Common mistakes most students made:

Per Unit Calculations

- V_b, S_b, Z_b and I_b are scalar quantities. They have magnitudes only and no phasor angles. They are real numbers and can be non-integers but they are not complex numbers.
- Per unit calculations cannot have engineering units like kV, MVA, ohms and amps until we convert them back to actual quantities by multiplying their respective bases.
- If we are required to compute complex power (active power or reactive power), use S = V I* (V I Cos θ or V I Sin θ). All values are expressed in per unit quantities. In per unit, we cannot use S = SQRT(3) V_L $I_L \angle\theta$ (and its real or imaginary part) which is meant for actual value calculations.
- Although S = V I* is used in per unit calculations, when computing I_b from S_b and V_b, we must use $I_b = S_b/(\text{SQRT}(3)\ V_b)$ and not $S_b = V_b\ I_b$. The latter is not used in base value calculations in three-phase systems. We use $S_b = V_b\ I_b$ in single-phase systems. Please note that we do not use conjugate in base value calculations since bases cannot have phasor angles.

Actual Value Calculations

- When computing $V_1 = V_2 + Z\ I$ for the three-phase power system, V_1 and V_2 must be phase voltages and not line voltages. The reason is that we assume a balanced three-phase power system and we perform analysis for each phase (single phase). Usually we do the analysis for phase a. In our analysis, we can only take in phase impedance of a Y-connected load and not Δ-connected load. A Δ-connected impedance can be converted to a Y-connected impedance by using $Z_Y = \frac{1}{3}Z_\Delta$.
- If we are required to produce results for phases b and c, we copy the corresponding magnitudes from phase a and adjust the phasor angles by -120 degrees and +120 degrees for phases b and c respectively. This also applies to per unit calculations.
- Since we deal with three-phase systems, we cannot use per unit formula, S = V I* in actual complex power (active or reactive power) calculations. Instead we must use S = SQRT(3) V_L $I_L \angle\theta$ = 3 V_p $I_p \angle\theta$. Please note that θ is the power factor angle. It is the angle between V_p and I_p and not between V_L and I_L since there may be a 30-degree phase shift between V_L and I_L.
- In the calculations, we would need to deal with SQRT(3), 3, and transformer turn ratios, impedances referred to HV and LV sides, etc. Hence actual calculations are more complex than per unit calculations.