB

-Dr Richards Joe Stanislaus

Assistant Professor - SENSE

Email: 51749@vitstudent.ac.in

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CHENNAI

Aim

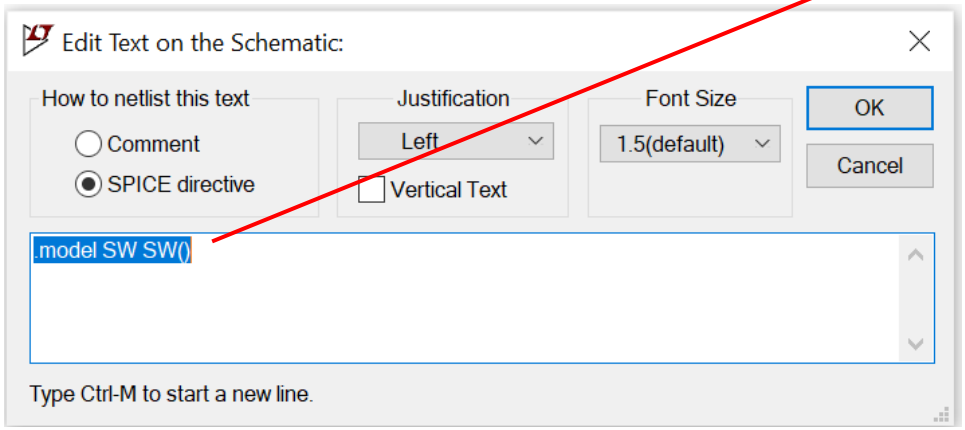
- To design the an emergency lamp with the following specifications:
  Input: 230V 50Hz ac supply
  Battery: 4.8V (four 1.2 V batteries connected in series)
  2 LEDs (in series): NSCW100 with 5 V breakdown voltage
- S1: The charging has to be controlled with an input power supply switch
- S2: A switch to control the emergency lamp settings.

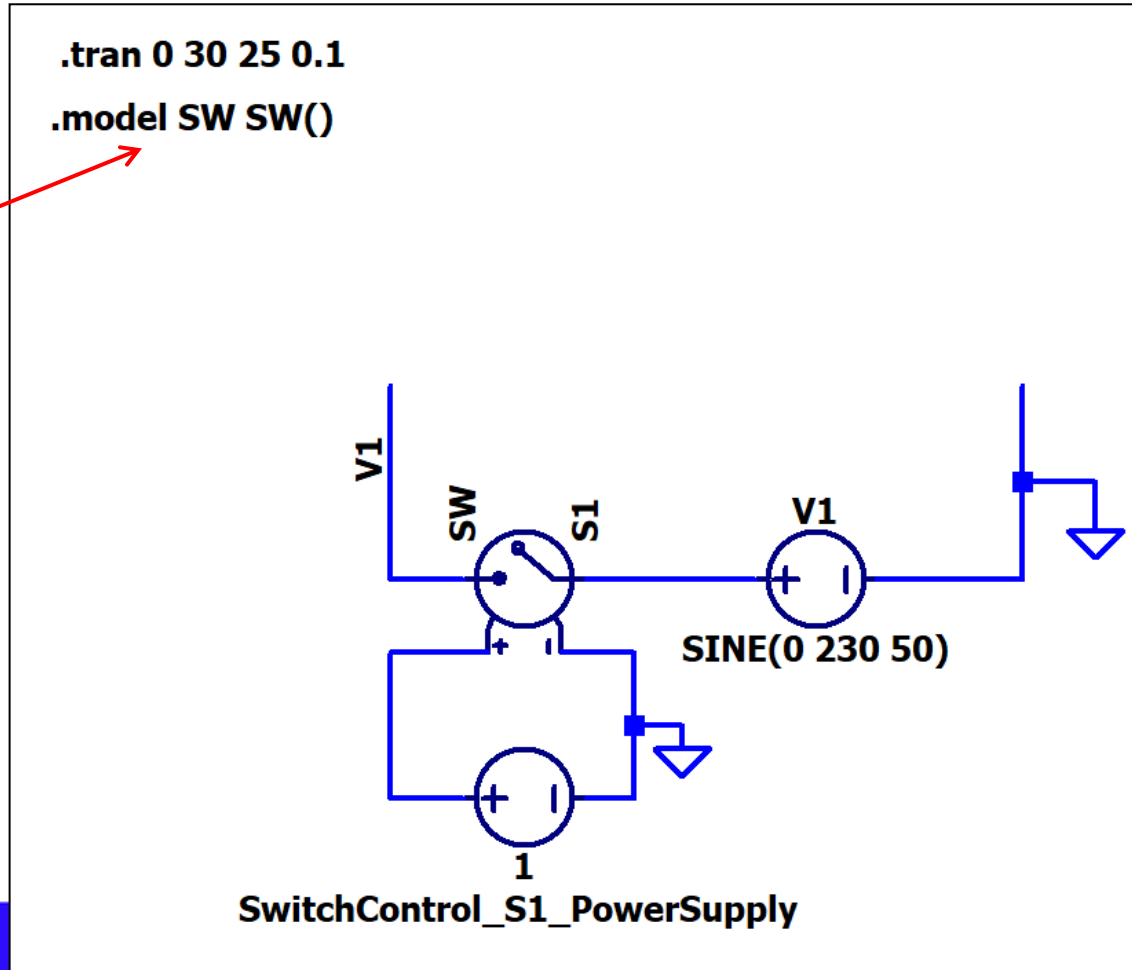
Design cases:

- S1: The charging has to be controlled with an input power supply switch
- S2: A switch to control the emergency lamp settings.
- Cases:
  S1 ON: Charging of batteries from power supply and LEDs are OFF.
  S1 OFF: The charging of batteries stop. Check the switch control of Emergency lamp settings if lamp should be ON or OFF.
  S1 OFF: S2 OFF: LEDs are OFF
  S1 OFF: S2 ON: LEDs are ON (take supply from Battery)

Task 1: Design the input Supply unit with switch control

- Design the following circuit and plot the voltage at V1 w.r.t ground.
- For Switch,
  Go to component library and type SW.
  Then, in spice directive,
  enter ".model SW SW()"





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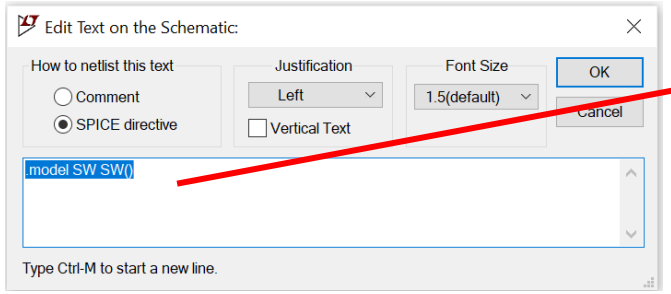
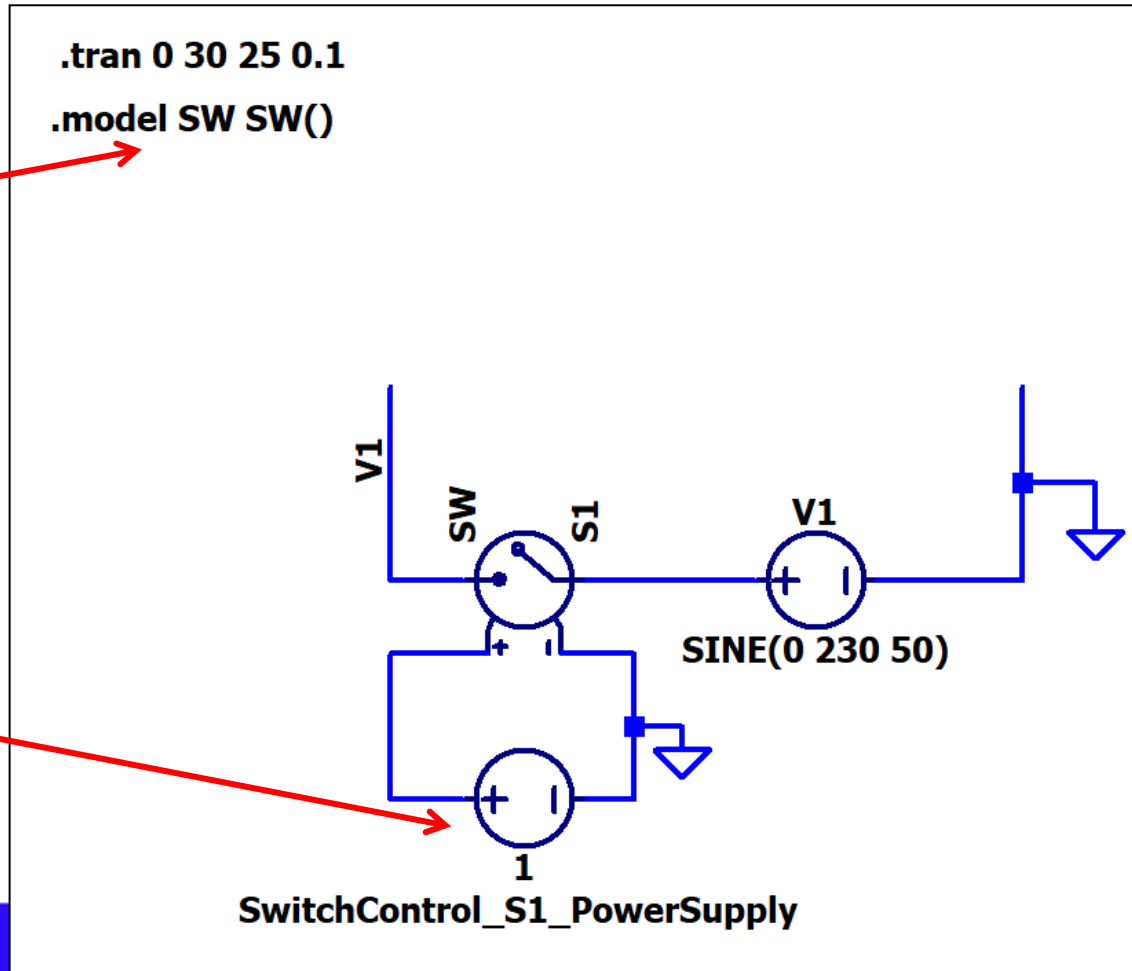
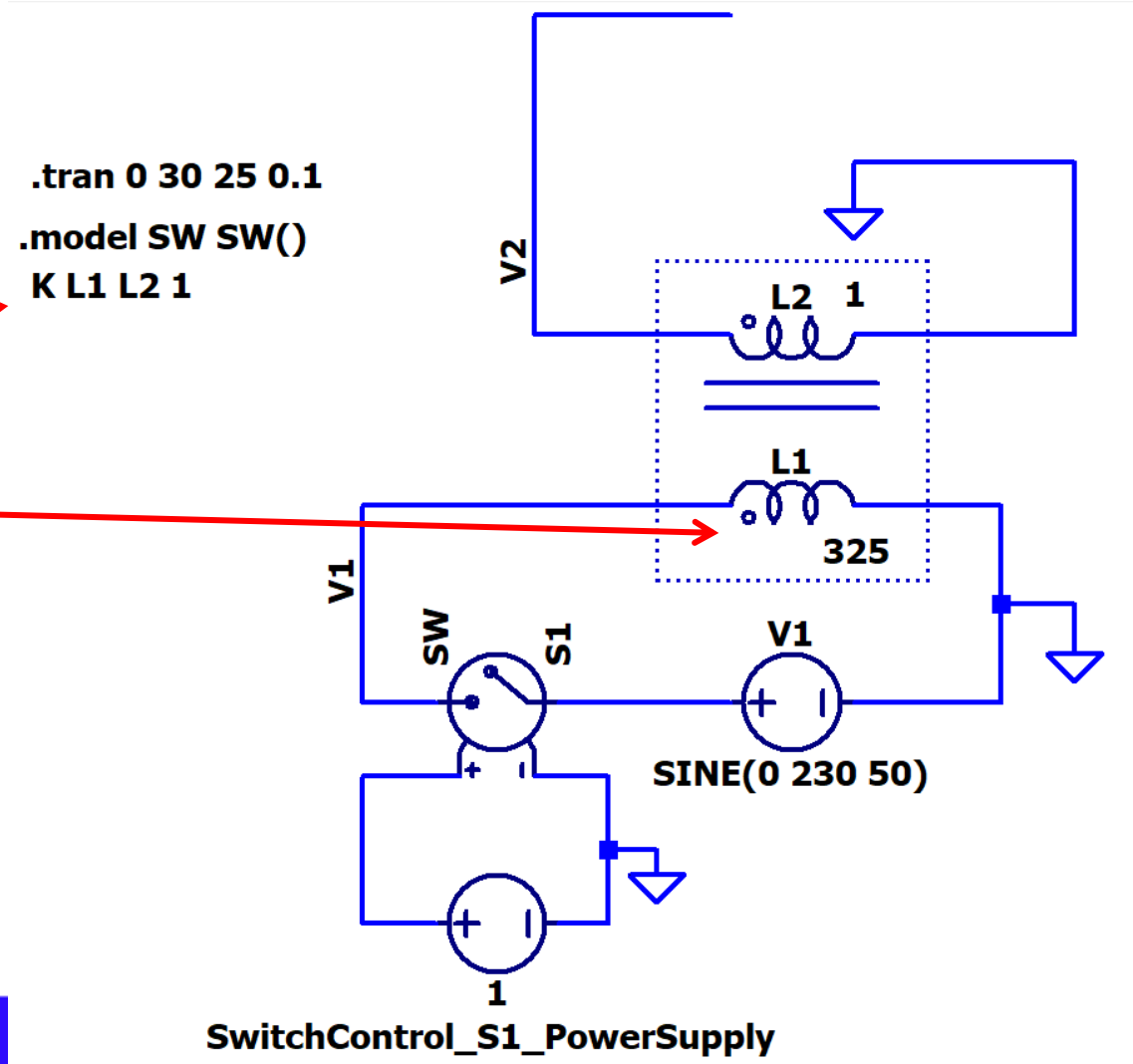


