Mansoura University
Faculty of Engineering
Dept. of Electrical Engineering

Third Year Exam (13/1/ 2013)
Full Mark : 70
Time allowed: 3 Hours

Electric Power Systems (2)

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Please Answer The Following Questions:

Question # 1: (15 Mark)

Figure 1 shows the one line diagram of a three phase power system. The system data are as follows:

G1: 25 MVA, 13.8 kV, X=0.12 per unit
G2: 30 MVA, 18 kV, X=0.1 per unit
T1: 25 MVA 13.8 /220 kV, X = 0.1 per unit
T2: 30 MVA, 18/220 kV, X = 0.08 per unit
T3: 50 MVA, 220 /11 kV, X = 0.1 per unit
Line 1 has an impedance $Z_1 = 12 + j100\ \Omega$/phase and Line 2 has $Z_2 = 10 + j80\ \Omega$/phase.
Load: S = 20 + j10 MVA at 11 kV.

a- By selecting a common base of 50 MVA and 11 kV on the load side, draw an impedance diagram showing all impedances in per unit.

b- If under loading conditions, the e.m.f of G1 is $1.04\angle 6^\circ$ p.u, find:
- **Current supplied by each generator.**
- **Complex power delivered by G2 in MW and MVAR.**
- **Total system active power losses in MW.**

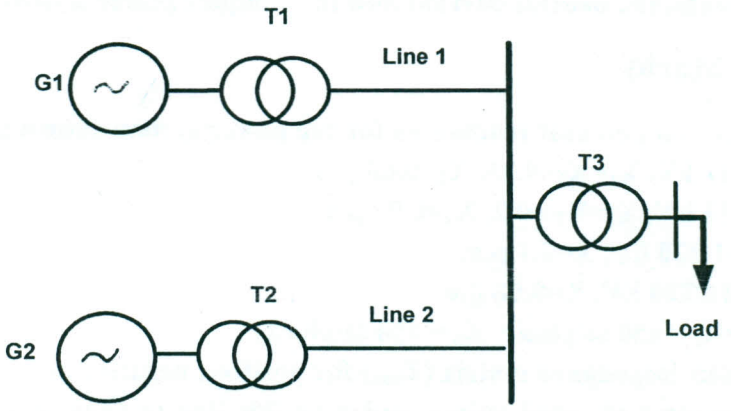

Figure (1)

Question # 2: (15 Mark)

Two generators are interconnected as shown in figure 2 by a tie-bar through current limiting reactors on a common system base of 50 MVA and 11 kV. A three-phase feeder is supplied as shown in figure at line voltage of 11 kV with $Z_f = 0.1 + j0.3\ \Omega$/phase. Neglecting pre-fault current and for a solid three-phase to ground fault occurs at point F, find:

a- The subtransient fault current in kA.
b- Momentary current of breaker A in kA.
c- Short circuit capacity of breaker C in MVA.

P.T.O

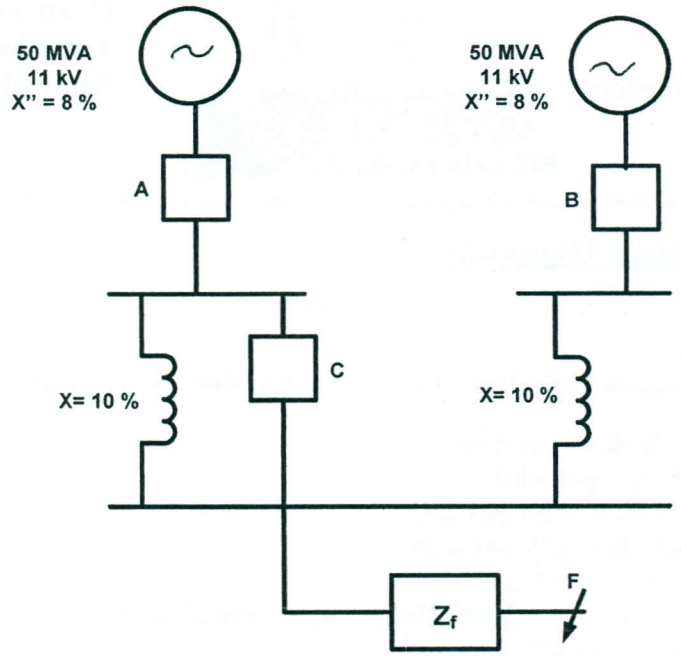

Figure (2)

Question # 3: (15 Mark) Solve using symmetrical components method

A Y-connected unbalanced voltage source with the sequence components of voltages $V_{a1} = 277 \angle -2^{\circ}$, $V_{a2} = 10\angle 216^{\circ}$ and $V_{ao} = 16\angle 62^{\circ}$ volts are applied to Y- connected load. The Y load has an impedance of (6 + j8) Ω/phase and its neutral is grounded through $Z_n = j2$ ohms. Draw the sequence networks and calculate the line currents, the neutral current and the complex power absorbed by the load.

Question # 4: (25 Mark)

The equipment ratings and per-unit reactances for the power system shown in figure (3) are as follows:

G1: 50 MVA, 11 kV, $X_1=X_2=0.25$, $X_0=0.08$ p.u.
G2: 30 MVA, 11 kV, $X_1=X_2= 0.2$, $X_0=0.06$ p.u.
T1: 50MVA, 11/220 kV, X=0.1 p.u.
T2: 30 MVA, 11/220 kV, X=0.08 p.u.
Line (L): $X_1 =X_2 = 150$ Ω/phase, $X_0 = 450$ Ω/phase.

a- Calculate the bus impedance matrix (Z_{bus}) for positive, negative and zero sequence networks.
b- The system operates at rated values and a double line to ground fault occurs at bus 1 through a fault impedance $Z_f = j20$ ohms, using elements of Z_{bus} to find:
- Fault current. - Voltage of bus 1 (a, b, c).

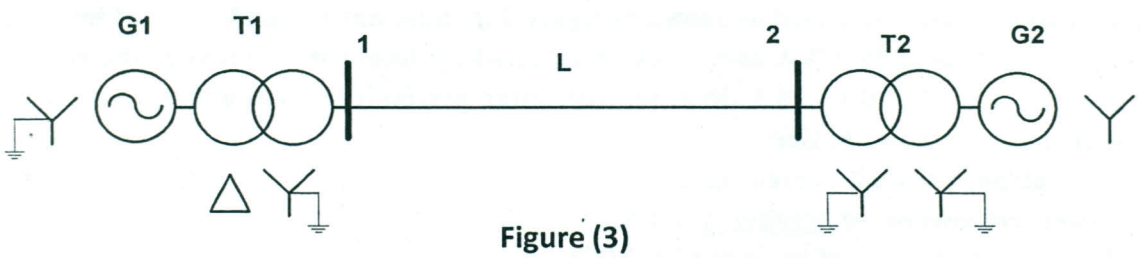

Figure (3)

With My Best Wishes
Prof. Dr. Mohammed El-Saied