Indian Institute of Technology, Delhi
EEL 101: Fundamentals of Electrical Engineering
Tutorial 8, 13th March, 2008

1. Three resistors of 20Ω each are connected in Δ across a 3-phase 440-V line. Calculate the currents in each resistor (phase current), as well as the line currents (currents coming from the power station through the three wires).

2. Three equal impedances are connected in a Δ across a 240 V, 3 phase line. One of the three line-to-line voltages is $240\angle 60^o$ Volts, and one of the three phase currents is $6\angle 200^o$ Amps. Identify the other line voltages and phase currents and show all on a phasor diagram. Determine the (most likely) impedance in each phase. Determine the three line currents.

3. The city of New Delhi distributes power with a three-phase system with 12.5 kV between the power carrying wires. Each group of houses is served from one phase and ground, and transformed to 220 Volts by a pole transformer. The center-tap on the secondary side is connected to ground. What is the turns ratio (primary/secondary) of the transformer? When a 1500 Watt air-conditioner is switched on in one of the houses, how much does the line current increase in the high voltage wire? (Assume a power factor of 0.6, and the transformer is 100% efficient.)

4. For a three phase balanced delta-connected load, the line-to-line voltage $\overline{V_{RY}}$ is $480\sqrt{2}\angle 0^o$ Volts and $\overline{I_R}$ is $10\sqrt{2}\angle -30^o$ Amps. What is $\overline{V_{BR}}$? What is the current in each phase of the load? What is the time-average power into the 3-phase load? What is the phase impedance? Compute an expression for the power into the 3-phase load as a function of time. What are the maximum and minimum powers, as a function of time, delivered to the three-phase load?

5. A 138-kV overhead power transmission line from the Bhakra-Nangal Dam to New Delhi has a series resistance and inductive reactance of 0.16 and 0.41 Ω/km respectively. Find the magnitude of the voltage required at Bhakra-Nangal Dam, if the magnitude of the voltage required at New Delhi is 138-kV. The distance between Bhakra-Nangal and New Delhi is 100-km. The apparent power on the line is 12.5-MVA at 0.9 power-factor lagging. Compute the power losses. Compute the percentage of power lost as a fraction of the power delivered.