- This power supply is equivalent for controlling the switch.
  When 1, S1 will be ON
  When 0, S1 will be OFF



Task 2: Design the step down transformer for reduced V2 voltage

- The transformer inductance values are such that L1=325H and L2=1H
- Both the coils have **series resistance** of 0.1Ω (Right click at inductor)
- Using Spice directive, enter:
  K L1 L2 1
  to mention the coupling between coils.



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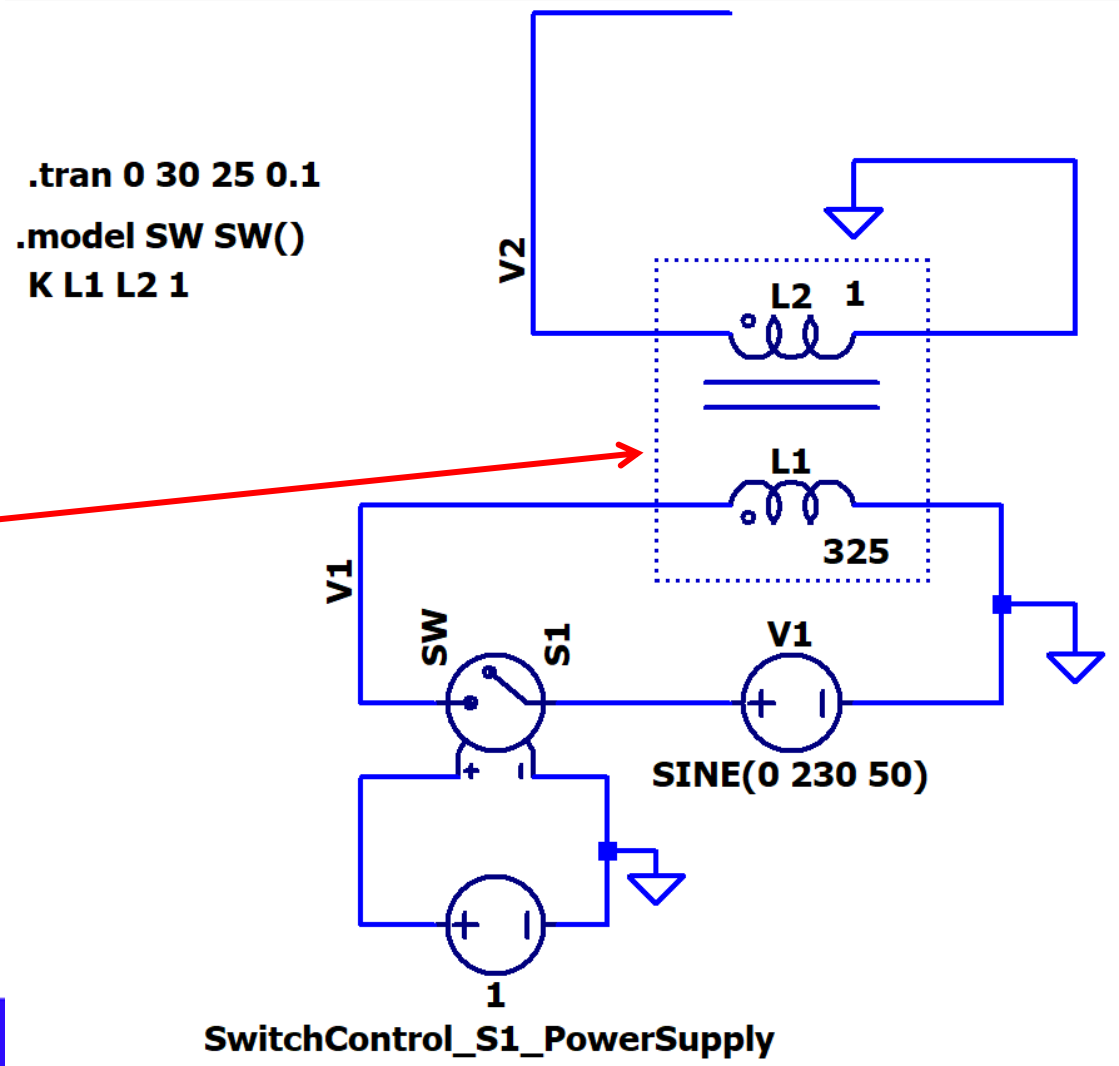
- Using Spice directive, enter:
  K L1 L2 1
  to mention the coupling between coils.
- Right click on screen, to draw two lines and box
- **Plot the voltage at V2 (stepped down voltage)**

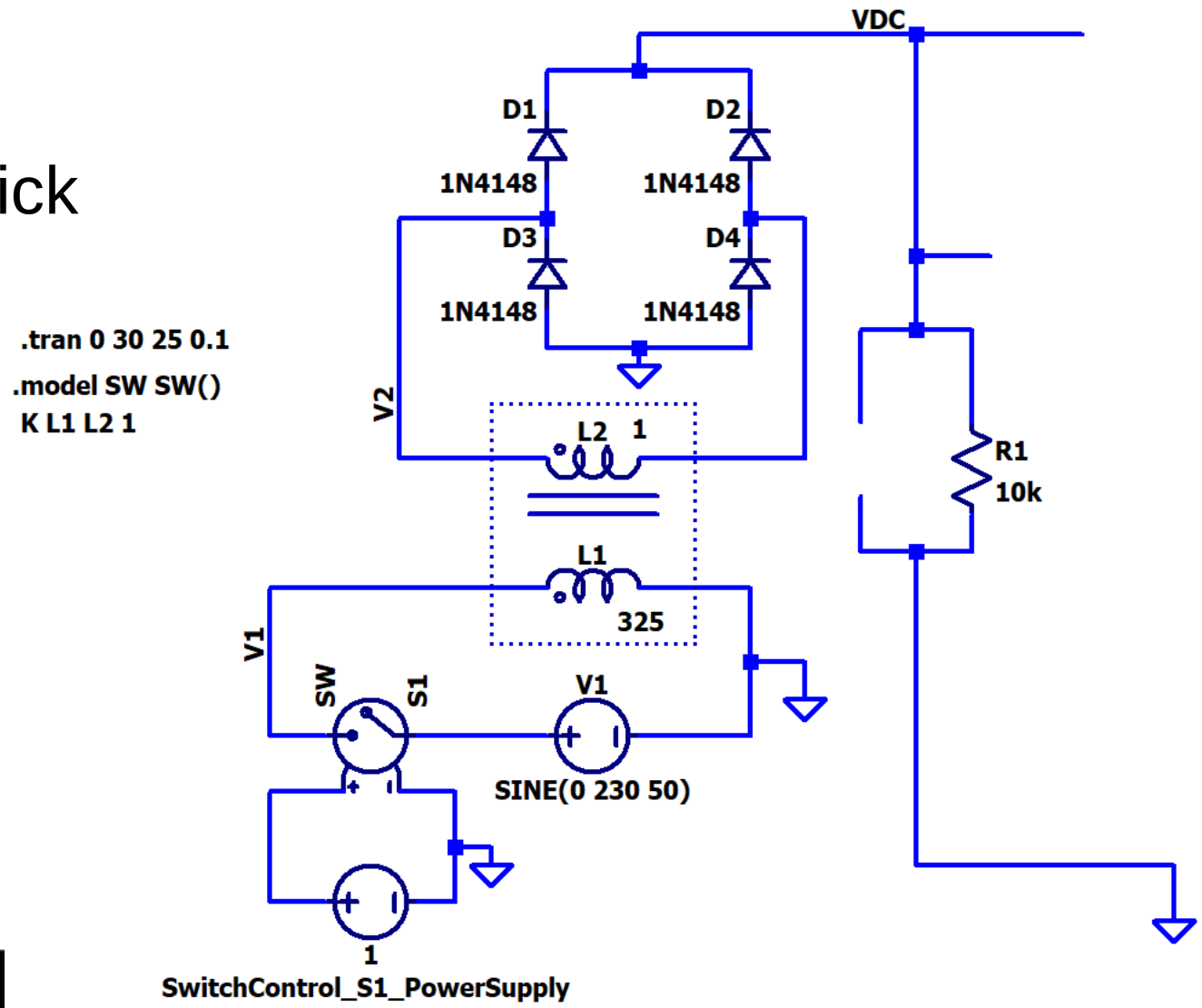


Task 3: Design of Bridge rectifier circuit (without Capacitor)

