Indian Institute of Technology Patna
Department of Electrical Engineering
EE381 - Power Systems
Autumn - 2024
Mid Semester Exam
September 27, 2024

There are 5 questions. They carry equal marks.

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

1. A manufacturing plant consumes 100 kVA at 0.6 p.f. lagging under normal operation. A synchronous motor is added to the plant to improve the overall power factor. The power required by the synchronous motor is 10 kW. Determine the overall power factor when the motor operates at 0.5 p.f. leading. What must be the power factor of the motor to improve the overall power factor to 0.9 lagging?

2. A double-circuit three phase line is shown bleow. The conductors a,a', b, b' and c,c' belong to the same phase, respectively. The radius of each conductor is 1.5 cm. Find the inductance of the double circuit line in mH/km/phase.
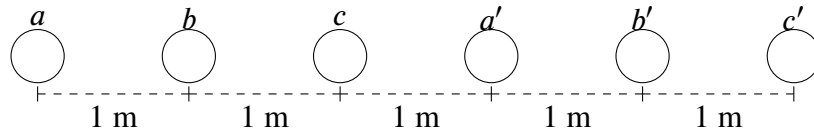
3. A 50 MVA generating station is connected to a three-phase line having impedance $Z = 300\angle75°\ \Omega$ and admittance $Y = j0.0010\ \mho$. The power at the generating station is 50 MVA at upf at a voltage of 220 kV. Find the

   (a) line voltage at the receiving end.
   (b) complex power (three phase) at the receiving end.

   Use nominal-T model for the transmission line.

4. In a system shown below, two single-phase transformers supply a 10 kVA resistance load at 200 V.

100:400 V
X=0.1 p.u.
10 kVA

400:200 V
X=0.15 p.u.
10 kVA
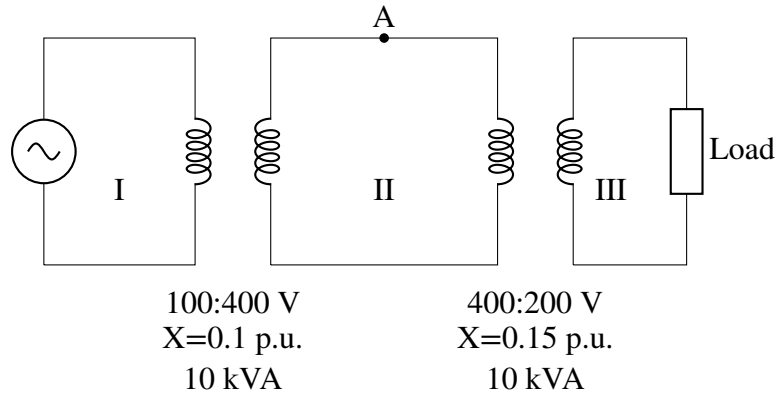
   (a) Show that the per unit load resistance is the same in each section(I, II and III).

   (b) Calculate the voltage in volt at point A if the source voltage is 100 V.

5. Consider the two bus power system network with given loads as shown in the figure. All the values shown in the figure are in per unit. Determine P_{G1}, Q_{G1} and Q_{G2}

$1\angle\delta$

$j0.1$

$1\angle 0°$

$P_{G1} + jQ_{G1}$ G_1

G_2 $20 + jQ_{G2}$

$S_{D1} = 15 + j5$

$S_{D2} = 25 + j15$