

21BDS0340

Abhinav Dinesh Srivatsa

Question 81

Electrical Lab FAT

Maximum Power Transfer Theorem

Aim:

To find the maximum power dissipated in the load resistor.

Apparatus:

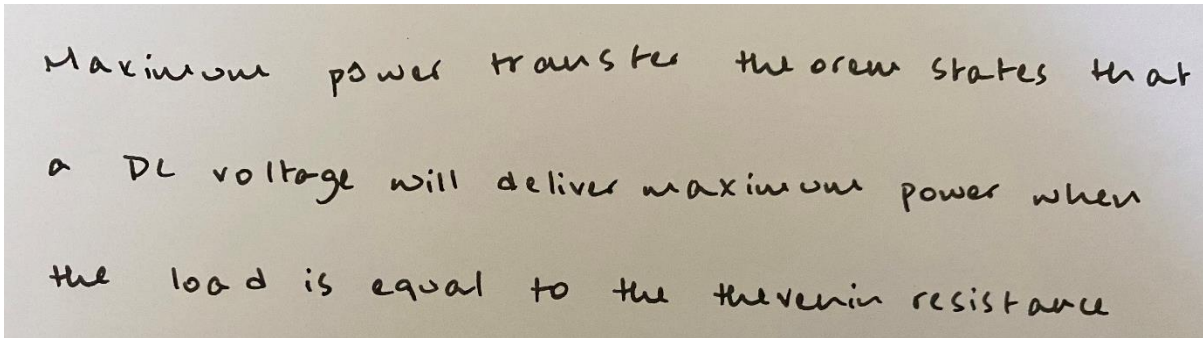
ORCAD / Capture CIS: Analog Library – R

Source Library – Vdc, Idc

Ground (GND) – 0 (zero)

Simulation Settings: Analysis Type – DC Sweep

Statement:



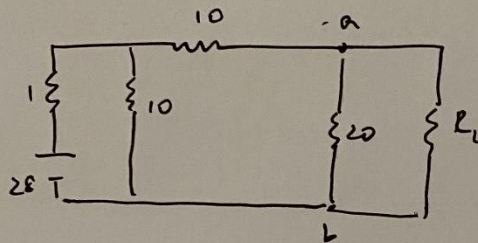
Maximum power transfer theorem states that a DC voltage will deliver maximum power when the load is equal to the thevenin resistance

Manual Calculations:

Registration No. 21BD50340

Question 81

$$V = 28 \text{ V}$$



Finding thevenin voltage:

~~considering outer loop?~~

$$\text{Eq. resistance} = 8.5 \text{ ohm}$$

$$I = \frac{28}{8.5} = 3.29 \text{ amps}$$

current in outer loop:

$$I = 0.824 \text{ amp}$$

Potential at a = V_a

$$\begin{aligned} V_a &= 28 - 1(3.29) - 10(0.824) \\ &= 16.47 \text{ V} \end{aligned}$$

$$V_b = 0$$

$$\begin{aligned} \therefore V_{th} &= V_a - V_b \\ &= \underline{16.47 \text{ V}} \end{aligned}$$

Finding thevenin resistance:

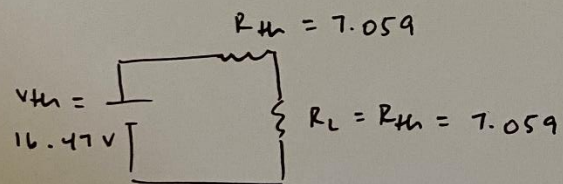
(DC source is shorted)

$R_{th} = ?$

$$\frac{\left(\frac{10}{11} + 10\right) \times 20}{\left(\frac{10}{11} + 10\right) + 20} = R_{th}$$

