Note16: 3-phase example problems

EX#1. A balanced three-phase Y-connected generator has a voltage of 120 V/ϕ. A balanced 3-phase Δ-load is fed from the source through a distribution line having an impedance of 0.5 + j 1.4 Ω/ϕ. The load impedance is 118.5 + j 85.8 Ω/ϕ. Use the a-phase voltage of the generator as the reference.

(a) construct 3-phase circuit

(b) construct a single-phase equivalent circuit

(c) calculate the line currents $\mathbf{I}_{aA}$, $\mathbf{I}_{bB}$, $\mathbf{I}_{cC}$.

(d) calculate the phase voltages at the load.

(e) calculate the total complex power delivered to the load

(f) calculate what percentage of the real power at the sending end of the line is delivered to the load?

SOLUTION:

(a)

(b)

(c) $I_{aA} =$

(d) $V_{AB} =$

(e) $S_T =$

(f) $P_{sending} = P_{load} + P_{loss(line)}$

EX#2. A balanced 3-phase Y-load requires 480kW at a lagging power factor of 0.8. The load is fed from a line having an impedance of 0.005+j0.025 Ω/ϕ. The line voltage at the terminals of the load is 600V.

(a) construct 3-phase circuit
(b) construct a single-phase equivalent circuit
(c) magnitude of the line current
(d) magnitude of the line voltage at the sending end of the line
(e) power factor at the sending end of the line

SOLUTION

(a)

(b)

(c) $|I_{aA}| = ?$

(i) Method 1: $S_A =$

(ii) Method 2: $P_{3\phi} =$

(iii) Method 3: $P_A =$

(d) From V_{an}

(e) power factor

(i) Method 1: $pf = \cos(\theta_v - \theta_i)$

(ii) From $S_{A(sending)} = S_{A(load)} + S_{A(line)}$ (hint: *cosine* of angle of *S* is the *pf*)