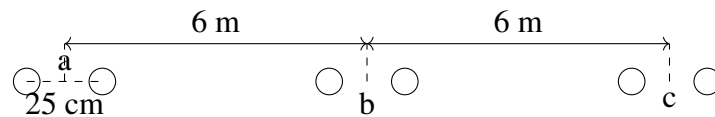


Indian Institute of Technology Patna
Department of Electrical Engineering
EE381 - Power Systems
Autumn - 2023
Mid Semester Exam
September 30, 2023

There are 5 questions. They carry equal marks.

$$(5 \times 6 = 30)$$

1. Determine the total inductance and capacitance of the single circuit, two-bundle and 200 km long line as shown below. The diameter of each conductor is 5 cm. ($\epsilon_0 = 8.854 \times 10^{-12} \text{ F/m}$)



2. A 250 km long, three phase, 50 Hz transmission line has the following constants.

$$A = D = 0.9 \angle 1^\circ$$

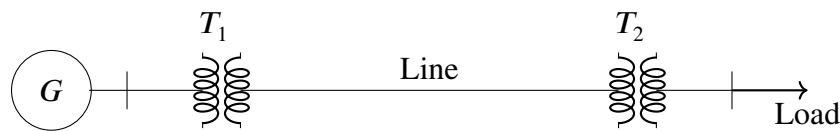
$$B = 120 \angle 72^\circ \Omega$$

$$C = 0.001 \angle 90^\circ \text{ S}$$

The sending end voltage is 230 kV. Find

- (a) the receiving end voltage and the line charging current when there is no load.
- (b) the sending end voltage angle at which the maximum real power can be transferred.
(Hint: Real power flow is a function of voltage angle. Take V_R as reference.)

3. The schematic diagram of a radial transmission system is shown below.



T_1 : 100 MVA, 11/220 kV. $X = 12\%$

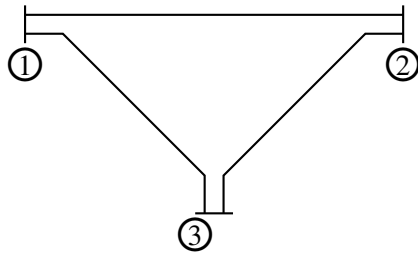
T_2 : 100 MVA, 220/66 kV. $X = 10\%$

Line: $j100 \Omega$.

Load: 60 MW at 0.9 pf lagging.

If the load voltage is to be maintained at 60 kV, what will be the terminal voltage in kV of the generator?

4. Consider the three node network.

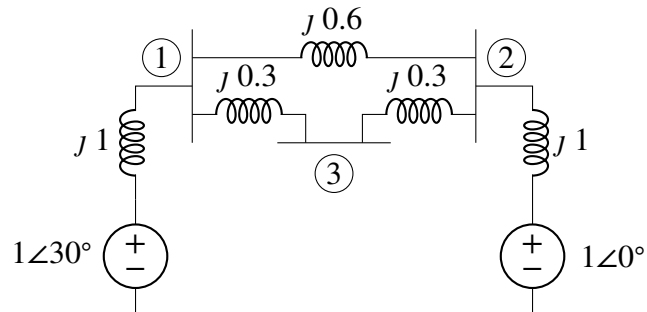


Line No	Z in p.u	$\frac{Y}{2}$ in p.u
1-2	$0.02 + j0.06$	$j0.03$
1-3	$0.08 + j0.024$	$j0.025$
2-3	$0.06 + j0.018$	$j0.02$

(a) Form the \mathbf{Y}_{bus} matrix.

(b) Modify the the \mathbf{Y}_{bus} matrix by eliminating node 3.

5. Consider the reactance network shown here.



(a) Find the voltage at node 3.

(b) Find the voltage at node 3 after connecting a capacitor having a reactance of 2.0 per unit connected between node 3 to the reference node. (Hint : Use Thevenin equivalent.)