

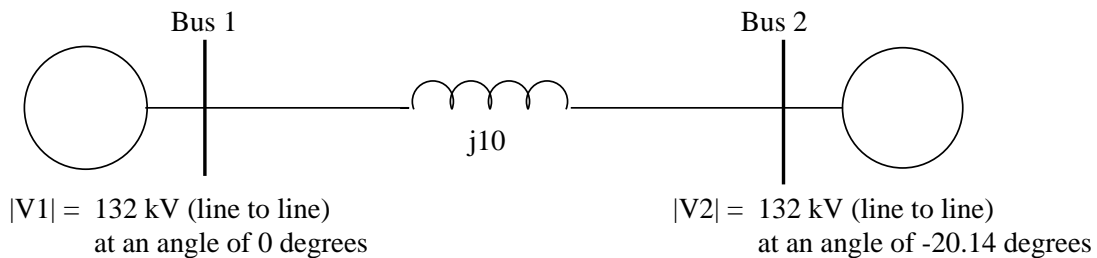
UTILITY APPLICATIONS OF POWER ELECTRONICS UI: ECE 529

Homework 1

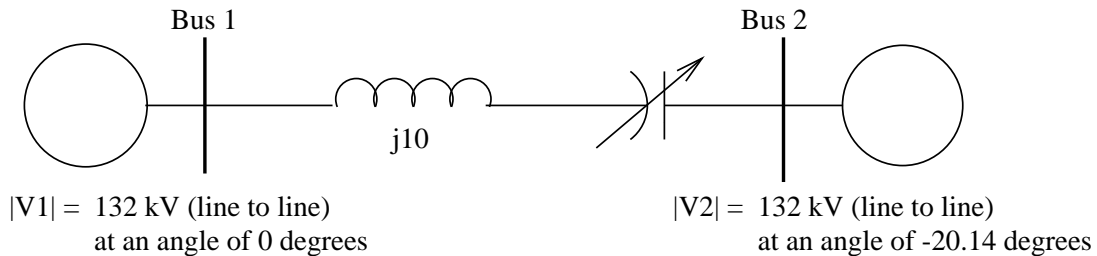
On campus: Due by 5:00pm on January 30

Off campus: Due session 9 (February 6)

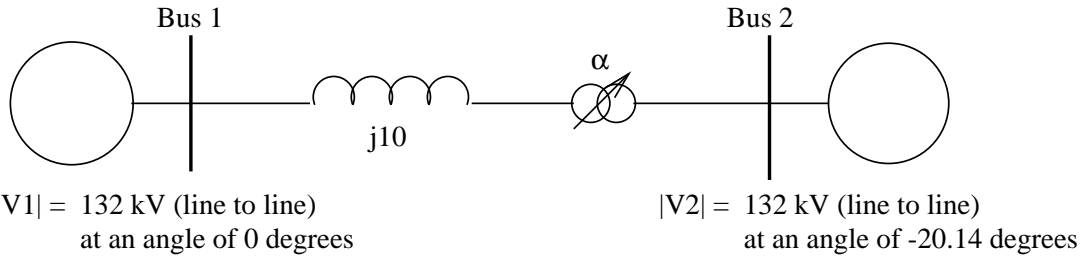
1. You are given a simple 2 bus system, shown below:



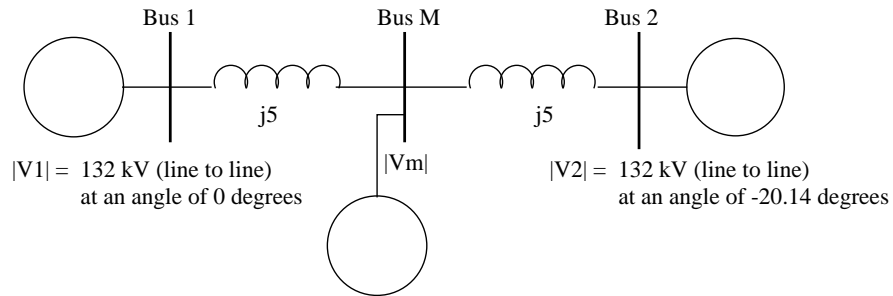
- (a) Compute P_{12}
- (b) We want to increase P_{12} to 700 MW. Consider the following options to do so. Given a written evaluation of each form of compensation.
- A** Add series capacitance. What size capacitor is needed?
What is the % compensation?
If max compensation is 60%, what is the P_{12max} .



- B** Instead of series capacitance, we add phase angle control. What phase angle, α , does the compensator need to produce?
Lets say that $\alpha_{max} = 8^\circ$, what is P_{12max} ?



- C** We next look at adding midpoint compensation. Lets just call it an ideal compensator right now. What midpoint voltage is needed? How much reactive power does the compensator provide? Do you consider this a feasible solution? Explain.



2. A semiconductor fab has a 4MW load that is sensitive to voltage sags and will trip when a sag lasting more than 5 cycles occurs. The plant is currently fed by a 13.2 kV distribution feeder.
 - A** Consider using a static series compensator with energy storage, such as a dynamic voltage restorer (DVR). If the plant is drawing 4 MW at a 0.9 lagging power factor, calculate what voltage the DVR must provide to compensate for a 40% voltage sag on all three phases as the worst case (i.e. the voltage falls to 0.6 p.u.). Restore the load voltage to 0.95pu). If the sags lasts for 6 cycles, how much energy storage is needed?
 - B** Now suppose that the compensator of part **A** sees a 50% voltage sag on one phase with a 30 degree phase shift in the voltage on that phase during the sag. What is the magnitude and angle of the voltage that is needed to restore the voltage to 0.95 p.u.
 - C** Next consider the application of static series compensator using a line energy supply. If the load draws 4 MW at a 0.9 lagging power factor calculate the voltage compensator must provide to correct for a 40% voltage sag on all three phases to 0.95 p.u. Calculate the line current supplied to the compensator to inject this voltage (and power) and compare to the load current supplied by the compensator.