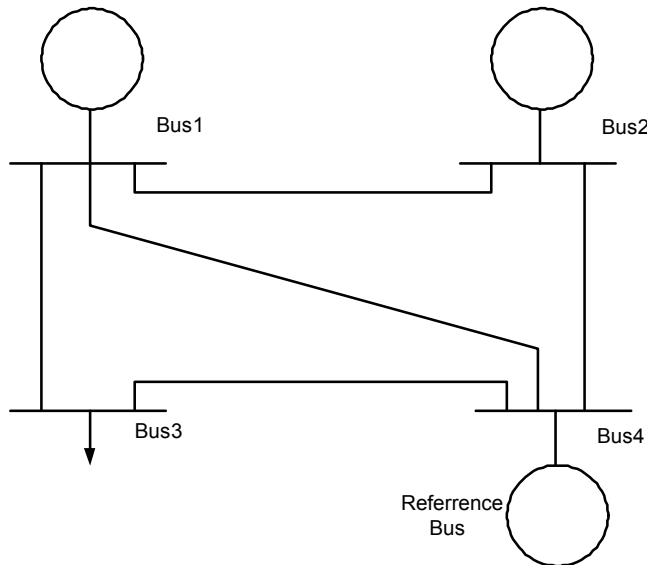


Problem 9 Power Systems and Power Electronics Problem

Problem 9(a): Power Systems: 2 points

You are given the sample power system below:



Where:

- The generator at bus 1 is operating with its voltage at scheduled (regulated) voltage and the MVAR output is not fixed
- The generator at bus 2 is operating with its voltage below scheduled voltage and the MVAR output is being held at the upper var limit.
- The Load bus at bus 3 is a common P+jQ load where P and Q are to be held to given values.
- The generator at bus 4 is the swing bus

The basic equation of the Newton Power Flow requires a Jacobian Matrix, an error vector and a correction vector for voltage angle and magnitude. Some equations in the Newton Power Flow are eliminated due to the conditions given above. Similarly some variables are also eliminated due to the conditions given above.

i) Indicate which equations must be retained in the Jacobian equation.

ii) Indicate what variables must be retained.

iii) Give the resulting Jacobian Matrix equation and indicate all terms in the Jacobian as either zero or derivatives $\frac{\partial P_i}{\partial \theta_j}$, $\frac{\partial P_i}{\partial V_j}$, $\frac{\partial Q_i}{\partial \theta_j}$, and $\frac{\partial Q_i}{\partial V_j}$, also give the terms in the error vector and the correction vector.

Problem 9 Power Systems and Power Electronics Problem

Problem 9(b): Power Electronics: 2 points

A Boost (step-up) dc-dc converter is operating in steady state. The input voltage varies in a range from 9 V to 16 V, but the output voltage is regulated at $V_o = 20V$ by adjusting the duty-ratio D . The switching-frequency $f_s = 200kHz$. The inductance $L = 40\mu H$. Assume ideal components and the output capacitor to be very large such that the output voltage $v_o(t) \approx$.

Calculate the minimum value of the output power P_o below which this Boost converter will go into the discontinuous current-conduction mode (that is, the inductor current becomes zero and remains zero) under all values of the input voltage V_{in} in a range from 9 V to 16 V.