- Design the bridge rectifier circuit

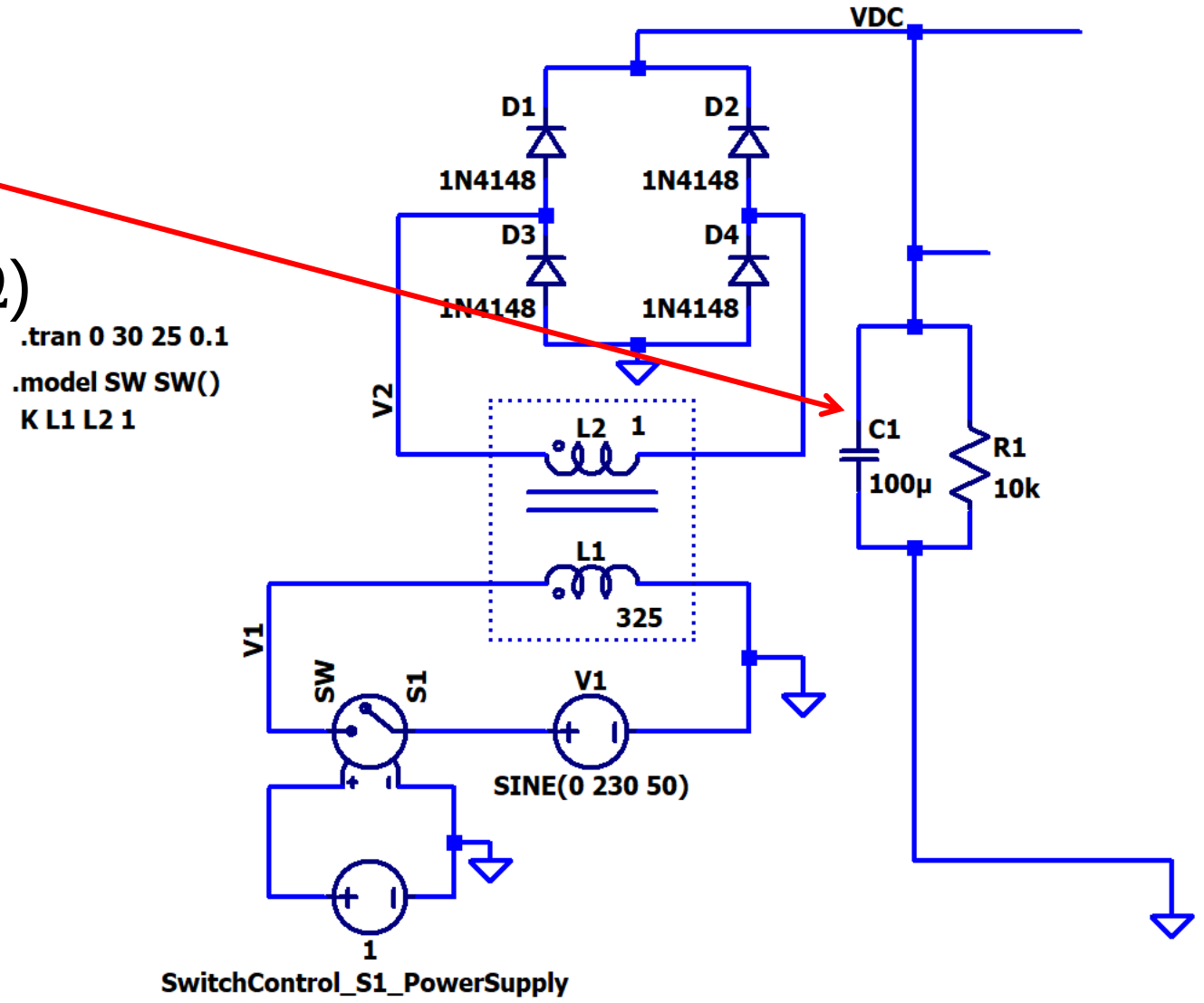
  Note: After placing diodes, right click and select 1N4148 diode.

- Plot the voltage at VDC (without capacitor across load)



Task 4: Design of Bridge rectifier circuit (with Capacitor)

- Design the bridge rectifier circuit with the capacitor (100uF)
- Plot the voltage at VDC (voltage across the load R1=10kΩ)

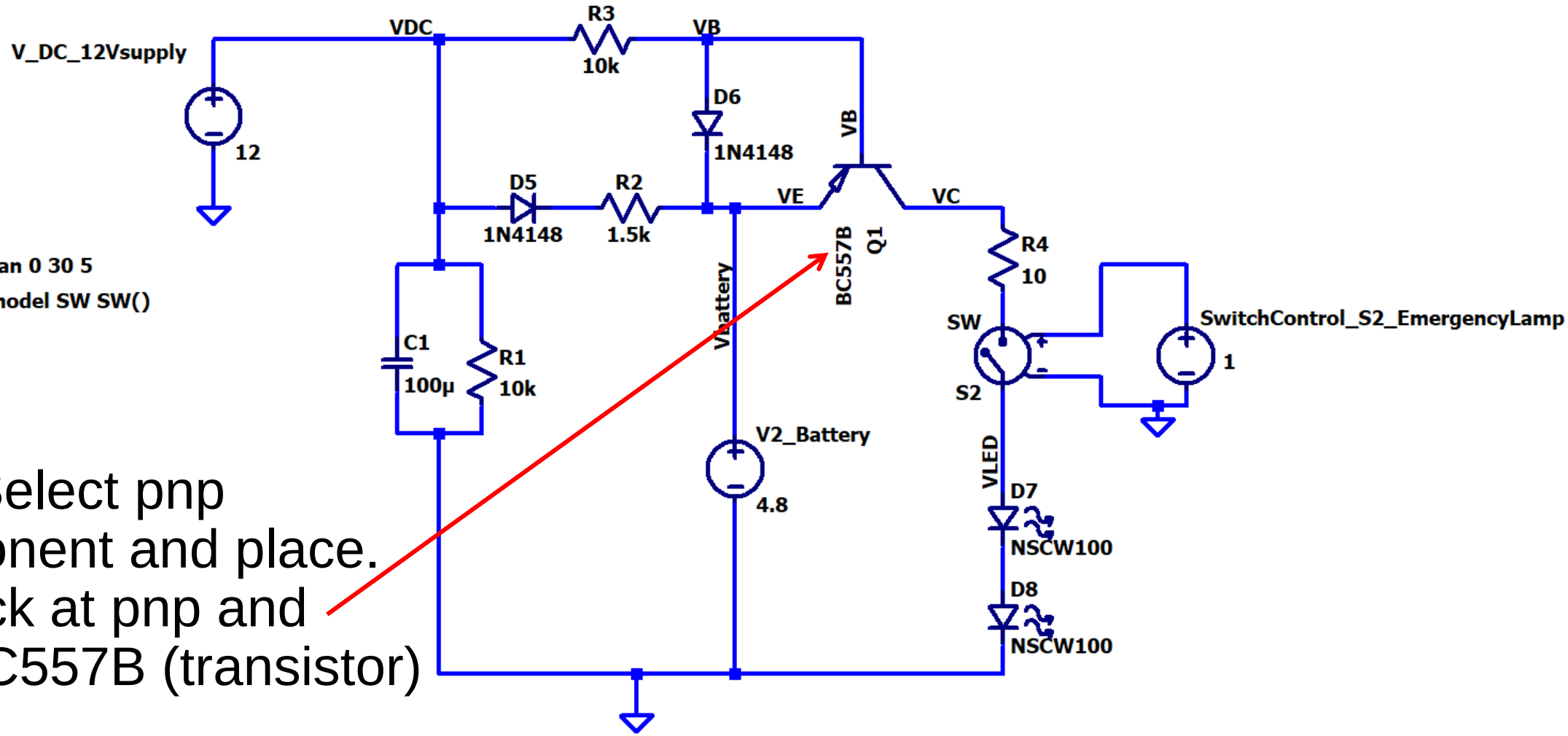


Task 5: Design of Charging circuit from 12V DC input supply

- Design the circuit as shown below and also name the nodes using Label

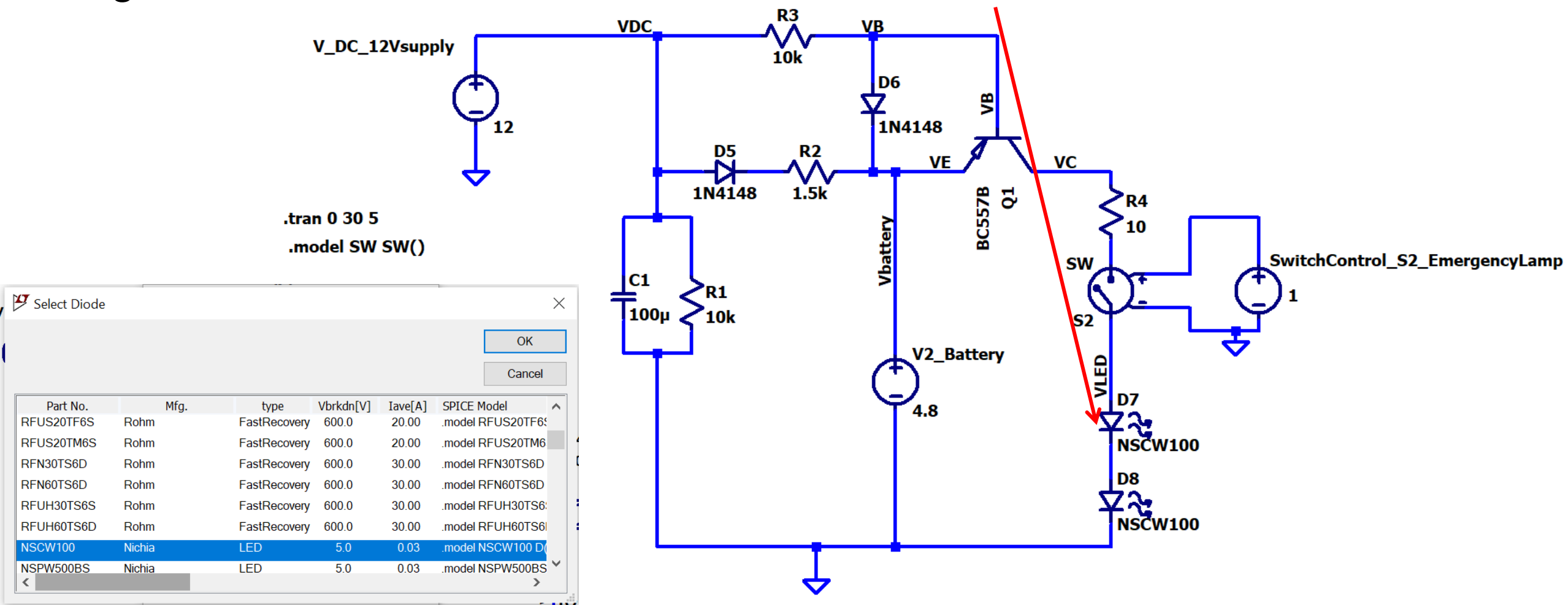
  VDC
  VB
  VE
  VC
  Vbattery
  VLED

- NOTE: Select pnp in component and place. Right click at pnp and select BC557B (transistor)



