Tanta University

Department: Electrical Power and Machines Engineering

Total Marks: 175 Marks

Faculty of Engineering

Course Title: Power System Analysis	Course Code: EPM3214	Year: 3rd
Date: 18 May 2015	Allowed time: 3 hrs	No. of pages: (2)

Answer all the following questions:

Question (1) (41 Marks)

Figure 1 shows the one-line diagram of a simple three-bus power system with generation at buses 1 and 2. The voltage at bus 1 is $1.0\angle 0°$ p.u and voltage magnitude at bus 2 is fixed at 1.05 p.u. The generated active power at bus 2 is 4 p.u. Using only two iterations find the bus voltages using Gauss-Seidel method considering the following initial values:

Bus number	V (p.u)	δ (degrees)
2	1.05	3.0
3	1.0	-4

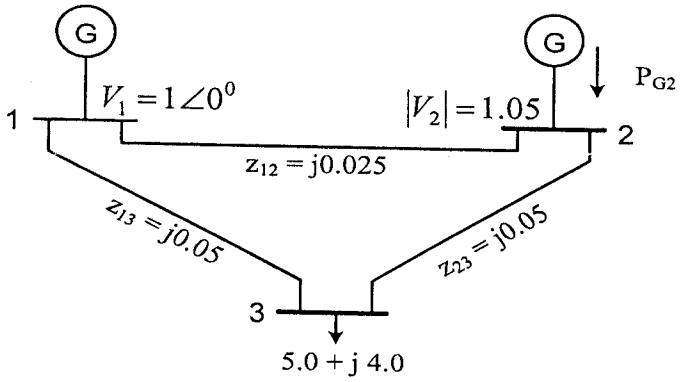

Figure 1

Question (2) (50 Marks)

Figure 2 shows the one-line diagram of a simple two-bus power system with generation at bus 1. The voltage at bus 1 is $1.0\angle 0°$ p.u. All data given are in per unit. Using Newton-Raphson method with only one iteration, find the voltage at bus 2. If a capacitor bank was inserted at the middle of the transmission line to keep the voltage at this point at 1.0 p.u., find the new value of the voltage at bus 2 using also Newton-Raphson method with only one iteration.

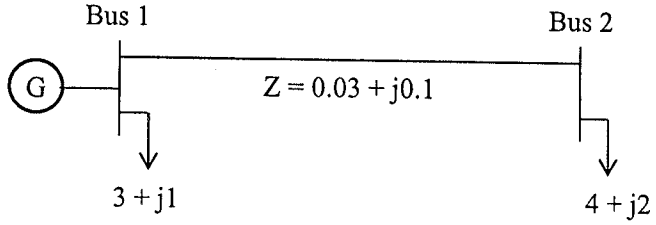

Figure 2

Question (3) **(84 Marks)**

A 30 MVA, 13.8 kV three-phase generator has a sub-transient reactance of 10%, negative-sequence reactance of 10%, zero-sequence reactance of 5% and neutral to ground reactance of 2%. The generator supplies three identical motors over a transmission line having transformers T_1 and T_2 at both ends, as shown in the one-line diagram of Figure 3. Each motor has rated input of 10 MVA and 6.9 kV at 0.8 lagging power factor. The reactances of each motor based on its own rating are 20% sub-transient reactance, 20% negative-sequence reactance, 4% zero-sequence reactance and 2% neutral to ground reactance. The transformers are three-phase rated at 30 MVA. T_1 is rated at 13.8 kV Δ on the generator side and 120 kV Y on the transmission line side, while, T_2 is rated at 6.9 kV Δ on the motor side and 120 kV Y on the transmission line side. Both transformers have a leakage reactance of 10% and they are solidly grounded. The reactances of the transmission line are $X_1 = X_2 = 15\%$ and $X_0 = 30\%$ on a base of 30 MVA and 120 kV.

(a) Find the sub-transient current in the transmission line for a symmetrical three-phase fault at the point P. Neglect pre-fault conditions. (14 Marks)

(b) Find the momentary currents in breakers A and B. Neglect pre-fault conditions. (14 Marks)

(c) Draw the positive, negative and zero sequence networks for the given system. (14 Marks)

(d) Find the sub-transient currents in the transmission line when a single line-to-ground fault occurs on phase a at the point P. Neglect pre-fault conditions. (14 Marks)

(e) Find the sub-transient currents in the breaker B when a line-to-line fault occurs between phases b and c at the point P. Neglect pre-fault conditions. (14 Marks)

(f) Repeat (d) considering pre-fault conditions if the motors were loaded at their rated conditions when the fault occurred. (14 Marks)

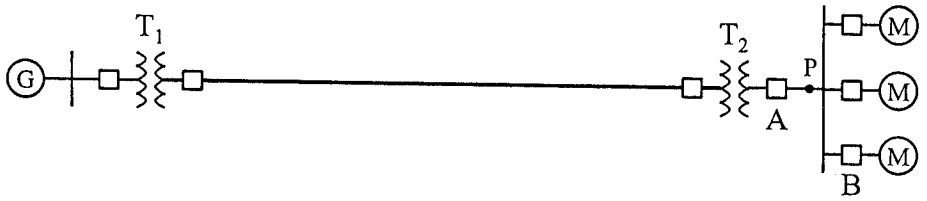

Figure 3

Best wishes:

Dr. Diaa-Eldin Mansour and Examination Committee