→ Give full credits if students have used the formula: Max. power transferred = $\frac{V_{Th}^2}{4R_{Th}}$

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ESC201 | **Mini-Quiz I** | **21/01/2025**

Total Marks: 5 | **Time: 10 minutes**

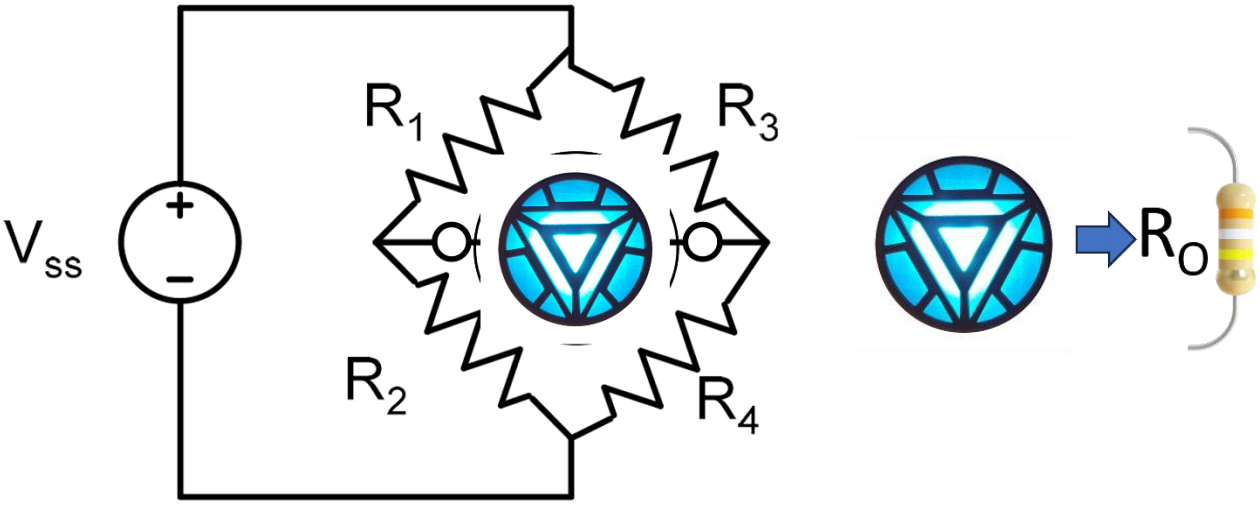
Instructions

- **Please write your name and roll number first.**
- **Read the question carefully and answer it in the question paper itself.**

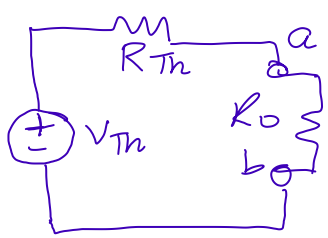
1) Tony Stark wants to design his arc reactor, represented by a lumped load resistor R_O, such that it gets maximum power delivered from the following circuit:

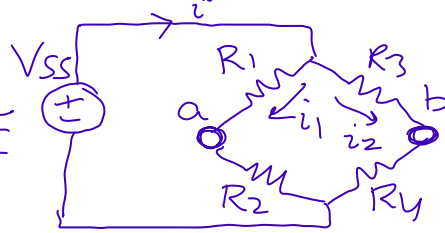
(a) Help the Iron man by finding out the appropriate value of R_O so that maximum power is delivered to his arc reactor. **(2 marks)**

(b) What is the value of the maximum power delivered to the arc reactor? **(3 marks)**



→ To find out the maximum power transfer, Let us construct the Thevenin equivalent ckt. →



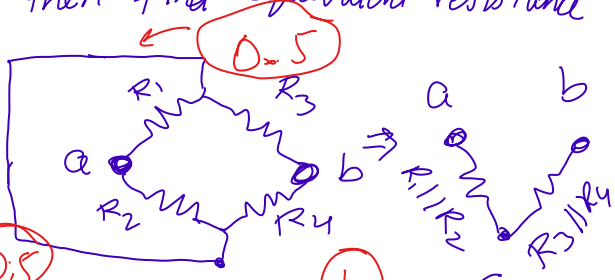


→ For maximum power transfer from the source; $R_O = R_{Th}$ (1)

→ Let us find R_{Th} first ∴ short V_{ss} & then find equivalent resistance

→ R_1 & R_2 are connected b/w a & c ⎤ $R_1 \| R_2$
R_3 & R_4 " " " b & c ⎦ $R_3 \| R_4$

∴ $R_{Th} = R_{a-b} = (R_1 \| R_2) + (R_3 \| R_4) = R_O$ (0.5)



→ Let us find out $V_{Th} = V_{OC} = V_a - V_b$ (1)

→ By voltage division ∴

$V_a = V_{ss}\left[\frac{R_2}{R_1+R_2}\right]$

$V_b = V_{ss}\left[\frac{R_4}{R_3+R_4}\right]$

$V_{Th} = V_{ss}\left[\frac{R_2}{R_1+R_2} - \frac{R_4}{R_3+R_4}\right] = V_a - V_b$ (1)

→ Current through $R_O = i_{R_O} = \frac{V_{Th}}{R_{Th}+R_O}$ (1)

→ Max. Power delivered = $i_{R_O}^2 \cdot R_O$ (1)