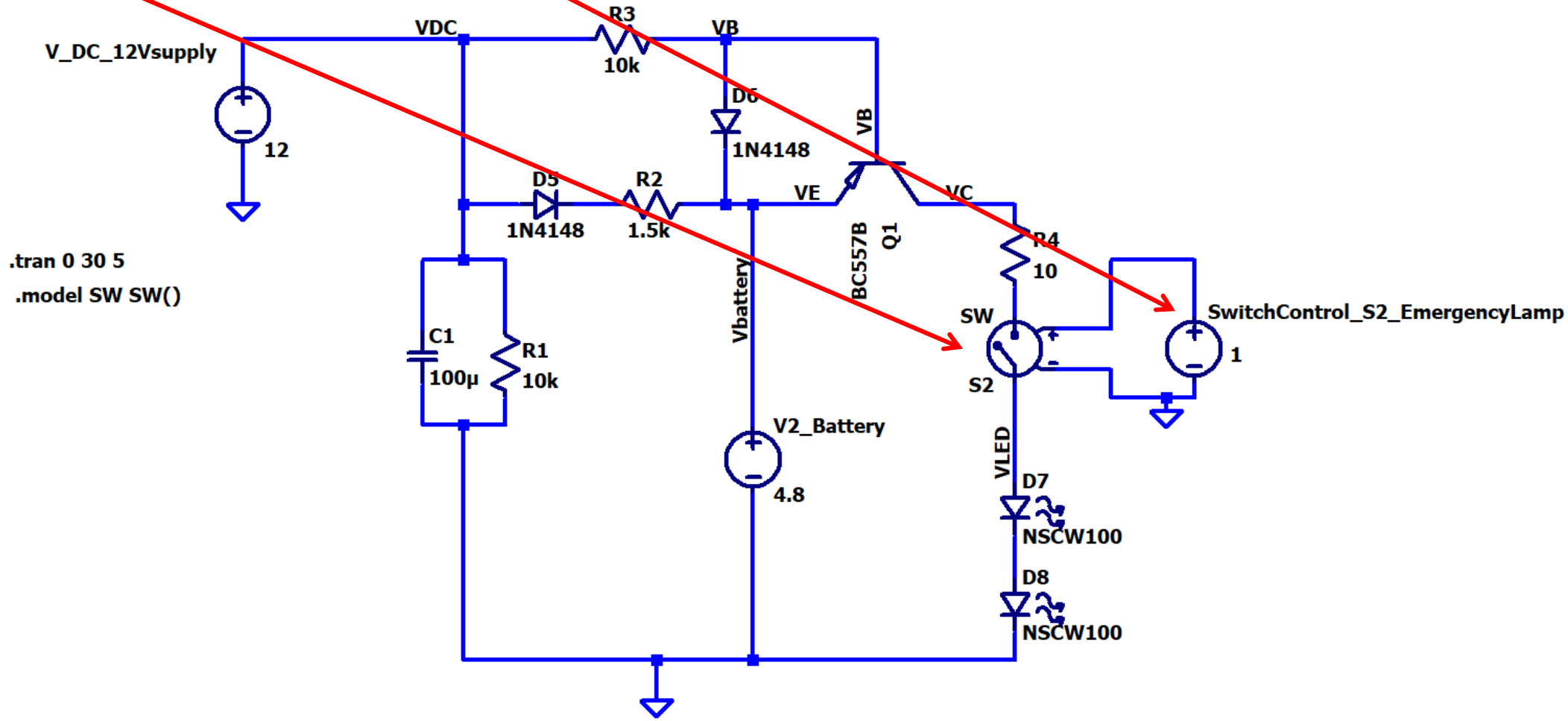
Task 5: Design of Charging circuit from 12V DC input supply

- For LEDs: Select diode in component library and place two diodes, Right click and select diode – Select NSCW100



Task 5: Design of Charging circuit from 12V DC input supply

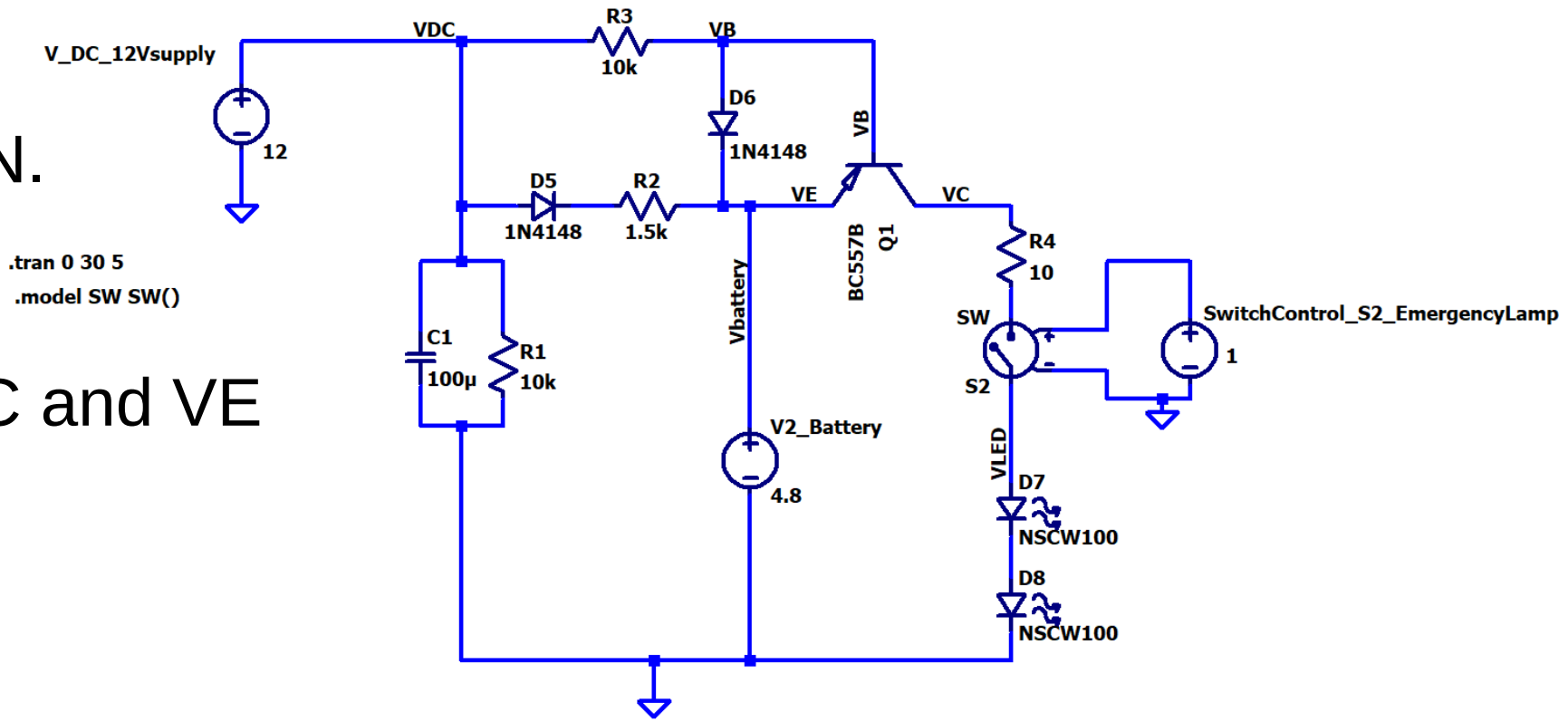
- Switch S2 has a control source with 1V for S2 ON.



Task 5: Design of Charging circuit from 12V DC input supply

Case 1: Input DC is ON.

- When VDC=12V, VE=4.8V
  Voltage between VDC and VE is 7.2V.
  This is across D5, R2 and across R3, D6.



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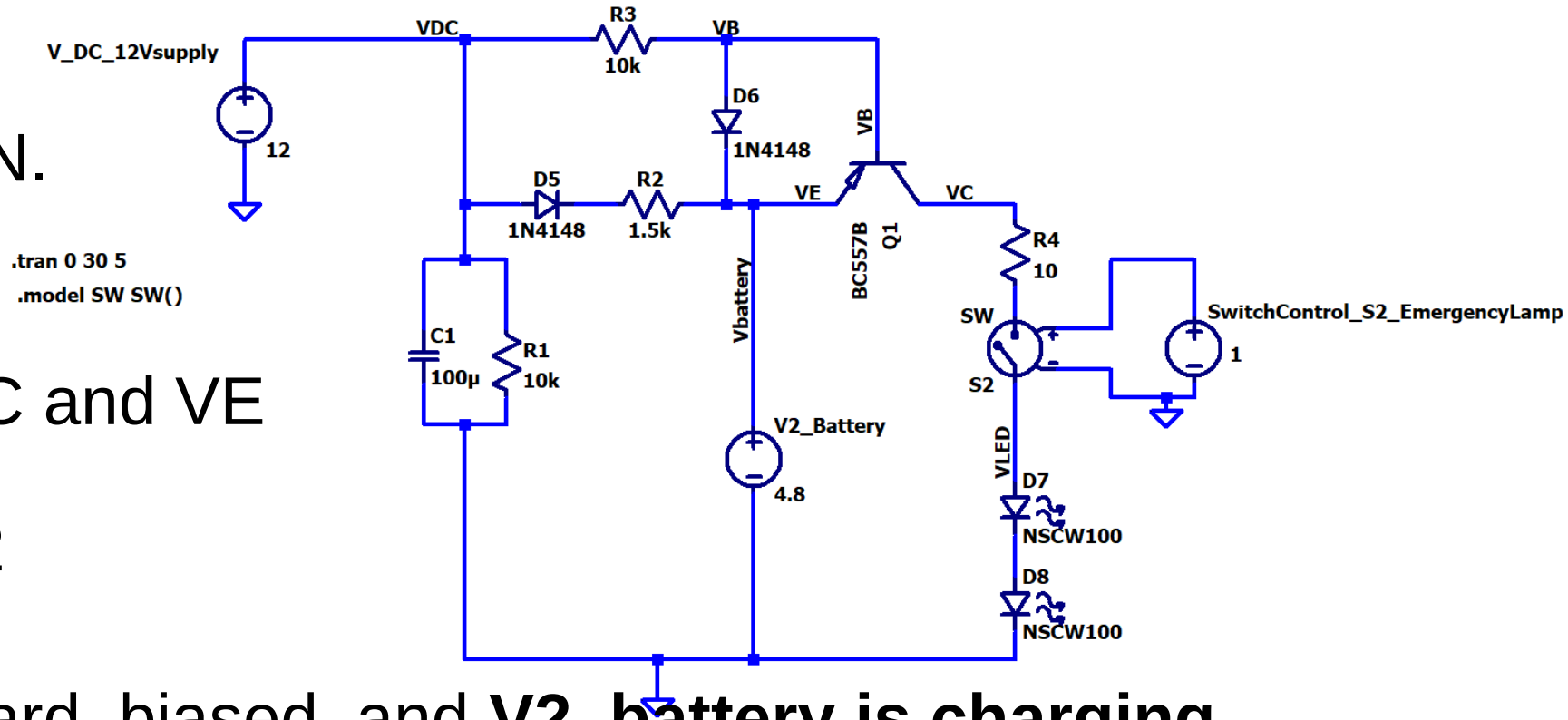
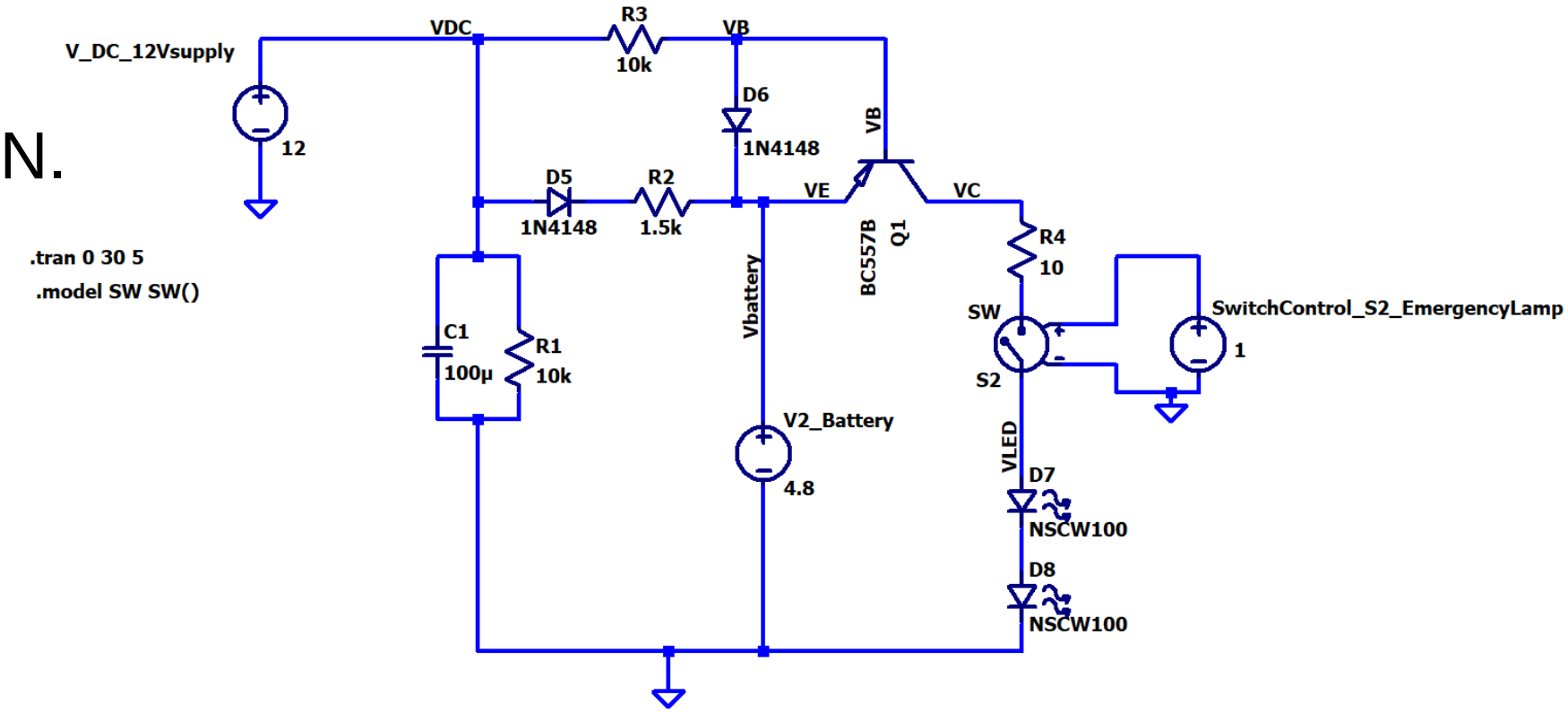


