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EE61

Sixth Semester B.E. Degree Examination, Dec. 07 / Jan. 08
Power System Analysis and Stability

Time: 3 hrs. Max. Marks:100

Note : *1. Answer any FIVE full questions.*
2. Assume missing data suitably.

1 a. Prove that p.u. value of reactance of a transformer is same whether reffered to H.T or L.T. **(05 Marks)**

b. Three parts of a single-phase electric system are designated A, B and C and are connected to each other through transformers as shown in Fig1(b) below . The transformers are rated as follows :

A – B : 10 MVA, 13.8 – 138 KV, X = 10%
B – C : 10 MVA, 69 – 138 KV, X = 8%

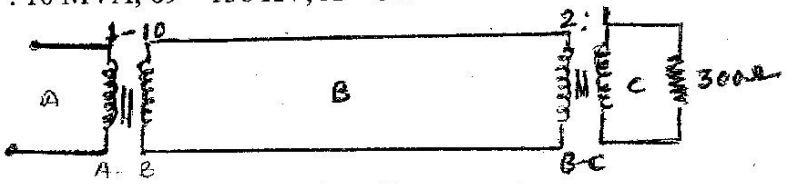

Fig. 1(b)

If the base in the circuit 'B' is chosen as 10 MVA, 138KV find the p.u. impedance of the 300Ω resistive load in circuit 'C' reffered to circuit C,B and A. Draw the impedance diagram neglecting magnetizing current, transformer resistance, line impedance. Determine the voltage regulation if the voltage at the load is 66KV, with the assumption that voltage input to circuit remains constant. **(15 Marks)**

2 a. A sudden 3-phase short circuit takes place at the terminals of an unloaded three-phase alternator. Discuss briefly on the different reactances that are met with, assuming that the damper windings are provided at the pole-faces of salient pole synchronous machine. **(07 Marks)**

b. From 'Bus admittance matrix' for the system given below.

Bus-code p-q	Zpq
1-2	j0.24
2-3	j0.18
3-1	J0.06

(07 Marks)

c. Write briefly on "Selection of C.B" **(06 Marks)**

3 a. Derive an expression for the three-phase complex power in terms of the sequence components and hence show that the symmetrical component transformation is power invariant. **(06 Marks)**

b. One conductor of a three-phase line is open. The current flowing to the Δ-connected load through line 'a' is 10 A. With the current in line 'a' as reference and assuming that line 'c' is open, find symmetrical components of the line currents.

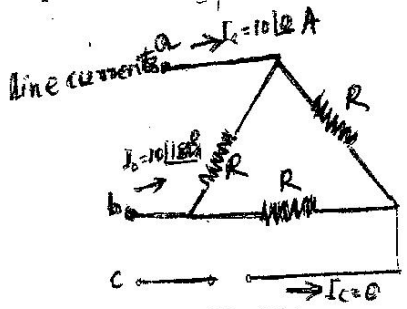

Fig.3(b) **(08 Marks)**

c. Justify the statements : i) Positive sequence currents are present in all types of faults ii) Negative sequence currents are present in all un-symmetrical faults. **(06 Marks)**

4 a. With the help of relevant phasor-diagrams of voltages, show that there exists a phase shift of positive and negative sequence components in a three-phase Y-Δ transformer bank. Assume H T. side to be Y-connected and L.T. side Δ connected. **(06 Marks)**

b. A 25 MVA, 13.2 KV alternator with solidly grounded neutral has a sub-transient reactance of 0.25 p.u. The negative and Zero sequence reactances are 0.35 and0.1 p.u respectively. A single line to ground fault occurs at the terminals of an unloaded alternator, determine the fault current. **(06 Marks)**

c. A 3-phase generator rated 15 MVA, 13.2 KV has a solidly grounded neutral. Its +ve, -ve, and 'o' sequence reactance are 40%, 30%, 5%respectively.

i) Find the value of reactance to be connected in the neutral circuit so that fault current for a single line to ground fault, does not exceed the rated line current ($Z_f = o$).

ii) Find the value of resistance to be connected in the neutral circuit to serve the same purpose. **(08 Marks)**

5 a. A generator with grounded neutral has sequence impedance of Z_1, Z_2 and Z_0 and generated emf(E). If a single-line to ground fault occurs on terminals of phase 'a', find V_b and V_c ($Z_f = 0$). **(06 Marks)**

b. Show that the Impedance Z_n between the Y-neutral and ground of a 3ϕ machine is represented equivalently as $3Z_n$ in its zero sequence diagram. **(08 Marks)**

c. Draw the interconnection of sequence network for a double-line to ground fault. **(06 Marks)**

6 a. A 3-ϕ, 5 MVA, 6.6KV alternator with a reactance of 8% is connected to a feeder of series impedance of 0.12 + j0.48Ωs/phase/km. The transformer is rated at 3 MVA, 6.6KV/33KV and has a reactance of 5%. Determine the fault current supplied by the generator operating under no-load, with a voltage of 6.9 KV, when a 3-ϕ symmetrical fault occurs at a point 15 km along the feeder.

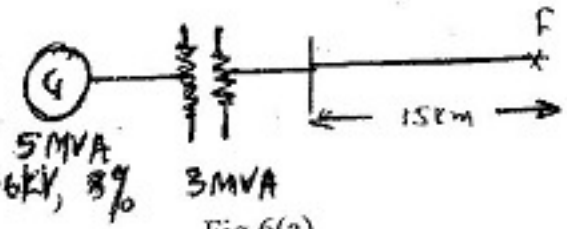

Fig.6(a)

Choose generator ratings as base values. **(10 Marks)**

b. A synchronous generator and motor are rated for 30 MVA, 13.2KV and both have subtransient reactance of 20%. The line connecting them has a reactance of 10% on the base of machine ratings. The motor is drawing 20 MW at 0.8 p.f (lead). The terminal voltage of the motor is 12.8KV. When a symmetrical 3ϕ fault occurs at motor terminals, find the subtransient current in - i) Generator ii) Motor. **(10 Marks)**

7 a. Explain the concept of : i) Steady state stability ii) Transient stability. **(06 Marks)**

b. Define M and H constants of a synchronous machine. Hence develop the relation between them. **(06 Marks)**

c. A 2- pole, 50HZ, 11KV, turbogenerator has a rating of 60 MW and p.f of 0.85(log). Its rotor has a moment of inertia 8800 kg-m^2. Find :

i) Its interia constant in MJ/MVA ii) Momentum in MJ-S/elect. degree. **(08 Marks)**

8 a. With a neat sketch, explain equal area criteria for finding stability limit. **(05Marks)**

b. Develop the expression for "critical clearing angle" for a fault on a double feed or power system.

c. A 50Hz, generator is supplying 50% of the power that it is capable of delivering through a transmission line to an infinite bus. A fault occurs that increases the reactance between the generator and the in-finite bus to 500% of the value before fault. When the fault is isolated, the maximum power that can be delivered is 75% of the original maximum value. Determine critical clearing angle (δ_L). **(10 Marks)**