$$\Rightarrow R_{th} = \underline{7.059 \text{ ohm}}$$

Thevenin Eq. circuit

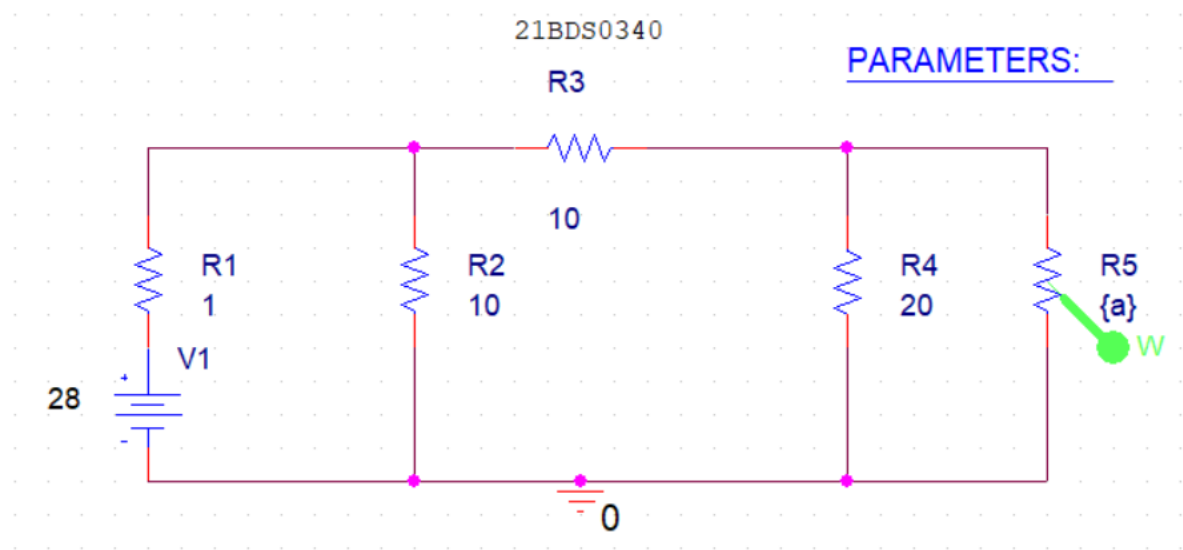


$$\therefore \text{Maximum power is } \frac{V^2}{R} = \frac{16.47^2}{7.059 \times 2}$$
$$= \underline{19.214 \text{ W}}$$

Max power with both resistors = 19.214 watts

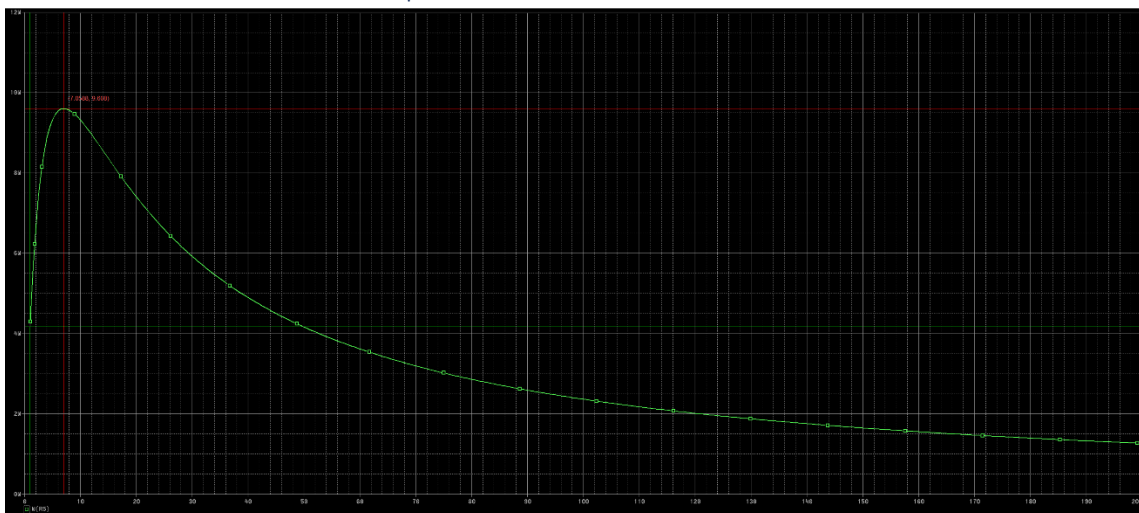
For load resistance only = 9.607 watts

Simulation Circuit:

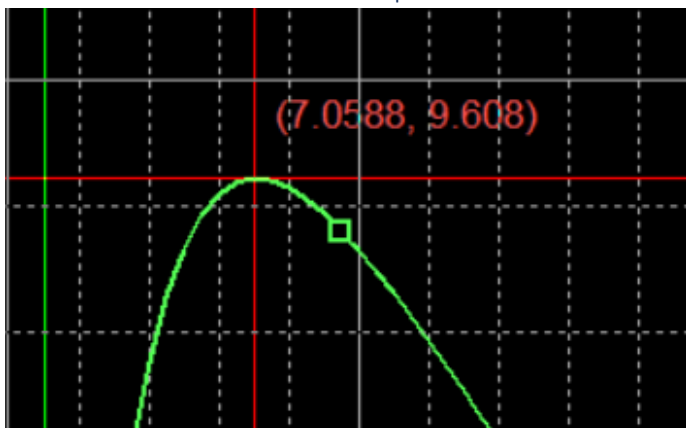


Result:

Resistance Value vs. Power Graph



Zoomed in value of maximum power



NOTATION	MANUAL CALCULATIONS	SIMULATED RESULT
R_{TH}	7.059	7.0588
P_{MAX}	9.607	9.608

Inference:

By comparing the simulation results to our manual results, the maximum power for the load resistance is $P = 9.608$ watts.