EE61

USN

NEW SCHEME

Sixth Semester B.E. Degree Examination, July 2006
E & EE
Power System Analysis and Stability

Time: 3 hrs.] [Max. Marks:100

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

1 a. i) List any three advantages of per unit system of computations.
ii) State the criteria for the selection of base quantities. (05 Marks)

b. Show that the per-unit impedance of a transformer is the same when referred to either its primary side or the secondary side. (05 Marks)

c. Draw the per unit impedance diagram for the system shown in fig.1(c), by taking a base of 100 MVA, 11 KV in the generator circuit. The various component ratings are: Transformer T1: 3 phase unit 90 MVA, 11/110 KV, X=10%, Transformer T2: made up of 3 single-phase units each rated 33.33 MVA, 68/6.6 KV, X=10%, Synchronous Generator: 80 MVA, 10 KV, X=10%, Synchronous Motor: 95 MVA, 6.3 KV, X=15% and the line reactance is 20 ohms. (10 Marks)

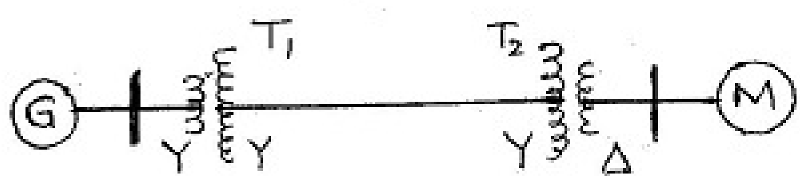

Fig.1(c)

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. By stating the generalized algorithmic equations for determining the elements of the bus admittance matrix by the rule of inspection, obtain the matrix, Y_{BUS} for the resistive network shown in fig.2(b). All the values shown are in Ohms. (05 Marks)

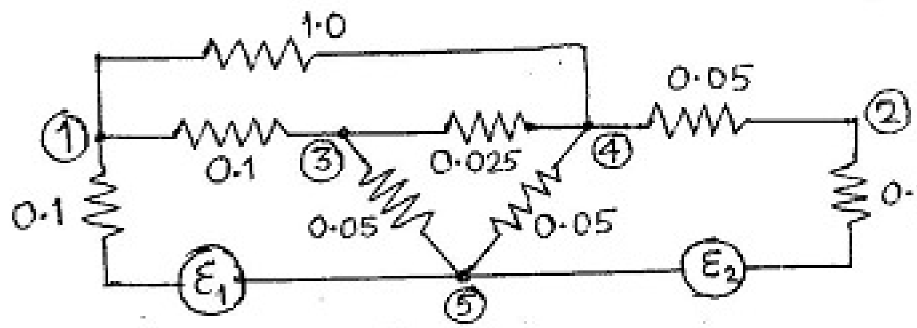

Fig.2(b)

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c. A transmission line of inductance, L = 0.1 Henry and resistance, R = 5 Ohms, is suddenly short circuited at t = 0, at the far end of line as shown in fig.2(c). If the source voltage is: $v = 100 \sin(100\pi t + 15^0)$, obtain the following:
i) Expression for the short circuit current, i(t).
ii) Exact value of the first current maximum and
iii) Instant of short circuit at which the DC off-set current is zero. **(08 Marks)**

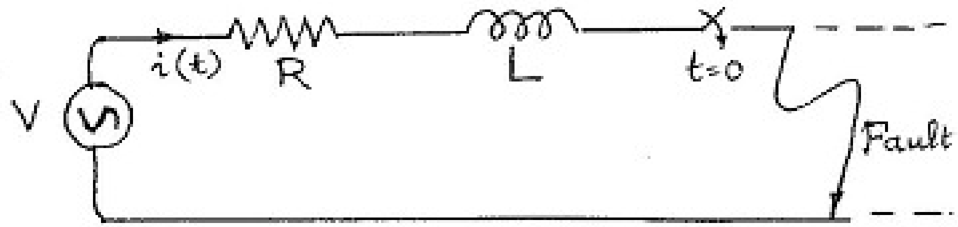

Fig.2(c)

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. A balanced delta connected load is connected to a symmetrical three-phase system and supplied to it is a current of 15 amps. If the fuse in line-C melts, determine the symmetrical components of the line currents. **(08 Marks)**

c. A synchronous generator rated 500 KVA, 440 V, 0.1 pu sub-transient reactance is supplying a passive load of 400 KW at 0.8 pf (lag). Calculate the initial symmetrical (rms) current for a three-phase fault at the generator terminals. **(06 Marks)**