- Both diodes are forward biased, and **V2_battery is charging**.
  Hence Voltage between VB and VE is positive. (VBE is positive)
- In **PNP transistor**, VBE should be negative for transistor to be ON. But here VBE is positive, hence transistor is in CUTOFF. Hence No supply to LEDs, **LEDs are OFF when input supply exists**.

Task 5: Design of Charging circuit from 12V DC input supply

Case 1: Input DC is ON.

- With
  DC ON,
  Plot VDC
  Plot Vbattery
  Plot VE
  Plot VB
  Plot VC
  Plot VLED



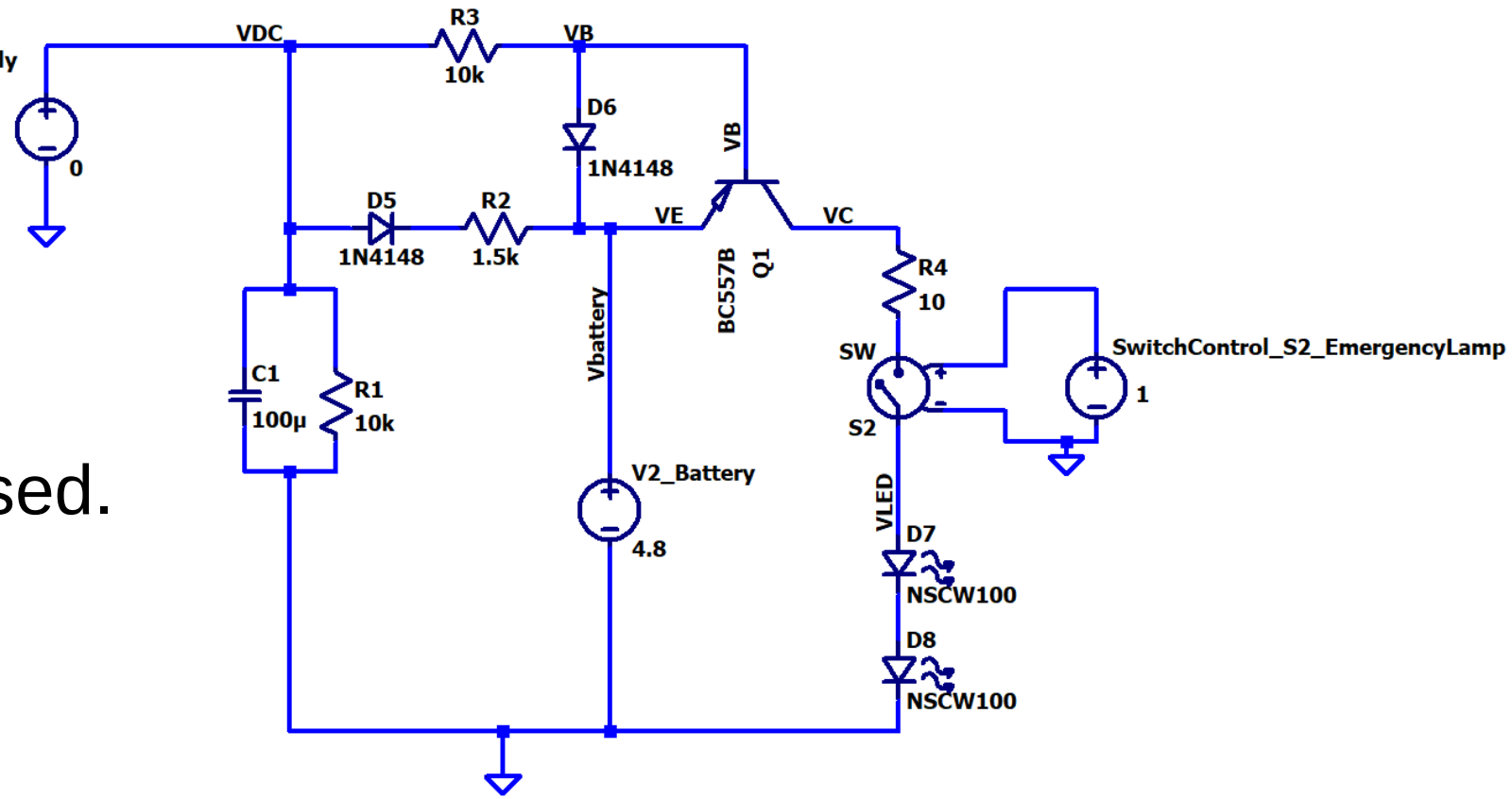
Task 5: Design of Charging circuit from 12V DC input supply

Case 2: Input DC is OFF.

VDC=0V

VE=4.8V

D5 and D6 are reverse biased.



Task 5: Design of Charging circuit from 12V DC input supply

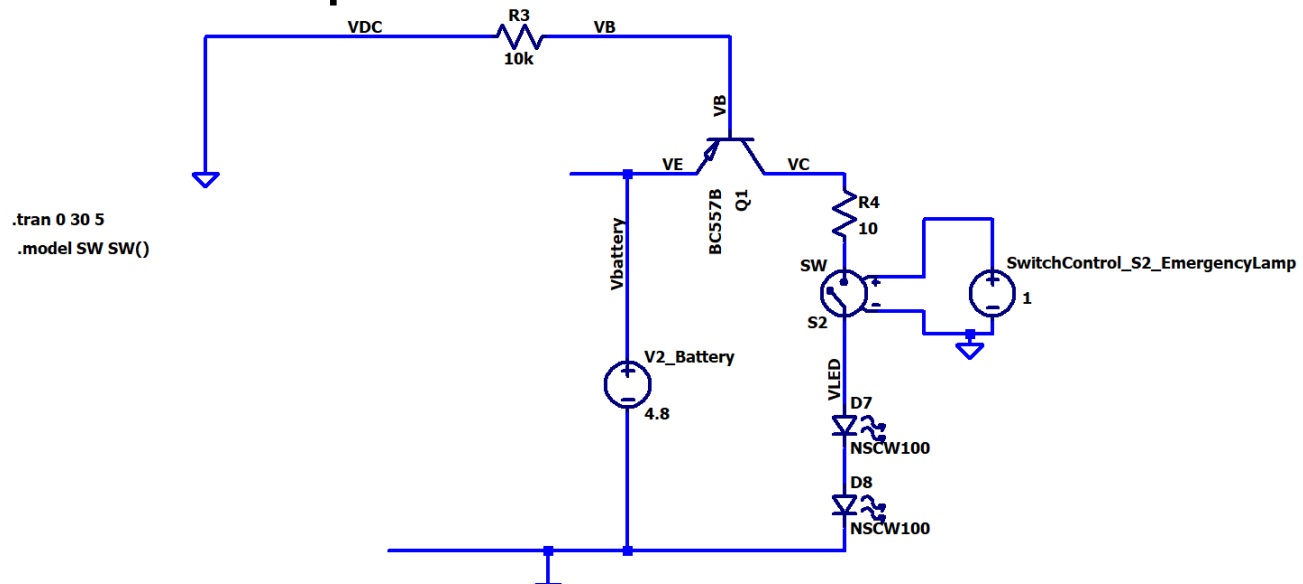
Case 2: Input DC is OFF.

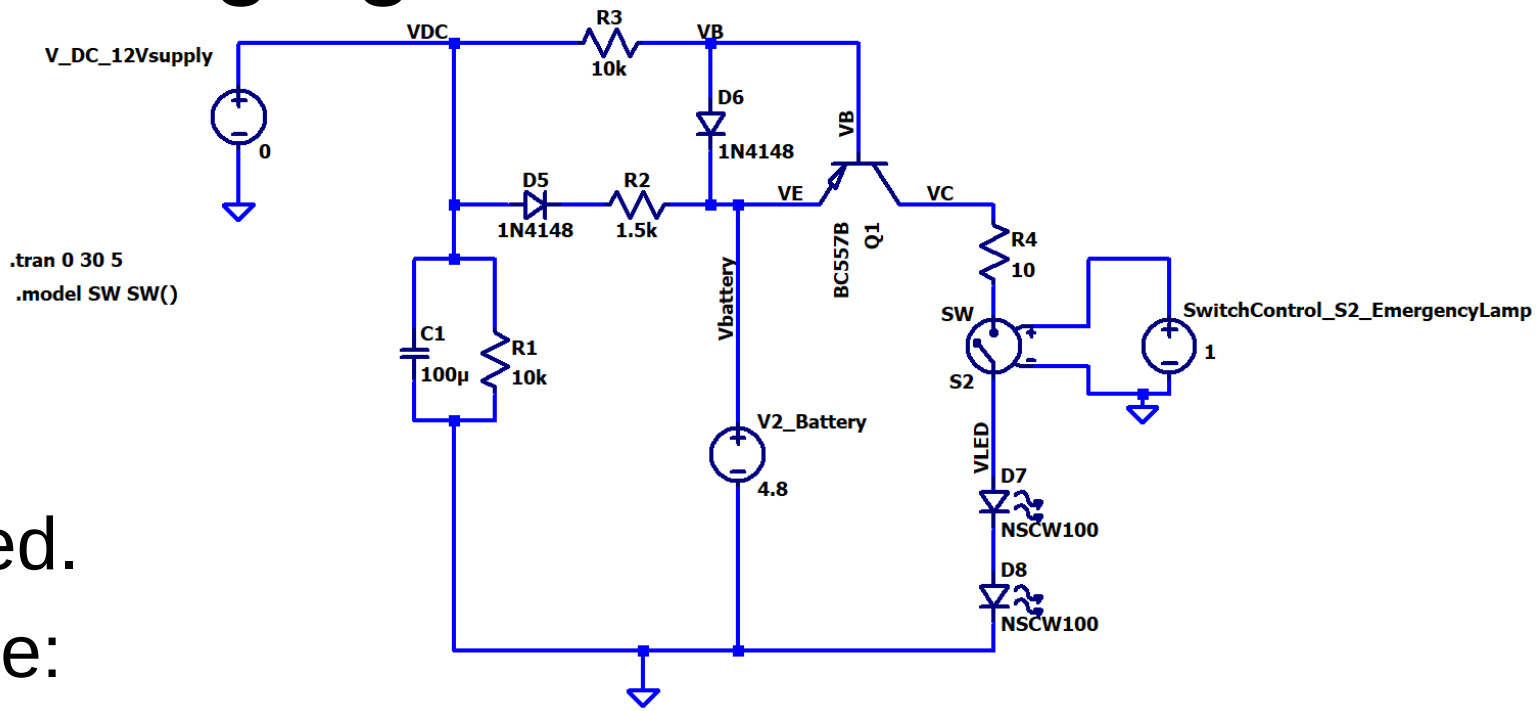
VDC=0V

VE=4.8V

D5 and D6 are reverse biased.

