NATIONAL UNIVERSITY OF SINGAPORE

Department of Electrical Engineering

EE2029 ELECTRICAL ENERY SYSTEMS

(Tutorial: Transmission Lines)

1. A three phase 765 kV, 60 Hz, 300 km line has the following positive sequence series impedance and shunt admittance; z= 0.0165+j0.3306 Ω/km and y= j4.674×10^{-6} S/km. Calculate ABCD parameters in a nominal Π circuit.

   (Answer: $A = D = \ 0.9305 + j0.0035, B = 4.95 + j99.18\Omega, \mathrm{C} = (-2.4 \times 10^{-6} + j0.0014\ )S$)

2. A 69 kV three-phase <u>short</u> transmission line is 16 km long. The line has a per phase series impedance of 0.125+j0.4375 Ω/km. Determine the sending end voltage per phase, voltage regulation, and the transmission efficiency when the line delivers 70 MVA, 0.8 lagging power factor at 64 kV.

   (Answer: 40.71 kV, 10.17%, and 95.91%)

3. A 200 km, 230 kV, 60 Hz three phase line has a per phase series impedance, z= 0.08+j0.48 Ω/km and a per phase shunt admittance y= j3.33×10^{-6} S/km. At full load, the line delivers 250 MW at 0.99 p.f. lagging and at 220 kV. Using the nominal Π circuit, find sending end voltage and current per phase.

   (Answer: $155.40\angle 23.58°\ kV, 635.38\angle -0.34°\ A$)

4. A 345 kV, 50 Hz, three-phase transmission line is 130 km long. The resistance per phase is 0.036 Ω/km and the inductance per phase is 0.8 mH/km. The shunt capacitance is 0.0112 μF/km where shunt conductance is negligible. The receiving end load is 270 MVA with 0.8 lagging power factor at 325 kV. Use nominal Π model, determine the voltage regulation and transmission line efficiency. If the power factor is corrected to 0.95 lagging, keeping the receiving end MVA constant, what will be the new voltage regulation and transmission line efficiency? What can you conclude from this problem?

   (Answer: 6.19%, 98.7%, 4.06%, 98.8%)