4 a. With the help of the 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 the HT side to be Y – connected and LT side, Δ - connected. **(08 Marks)**

b. Discuss on the sequence reactance – diagrams of transformers for their winding connections as follows: i) Y - Δ ii) Y - Y iii) Δ - Y iv) Δ - Δ **(06 Marks)**

c. Obtain the zero sequence diagrams for the system shown in fig.4(c). **(06 Marks)**

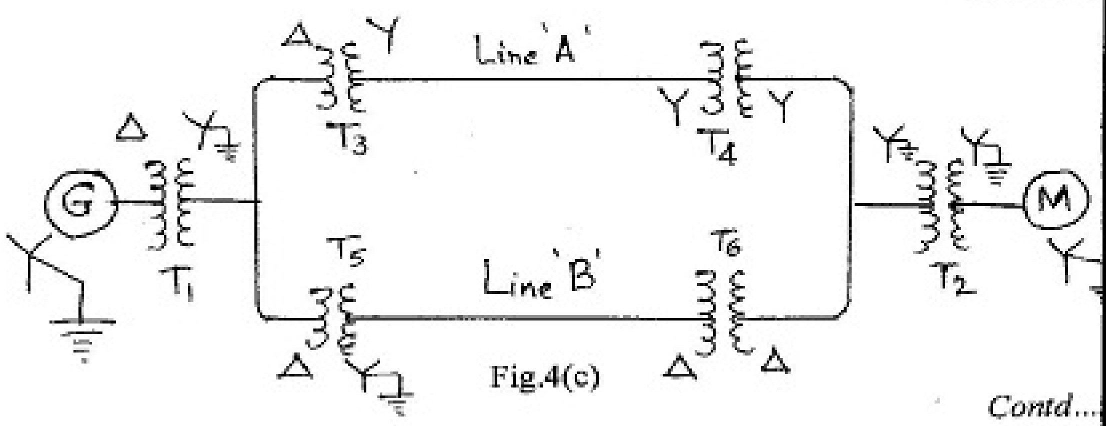

Fig.4(c)

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5 a. Show that the impedance Z_n between the Y-neutral and ground of a three-phase machine is represented equivalently as $3Z_n$ in its zero sequence diagram. **(04 Marks)**

b. Derive the expression for the fault current in terms of the sequence impedances and hence obtain the connection diagram of the sequence networks for a line-to-line (LL) fault through the fault impedance, Z_f at the terminals of a Y–connected alternator. **(10 Marks)**

c. A three-phase generator with constant internal voltages gave the fault currents under two different unsymmetrical faults as follows:
L-L fault : 1400 Amperes and L-G fault : 2200 Amperes.
If E_{a1} = 2 KV, and the positive sequence reactance is 2 Ohms, find the negative-sequence and zero-sequence impedance values. **(06 Marks)**

6 a. Discuss briefly about the open-conductor faults in electric power systems. **(06 Marks)**

b. Three 6600 Volts, 10 MVA, 3-phase alternators are connected to a common set of bus-bars. Each has a positive-sequence reactance of 15%. The negative-sequence and zero-sequence reactances are respectively equal to 75% and 30% of the positive-sequence value. Find the fault current for L-G fault at the bus terminals if:
i) Only one of the generator neutrals is solidly grounded.
ii) Only one of the neutrals is earthed through a resistance of 0.3 Ohm. **(14 Marks)**

7 a. Distinguish between steady state stability and transient stability in power systems. Also elaborate on the corresponding power limits. **(06 Marks)**

b. Develop the swing equation of a synchronous machine working on an infinite bus. **(06 Marks)**

c. A 50 Hz, 4-pole turbo-alternator, rated 20 MVA, 11 KV has an inertia constant of H = 9 KWs/KVA. Find the acceleration if the input less the rotational losses is 26,800 HP and the electrical losses developed amount to 16 MW. **(08 Marks)**

8 a. Bring out the importance of the inertia constants M and H. **(04 Marks)**

b. Explain the Equal Area Criterion of stability for a two-machine power system. State the assumptions made. **(08 Marks)**

c. Obtain the power angle characteristic equations for a two-machine loss-less power system connected by a series impedance. **(08 Marks)**

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