The circuit has equivalent like:





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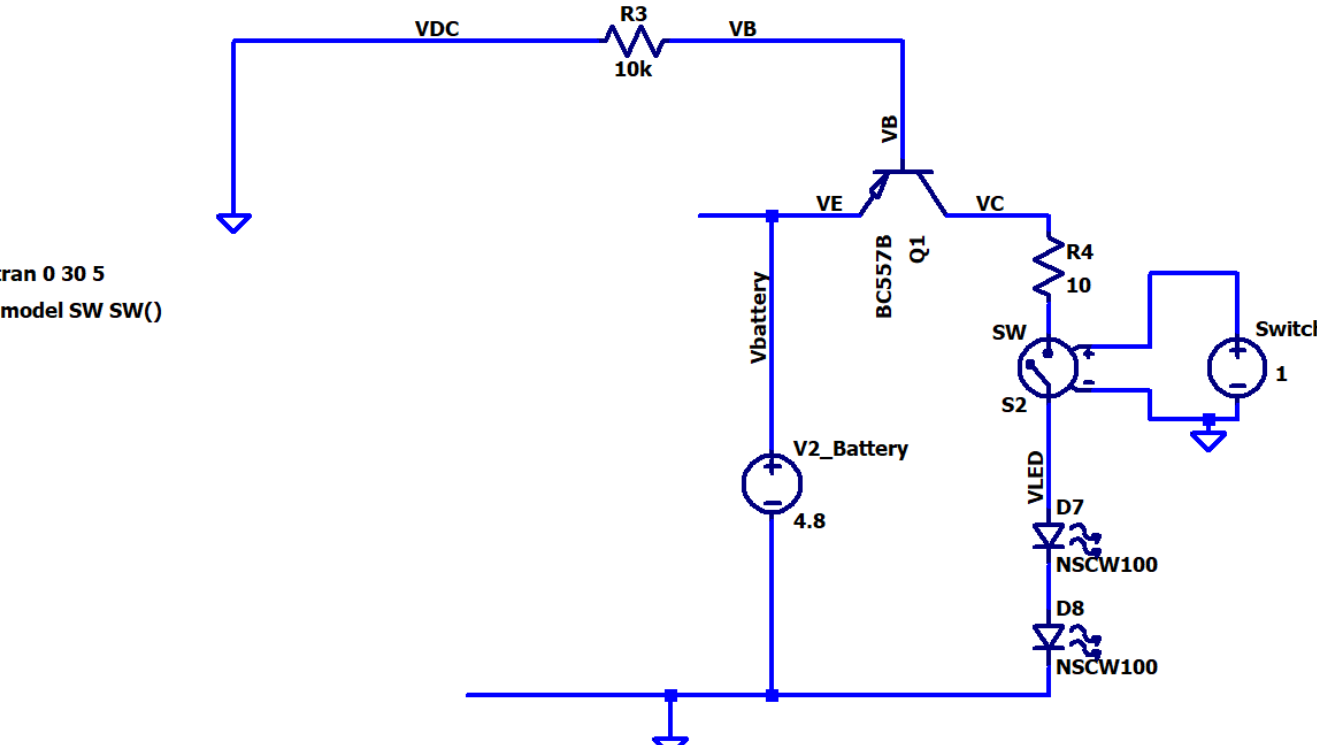
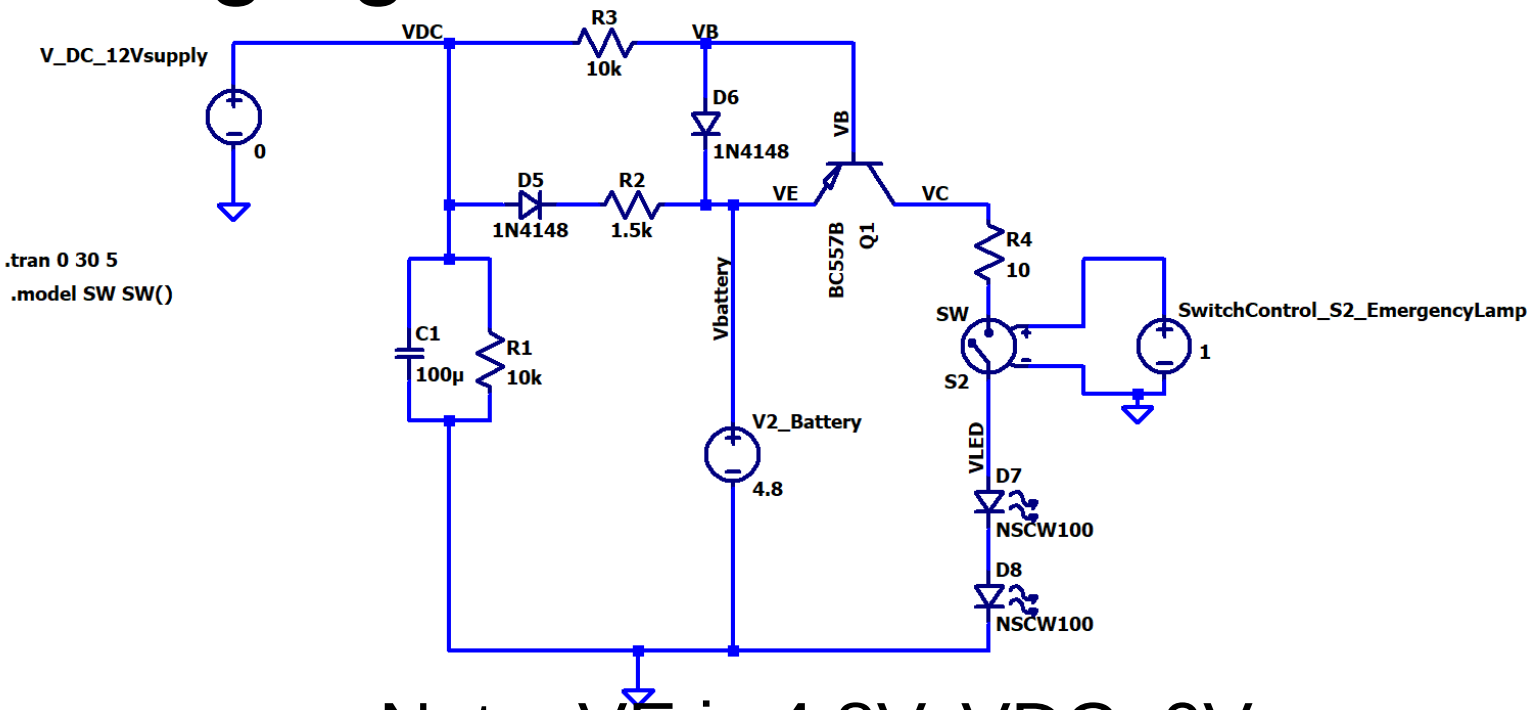




Note: VE is 4.8V, VDC=0V
VBE is negative

PNP: VEB is positive (VBE is –ve)
Transistor conducts:
4.8V across VC. With S2 ON, LEDs are ON

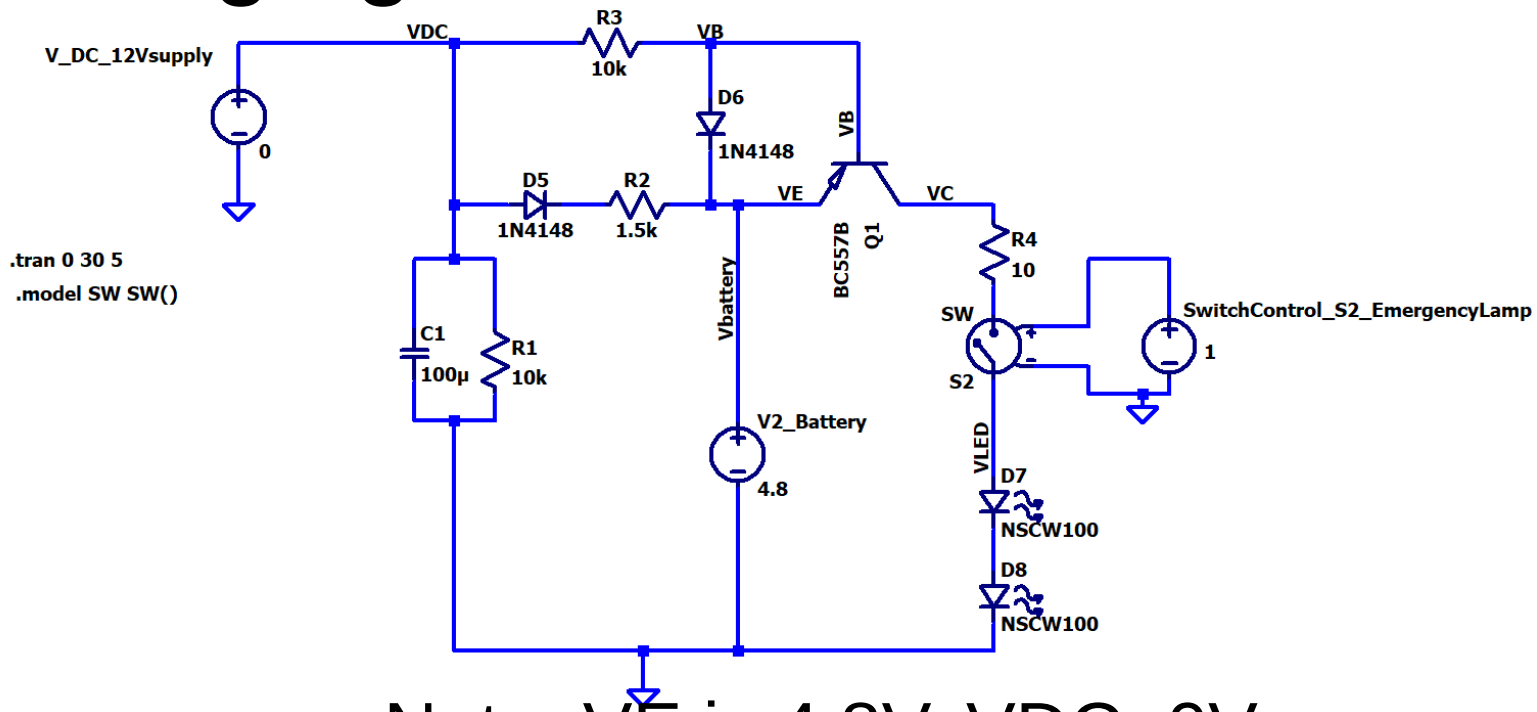
Task 5: Design of Charging circuit from 12V DC input supply

Case 2: Input DC is OFF.
VDC=0V

VE=4.8V
D5 and D6 are reverse biased.

