Practical Work No. 03: Medium Lines

1. Objective of the Practical Work

- Study of a medium line: no-load test and load test (R, RL, and RC),
- Influence of the load on electrical quantities (voltage and current).

2. Preparation work

- The circuit in Figure 1 has a receiver which is a load R, R-L, and R-C in series.
- The parameters are: R_L=10(Ω), L_L=10mH, R_{load}=340 Ω, L_{load}= 1 H, and V_s=80 (V), f=50Hz.
- Complete Table 1 by calculating the following values: I_s, I_r, V_r, P_s, P_r, Q_s, Q_r, cos(φ_s), cos(φ_r), and η.
- Draw the diagram or phasor diagram for a resistive load (R) and an inductive load (R-L) for Pi (π) and T circuits.

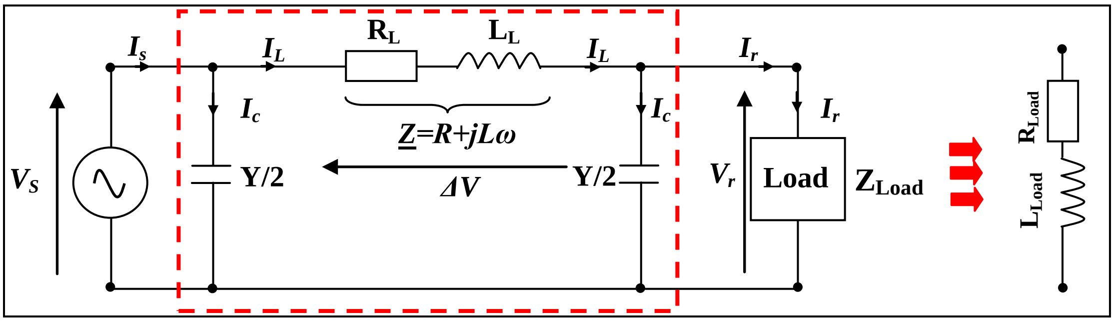

Figure 1. Pi (π)-Circuit Configuration for R and R-L Loads.

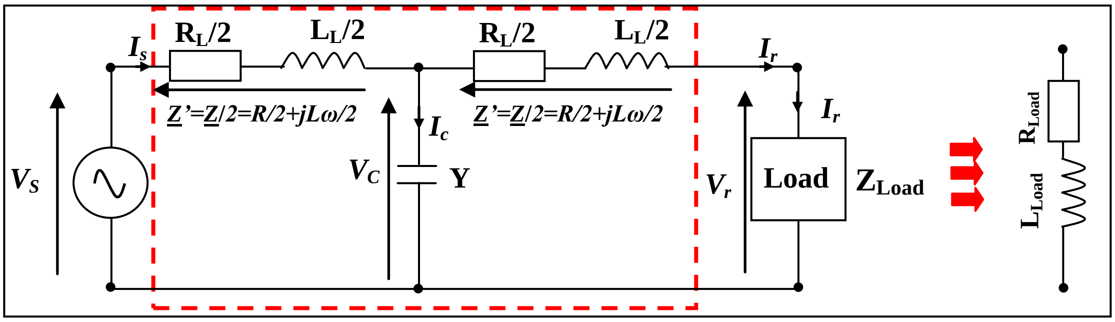

Figure 2. T-Circuit Configuration for R and R-L Loads.

Such as:: $|Z_c|=|1/C\omega|$, $|Y|=1/|Z_c|$.

Table 1.

	Source						Receiver						η (%)= P_r/P_s
	V_s (V)	I_s (A)	P_s (w)	Q_s (VAR)	S_s (VA)	Cos φ_s	V_r (V)	I_r (A)	P_r (w)	Q_r (VAR)	S_r (VA)	Cos φ_r	
R_{Load}=340 Ω	80												

Practical Study

3.1. No-Load Test (K_{Open})

Implement the following setup:

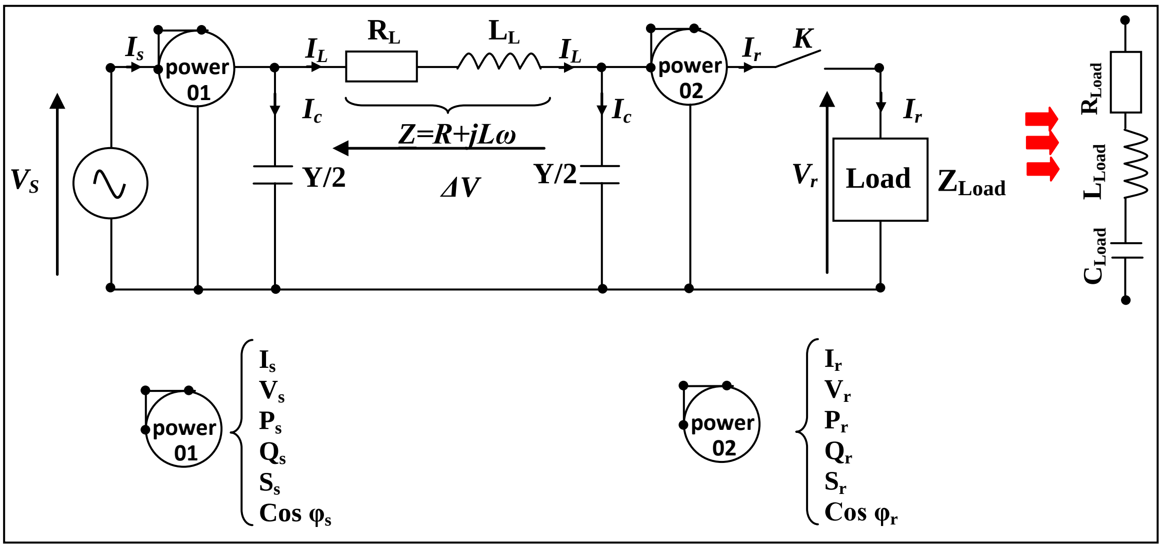

Figure 3. Medium line.

Given: R_L =…………...Ω, L_L =………H, V_s=80 V, then V_s=100 V.

- Record in a table: I_s, I_r, V_r, P_s, P_r, Q_s, Q_r, cos(φ_s), and cos(φ_r).
- Calculate the efficiency in both cases, (80V and 100V).

Source						Receiver						η= P_r / P_s (%)
V_s (V)	I_s (A)	P_s (w)	Q_s (VAR)	S_s (VA)	Cos φ_s	V_r (V)	I_r (A)	P_r (w)	Q_r (VAR)	S_r (VA)	Cos φ_r	
80 V												
100 V												

3.2. R Load (K_{Closed})

Implement the setup from Figure 3 with a resistive (R) load:

- Given: R_L=……..….Ω, L_L=………..H, and **<u>V_s=80 V</u>**.
- Vary the load R_{Load}.
- For each variation of L_{Load}, measure the following quantities: I_s, I_r, V_r, P_s, P_r, Q_s, Q_r, cos(φ_s), cos(φ_r).
- Calculate the efficiency in both cases ($R_{Load\ 1}$ and $R_{Load\ 2}$).

	Source						Receiver						η= P_r/ P_s (%) $R_{Load\ 1}$	η= P_r/ P_s (%) $R_{Load\ 2}$
	V_s (V)	I_s (A)	P_s (w)	Q_s (VAR)	S_s (VA)	Cos φ_s	V_r (V)	I_r (A)	P_r (w)	Q_r (VAR)	S_r (VA)	Cos φ_r		
$R_{Load\ 1}$= ……….Ω	80													
$R_{Load\ 2}$= ……….Ω	80													

3.3. R-L Load (K_{Closed})

Implement the setup from Figure 3, where the receiver is an R-L load in series:

- Given: R_L=……..….Ω, L_L=………..H, R_{Load} = ……….. Ω (fixed), and **V_s=80 V**.
- Vary the load L_{Load}.
- For each variation of L_{Load}, measure the following quantities: I_s, I_r, V_r, P_s, P_r, Q_s, Q_r, $\cos(\varphi_s)$, $\cos(\varphi_r)$.
- Calculate the efficiency in both cases ($L_{Load\ 1}$ and $L_{Load\ 2}$).

		Source						**Receiver**						**η (%) $L_{Load\ 1}$**	**η (%) $L_{Load\ 2}$**
		V_s (V)	**I_s (A)**	**P_s (w)**	**Q_s (VAR)**	**S_s (VA)**	**Cos φ_s**	**V_r (V)**	**I_r (A)**	**P_r (w)**	**Q_r (VAR)**	**S_r (VA)**	**Cos φ_r**		
R_{Load}= ………Ω	**$L_{Load\ 1}$= ………..H**	**80**													
	L_{Load2}= ………..H	**80**													

3.4.R-C Load (K_{Closed})

Implement the setup from Figure 3, where the receiver is an R-L load in series:

- Given: R_L=……..….Ω, L_L=………..H, R_{Load} = ……….. Ω (fixed), and **V_s=80 V**.
- Vary the load C_{Load}.
- For each variation of C_{Load}, measure the following quantities: I_s, I_r, V_r, P_s, P_r, Q_s, Q_r, $\cos(\varphi_s)$, $\cos(\varphi_r)$.
- Calculate the efficiency in both cases ($C_{Load\ 1}$ and $C_{Load\ 2}$).

		Source						**Receiver**						**η (%) $C_{Load\ 1}$**	**η (%) $C_{Load\ 2}$**
		V_s (V)	**I_s (A)**	**P_s (w)**	**Q_s (VAR)**	**S_s (VA)**	**Cos φ_s**	**V_r (V)**	**I_r (A)**	**P_r (w)**	**Q_r (VAR)**	**S_r (VA)**	**Cos φ_r**		
R_{Load}= ………Ω	**$C_{Load\ 1}$= ……….µF**	**80**													
	C_{Load2}= ……….µF	**80**													

4. Required Work

- Plot the curves: $V_r = f(I_r)$; $\cos(\varphi_r) = f(I_r)$.
- Interpret the obtained results.
- Explain the influence of different types of loads on electrical quantities and active and reactive powers.
- Suggest how to improve the efficiency of the electrical line.
- Provide a general conclusion for this practical work.