Department of Electronics & Communication Engineering

Faculty of Engineering, Integral University, Lucknow

Assignment Sheet 2

POWER SYSTEM ANALYSIS (EE 602)

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Due Date : 25 April, 2012

Problems : 14

1. The unbalanced set of line to neutral voltages at a fault point in a power system are given by

   $V_a = 7.5\ \angle -30^0$ kV; $V_b = 7.5\ \angle -150^0$ kV; $V_c = 0$; $I_a = 2500\ \angle -90^0$ A; $I_b = 2500\ \angle 90^0$ A; $I_c = 0$

   Determine the complex power calculated with (a) symmetrical components (b) unbalanced phase components.

2. Explain how an unsymmetrical system of three phase currents can be resolved into three symmetrical component systems.
3. Explain the physical significance of sequence components of components of voltages in power system.
4. Prove that for a line to ground fault, all three sequence networks must be connected in series to obtain the sequence currents.
5. Draw the zero sequence network diagram of a delta-delta connected transformer.
6. Express the following equations in terms of number plus j operator
   - a^2
   - $1+a$
   - $1+a^2$
   - $1+a+a^2$
   - $1-a+a^2$
   - $1+a-a^2$
   - $1-a-a^2$

7. We have represented vector "a" in terms of vector j. Can you represent vector j in terms of vector "a"?
8. Draw the zero sequence networks for the system shown in fig.1. It has a generating supplying power to a distant village 80km away. The transmission is done on 220kV transmission line. The generator is rated at 500MVA giving the output at 11 kV and has the zero sequence reactance of 5%. The load consists of motors running at 11 kV and rated for 100, 100, and 200MVA. The zero sequence reactance of motors is 5%. The current limiting reactors has been provided between the neutral and ground of motor 1 having a value of 0.02 and between the neutral and ground of motor 3 having a value of 0.04. The transformer at the generating station is rated for 450 MVA with zero sequence reactance of 4% and voltage rating of 11/220kV. The transformer at the village is rated for 400 MVA with a leakage reactance of 4% and voltage rating 220/110kV. The zero sequence reactance of the line is 0.1 ohm/km. Draw the zero sequence reactance diagram of the system.
9. A synchronous generator is feeding 250MW to a large 50Hz network over a double circuit transmission line. The maximum steady state power that can be transmitted over the line with both circuits in operation is 500MW and is 350MW with any one of the circuits.

   A solid three phase fault occurring at the network end of one of the lines causes it to trip. Estimate the critical clearing angle in which the circuit breaker must trip so that synchronism is not lost.

   What further information is needed to estimate the critical clearing angle?

   Ans. 53^0

10. Prove that a group of coherently swinging machines can be represented by a single machine whose inertia constant is the sum of the inertia constants of the individual machines. State any assumption(s) made.
11. Three synchronous generators have the following MVA ratings and inertia constants:

    Generator1 G=200MVA H=4.0 MJ/MVA

    Generator2 G=500MVA H=3.0 MJ/MVA

Generator3 G=750MVA H=5.0 MJ/MVA

If the generators are a part of a synchronously operating power system whose base MVA is 1000, determine (i) equivalent H and (ii) equivalent M

Ans. (i) 6.05 MVJ/MVA (ii) 0.6722MJs/electrical degree

12. Write short note on Bewley's lattice diagram.
13. Obtain an expression for the surge impedance of a transmission line and for the velocity of propagation of electric waves in terms of the line inductance and capacitance.
14. Describe the difference between transient and steady state stability of a synchronous system. Describe a tabular method of computing of transient stability by a step-by-step process, and indicate how a model network may be used to assist the computation.

Do the assignment on A-4 sheets only. Use both side of the page. After the date of submission, assignment will not be accepted and zero marks will be allotted to the student who fail to submit the assignment on due date.