The circuit has equivalent like:

With battery supply, the Emergency lamp is ON.



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VBE is negative

PNP: VEB is positive (VBE is –ve)
Transistor conducts:
4.8V across VC. With S2 ON, LEDs are ON

Task 5: Design of Charging circuit from 12V DC input supply

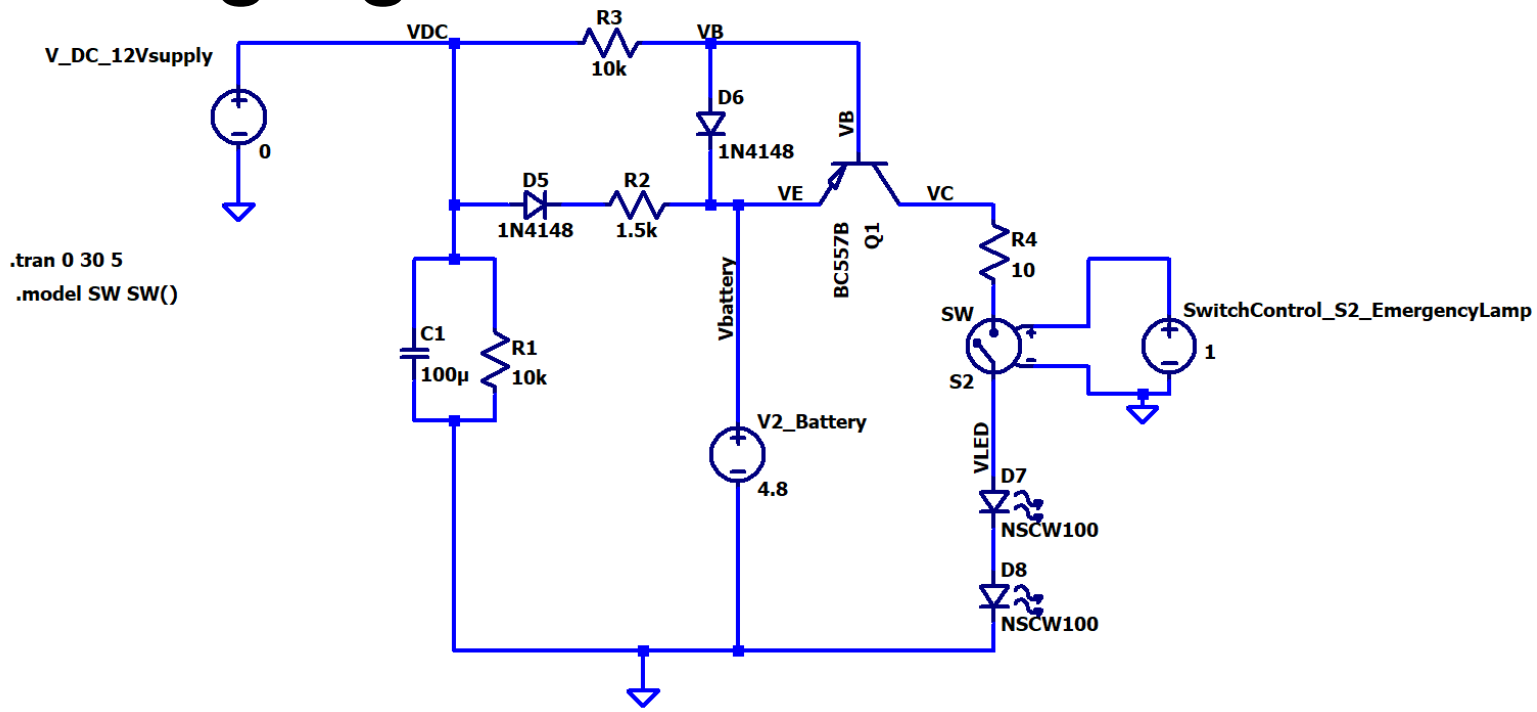
Case 2: Input DC is OFF.
VDC=0V

Plot VB
Plot VE

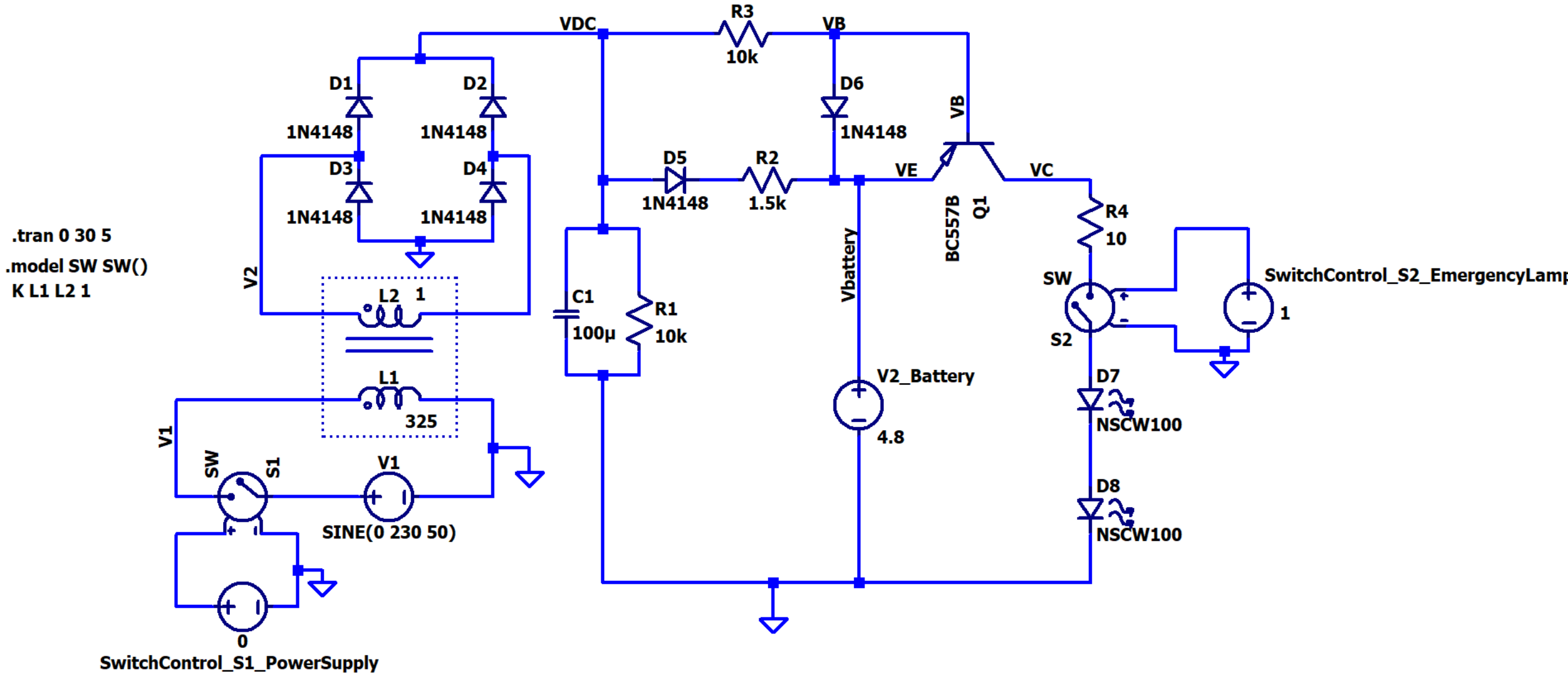
Plot VC

Plot VE

Plot VLED



Task 6: Integrate Bridge circuit to Emergency Lamp: Complete the circuit



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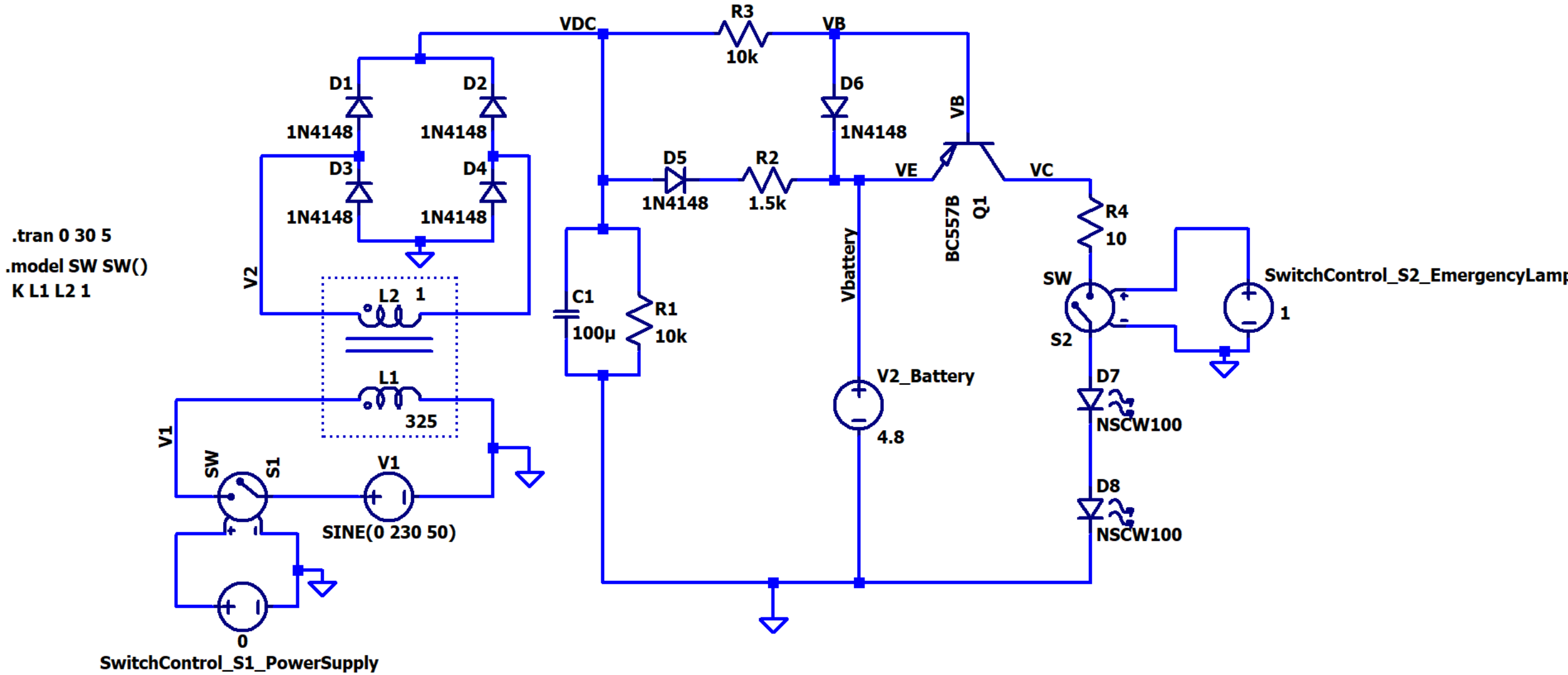
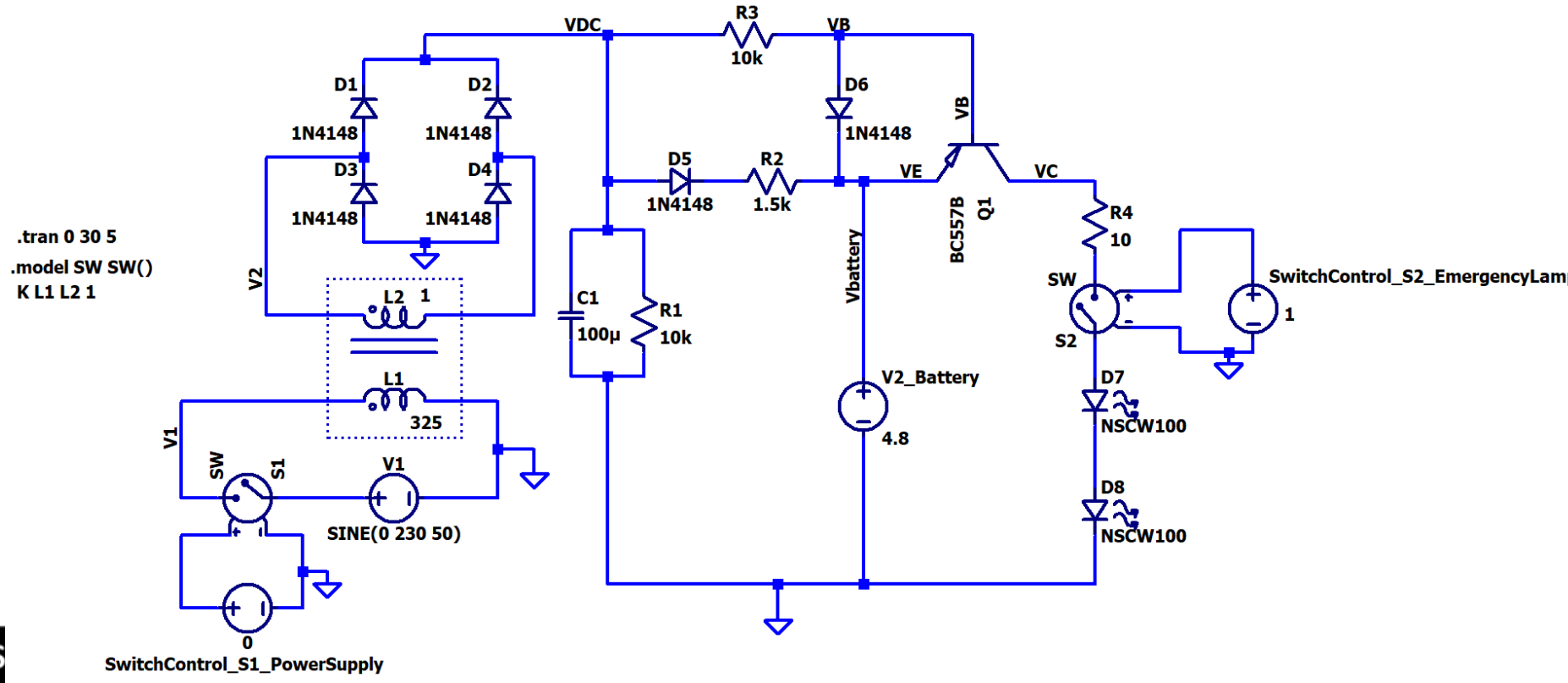


