ENERGY SYSTEMS 424

Glover and Sarma Power System Analysis and Design 5th Edition

Course Notes - 2017

6. Power flows	
Section	**Remarks**
6.1 Direct solutions to linear algebraic equations: Gauss elimination	**Cover completely.** Apply Gauss elimination and back substitution to solve a linear matrix equation in upper triangular format: Examples 6.1 and Example 6.2.
6.2 Iterative solutions to linear algebraic equations: Jacobi and Gauss-Seidel	**Cover completely, except for example 6.5 and the theory on divergence on page 320.** Use the Jacobi method to obtain an iterative solution to a set of linear algebraic equations: Example 6.3. Use the Gauss-Seidel method to obtain an iterative solution to a set of linear algebraic equations: Example 6.4
6.3 Iterative solutions to nonlinear algebraic equations: Newton-Raphson	**Cover completely.** Use the Newton-Raphson method to solve polynomial equations iteratively: Example 6.6. Use the Newton-Raphson method to solve a set of nonlinear algebraic equations iteratively: Examples 6.7 and 6.8.
6.4 The power-flow problem	**Cover completely.** Identify bus types and assign input/output data for power flow analysis of a network: Example 6.9. Compute the elements of the admittance matrix Y_{bus} of a network: Example 6.9. Deduce the nonlinear power flow equations given by equations 6.4.10 and 6.4.11.
6.5 Power-flow solution by Gauss-Seidel	**Cover completely.** Use the Gauss-Seidel method (equations 6.5.2 and 6.5.3) to calculate the bus voltages for a network: Example 6.10.

6.6 Power-flow solution by Newton-Raphson	**Cover up to Example 6.11.** Compute the bus voltages for a power system using the four-step (pg. 336) Newton-Raphson method: Example 6.11
6.7 Control of Power Flow	**Cover up to (not including) Example 6.14.**
7 Symmetrical faults	
Section	**Remarks**
7.1 Series R-L circuit transients	**Cover completely.** Deduce the time domain equations (7.1.3 – 7.1.12) for the transient responses of a series RL circuit. Calculate the transient current responses of a series RL circuit: Example 7.1.
7.3 Power system three-phase short circuits	**Cover completely.** Use the superposition method to calculate the fault current and current distribution for a three-phase fault in a symmetrical power system: Example 7.3
7.4 Bus impedance matrix	**Cover up to (not including) example 7.5.** Obtain the bus impedance matrix Z_{bus} of a network from the inverse of the bus admittance matrix $Y_{bus.}$ Calculate the fault current and bus voltages of a network for a three-phase fault, using the bus impedance matrix of the system: Example 7.4. Represent a network by a bus equivalent (rake equivalent) circuit .
9 Unsymmetrical faults	
Section	**Remarks**

9.1 System representation	**Cover completely.** Know the assumptions on which the sequence network representations of a power system are based. Deduce the sequence networks and the associated Thevenin equivalent circuits for a power system network: Example 9.1 Calculate the fault currents for a three-phase fault using sequence networks: Example 9.2.
9.2 Single line-to-ground fault	**Cover completely.** Use sequence networks to calculate the phase currents and phase voltages at the fault for a single line-to-ground fault: Example 9.3.
9.3 Line-to-line fault	**Cover completely.** Use sequence networks to calculate the phase currents and phase voltages at the fault for a line-to-line fault: Example 9.4.
9.4 Double line-to-ground fault	**Cover completely up to (not including) example 9.6.** Use sequence networks to calculate the phase currents and phase voltages at the fault for a double line-to-ground fault: Example 9.5.
10 System protection	
Section	**Remarks**
10.1 System protection components	**Read through.**
10.2 Instrument transformers	**Cover up to example 10.2.** Give the equivalent circuit of a CT. Evaluate the performance (calculate the CT error) of a CT as a function of secondary current: Example 10.1. Determine if a relay will operate for a specific CT and burden combination: Example 10.2.

10.3 Overcurrent relays	**Cover completely.** Understand the use of current tap and time-dial settings. Given the current tap setting, time-dial setting and operating current, calculate the relay operating time from the time curves: Example 10.3.
10.4 Radial system protection	**Cover completely.** Determine current tap and time-dial settings for overcurrent protection of a radial system: Example 10.4 .
10.5 Reclosers and fuses	Read through.
10.8 Zones of protection	**Cover completely.** Identify protection zones for a network and determine which breakers must open for a fault at a specific location: Example 10.7.
10.10 Differential relays	**Cover completely.** Deduce the equations (Eq. 10.10.4) for the operating region of a simple differential relay.
10.11 Bus protection with differential relays	**Cover completely.** Draw the differential protection system layout for typical bus.
10.12 Transformer protection with differential relays	**Cover up to (not including) example 10.9.** Sketch a differential protection system layout for a single-phase transformer: Figure 10.36. Sketch a differential protection system layout for a three-phase transformer: Figure 10.37.
11 Transient stability	
Section	**Remarks**

11.1 The swing equation	**Cover completely.** Deduce the swing equation in mechanical (eq. 11.1.10) & electrical (eq. 11.1.16) format. First-order diffrential equation format of the swing equation: Eq. 11.1.18 and Eq. 11.1.19. Apply the swing equation to analyse the transient response of a single machine: Example 11.1 Apply the swing equation to analyse the transient response of multiple coherent machines: Example 11.2
11.2 Simplified synchronous machine model and system equivalents	**Cover completely.** Power transfer equation between a synchronous machine & infinite bus Simplified synchronous machine model for transient stability studies: Fig. 11.2 Synchronous machine and power system representation for transient stability studies: Fig. 11.3 Perform steady-state analysis to determine generator voltage and power angle for a given system: Example 11.3.
11.3 The equal-area criterion	**Cover completely excluding 11.4, 11.5, 11.6 and 11.7.** Deduce the equal-area criterion: Equation 11.3.5. Apply the equal-area criterion to perform transient stability analysis of power systems: Examples 11.4, 11.5 and 11.6
11.6 Design methods for improving transient stability	Read through
11 Power System Controls	
11.1 Generator-voltage control	**Cover completely.**
11.2 Turbine-governor control	**Cover completely.**

11.3 Load-frequency control	**Cover completely.**