Lab#11
Line Performance of a Loaded System at Receiving End

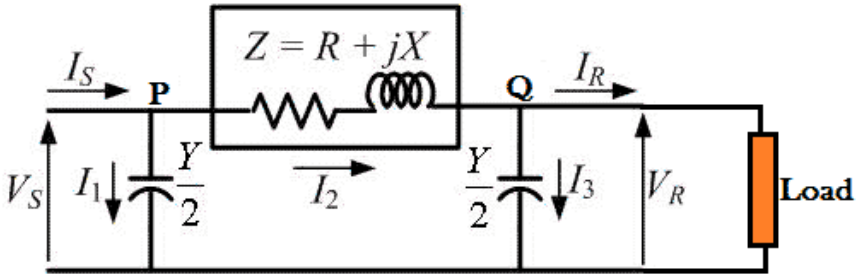
Aim:

To determine line performance when loaded at receiving end

Theory:

Nominal π Representation of a Medium Transmission Line:

In case of a nominal **π** representation, the lumped series impedance is placed at the middle of the circuit whereas the shunt admittances are at the ends. As we can see from the diagram of the **π** network below, the total lumped shunt admittance is divided into 2 equal halves, and each half with value Y/2 is placed at both the sending and the receiving end while the entire circuit impedance is between the two. The shape of the circuit so formed resembles that of a symbol **π**, and for this reason it is known as the nominal **π** representation of a medium transmission line. It is mainly used for determining the general circuit parameters and performing load flow analysis.



Nominal π network of medium transmission line.

As we can see here, V_S and V_R is the supply and receiving end voltages respectively, and
I_S is the current flowing through the supply end.
I_R is the current flowing through the receiving end of the circuit.
I_1 and I_3 are the values of currents flowing through the admittances. And
I_2 is the current through the impedance Z.
Now applying KCL, at node P, we get.

$$I_s = I_1 + I_2 \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Similarly applying KCL, to node Q

$$I_2 = I_3 + I_R \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Now substituting equation (2) to equation (1)

$$I_S = I_1 + I_3 + I_R$$

$$= Y/2V_S + Y/2V_R + I_R \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Now by applying KVL to the circuit,

$$V_S = V_R + ZI_2$$

$$= V_R + Z\,(V_R Y/2 + I_R)$$

$$= (Z\,Y/2 + 1)\,V_R + ZI_R \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (4)$$

Now substituting equation (4) to equation (3), we get

$$I_S = Y/2[(Y/2\,Z + 1)\,V_R + ZI_R] + Y/2V_R + I$$

$$= Y\,(Y/4\,Z + 1)\,V_R + (Y/2Z + 1)\,I_R \ldots\ldots\ldots\ldots\ldots\ (5)$$

Comparing equation (4) and (5) with the standard ABCD parameter equations

$$V_S = AV_R + BI_R$$

$$I_S = CV_R + DI_R$$

We derive the parameters of a medium transmission line as:

$$A = (Y/2\,Z + 1)$$

$$B = Z\,\Omega$$

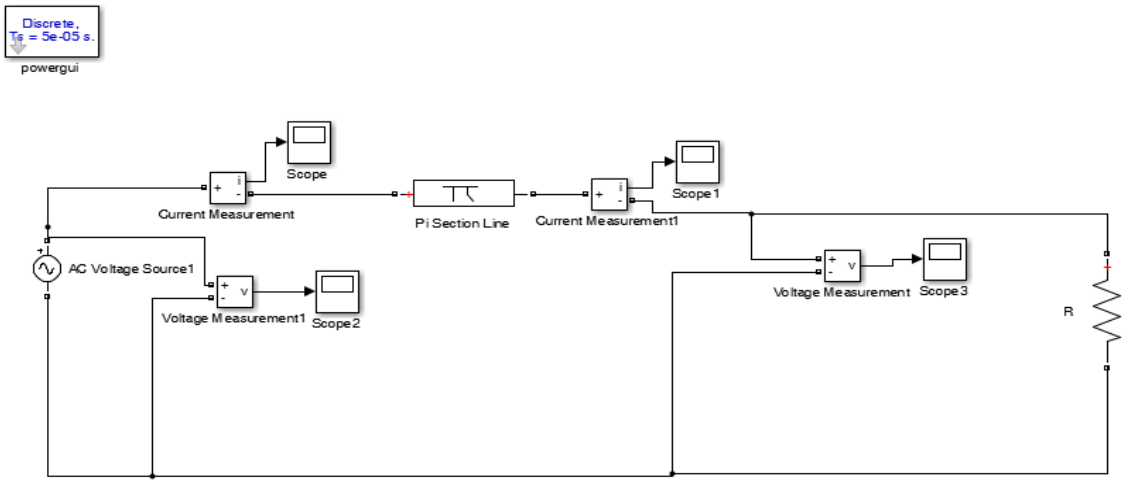
$$C = Y(Y/4\,Z + 1)$$

$$D = (Y/2Z + 1)$$

Voltage regulation of transmission line is measure of change of receiving end voltage from no-load to full load condition.

% regulation = no load receiving end voltage – full load receiving end voltage/full load voltagex100%

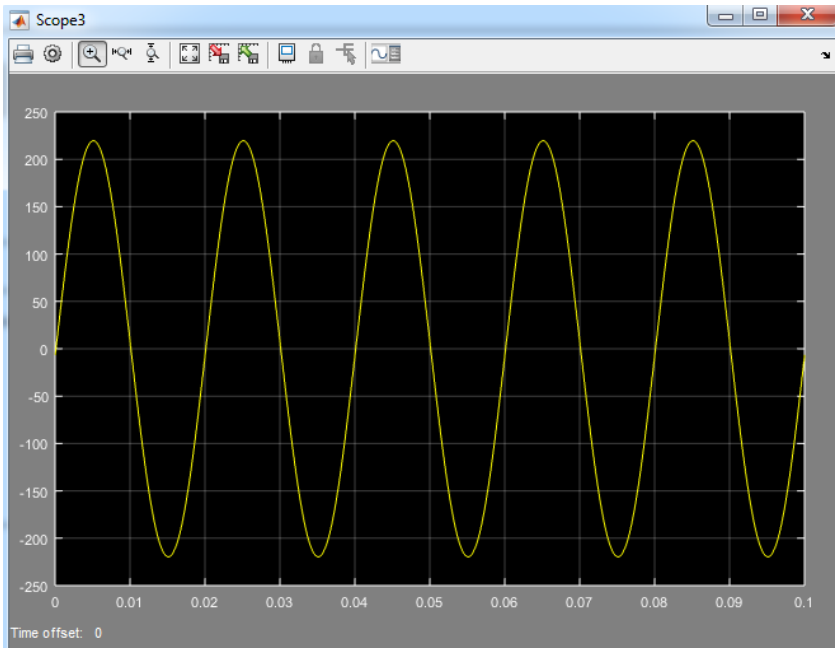
Circuit Diagram:



Procedure:

1. Open Matlab-->Simulink--> File ---> New---> Model
2. Open Simulink Library and browse the components
3. Connect the components as per circuit diagram
4. Set the desired voltage and required frequency
5. Simulate the circuit using MATLAB
6. Obtain the line performance of a line.

Output:



So by clicking on the scope of voltage measurement we get the voltage and from this we determine the line performance of the system.

Lab Task:

a) Explain the following:

1. Nominal $\boldsymbol{\pi}$ representation.
2. Nominal **T** representation.
3. End Condenser Method.

b) In which case does nominal "T" and nominal "π" are used and which one is superior for which kind of analysis?

c) Simulate the transmission line in Matlab Simulink.

Marks Obtained: ……. **Remarks:** ……..