Task 6: Integrate Bridge circuit to Emergency Lamp: Complete the circuit

a) With S1 ON, S2 ON, Plot the following:
   - V1
   - V2
   - VDC
   - Vbattery
   - VB
   - VE,
   - VC,
   - VLED

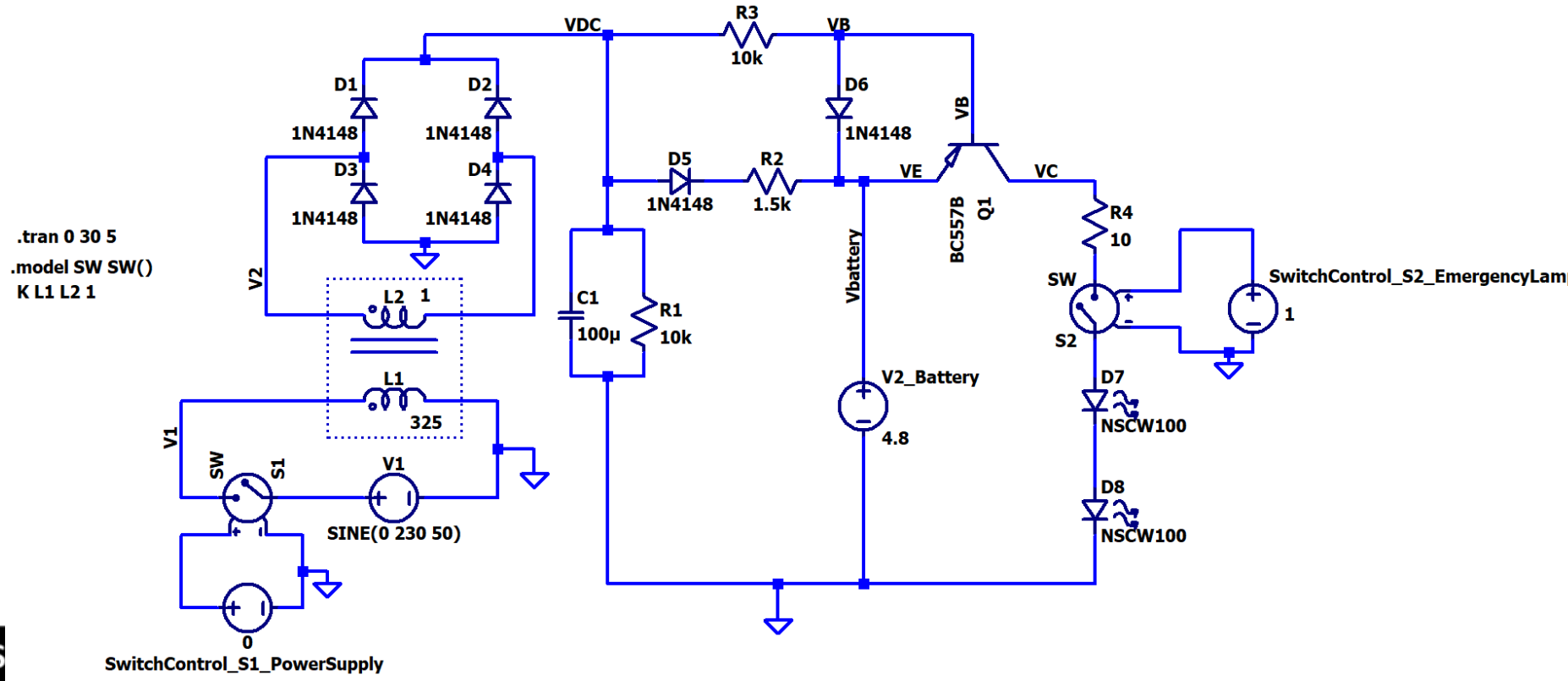
Comment on VC, VLED



Task 6: Integrate Bridge circuit to Emergency Lamp: Complete the circuit

b) With S1 OFF, S2 ON, Plot the following:
- V1
- V2
- VDC
- Vbattery
- VB
- VE,
- VC,
- VLED

Comment on VLED

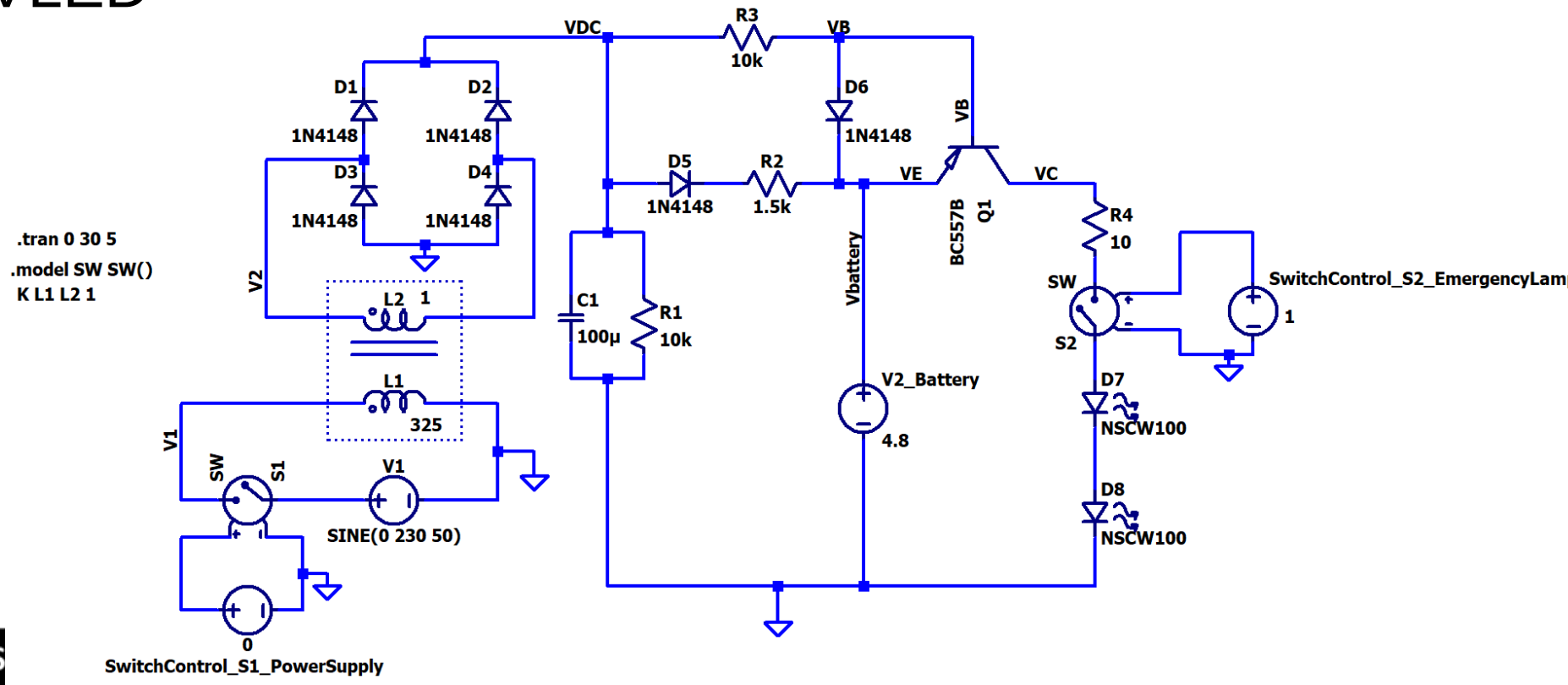


Task 6: Integrate Bridge circuit to Emergency Lamp: Complete the circuit

c) With S1 OFF, S2 OFF, Plot the following:

VLED

Comment on VLED



Important NOTE

- Enter your **registration number** and **Full Name** next to

  all your circuits and
  the output plots.
- Keep the background of circuit and plot as white.

LAB record instructions:

For the lab experiment,

- Write the **Aim**.
- Complete the **Software/Hardware components used**.
- **Obtain the expression for the outputs.**
- Place the respective **circuits in LT Spice**.
- Connect the inputs and outputs. Name them and **write the same in the lab copy(inputs and outputs section)**.
- Use probe in LT spice to plot all possible combinations.
- Write a **concluding statement for each circuit**.
- **Submit** the document's soft copy **on time** in lms.vit.ac.in when available.