Lab 4: Temperature dependance of Solar cell characteristics

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Part 1: I-V characteristics of Solar cell

- Modify the netlist written for I/V characteristics of a solar cell in the previous lab.
- Run the simulation to measure the dark forward characteristics at 35^0C, 45^0C, 55^0C, 65^0C, and 75^0C.
- Note the values of V_D for I_D=1mA, 2mA and 5mA.
- Fill up in the observation table 1 below. Calculate η for low forward bias (1mA) and for high forward bias (5mA) at all the temperatures.

Sr.No	$V_D$for I_D=1mA	V_D for I_D=2mA	$V_D$for I_D=5mA	η for I_D=1mA	η for I_D=5mA
35^0C					
45^0C					
55^0C					
65^0C					
75^0C					

Table 1

Note:-Refer ngspice commands to run simulation at different temperature.

Part-2: Lighted I/V Characteristics

In this part, we will plot the I/V characteristics of the solar cell when used as a power source. We will measure I/V characteristics at various temperatures when the solar cell is lighted at the intensity to generate I_L=8mA.

- A load resistor R is connected across the solar cell same as you have done in the previous lab. The value of R is varied from 1 to 500Ω and the values of I_R and V_R are recorded for the temperatures 35^0C to 75^0C in steps of 10^0C.
- Plot I_D-V_D and P_R-V_D characteristics under lighted condition at all the temperatures. Note the values of Voc and Isc values for all temperatures.
- Obtain Fill Factor (FF) for all the temperature and plot FF v/s temperature.
- Plot V_D v/s Temp and V_{oc} v/s Temp. You will get three sets of V_D for I_D = 1mA, 2mA and 5mA obtained in Part-1.
- Comment on the dependence of V_{oc}, I_{sc}, and FF.

Part-3:Effect of R_S and R_{sh}

- Plot I/V characteristics for series resistance $R_S = 0$, 10, and 30 Ω. You may plot the part of characteristic in fourth quadrant, in the first quadrant for convenience if you should.
- How the I/V characteristics of solar cell is affected by the series resistance R_s?
- Plot I/V characteristics for shunt resistance $R_{sh} = 100$ Ω, 500 Ω, and 5 KΩ.
- What do you observe? What is effect of larger values of shunt resistance on the performance of the solar cell?
- Also plot Voc ,Isc and fillfactor versus R_s and R_{sh} and comment on dependence of these parameters on R_s and R_{sh}
  Note:-Rs and Rsh are the series and shunt resistances of the solar cell hence their values should be varied in the model file to observe the effect.