DU – 097

VI Semester B.E. (E&E) Degree Examination, Dec. 2017/Jan. 2018
(2K11)
EE 602 : POWER SYSTEM ANALYSIS

Time : 3 Hours Max. Marks : 100

Instruction : *Answer **five full** questions selecting at least **two** questions from **each** Part.*

PART – A

1. a) Define perunit quantity. Mention the advantages of perunit system. **6**

   b) Show that perunit impedance of a transformer is same on either sides of it. **6**

   c) Draw the preunit impedance diagram of power system shown in Fig. 1(c). Select the bases of 100 MVA, 200 kV, in transmission line circuit. The ratings of the machines are as follows : **8**

   Generator : 100 MVA, 25 kV, X = 20%

   Motor : 50 MVA, 11 kV, X = 30%

   Y-Y-Transformer 40 MVA, 33-220 kV, X = 15%

   Y-Δ-Transformer 30 MVA, 11-220 kV, X = 15%

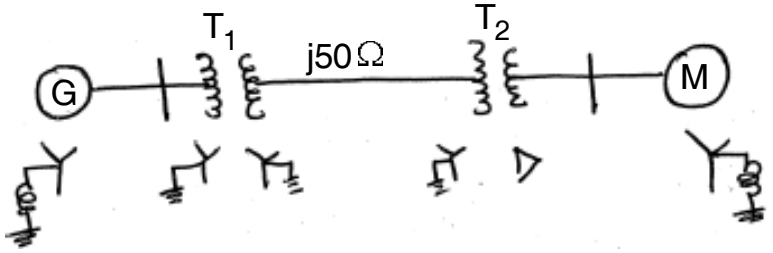

Fig. 1(c)

2. a) With the help of oscillograms of short circuit currents, of synch. generator operating on no load, distinguish between subtransient, transient and steady state reactances. Draw the corresponding equivalent circuits used to compute X′d′, Xd′ and Xd. **10**

   b) A generator is connected to a motor through a transformer. On a common base, the sub transient reactances are, 0.15, 0.35 and 0.1 pus respectively. When a 3 phase fault is occurred of the motor terminals, the generator was delivering current of 1pu at a PF 0.9 leading of terminal voltage of 0.9 pu. Find the subtransient currents. **10**

P.T.O.

3. a) What are symmetrical components ? How they are useful in the power system analysis ? **5**

   b) Derive an expression for three phase power in terms of symmetrical components. **8**

   c) In a 3 phase system $I_{a_1} = 100 \angle 30^\circ$ A, $I_{b_2} = 40 \angle 90^\circ$ A and $I_{C_0} = 10 \angle -30^\circ$ A. Find the line currents. **7**

4. a) Resolve the unbalanced 3-phase voltages into their symmetrical components. Also obtain its converse relation. **5**

   b) Prove that balanced 3-phase voltages will only positive sequence components. **5**

   c) A delta connected balanced load is connected to 3 phase supply. When one of its line is opened, the current through other line is 20t. Find the sequence components of the line and phase currents. **10**

PART – B

5. a) A double line fault is occurred at the terminals of an unloaded star connected alternator. Derive the expression for fault current in terms of sequence impedences and hence arrive at interconnection diagram of sequence networks. **8**

   b) A single line to ground fault occurs at mid point of the transmission line of the power system shown in Fig. 5(b). Determine the fault currents in pu and in ampers from the generator, if the system is on no load and at a voltage of 100 kV at the fault point. Use base of 50 MVA and 110 kV in transmission line circuit. **12**

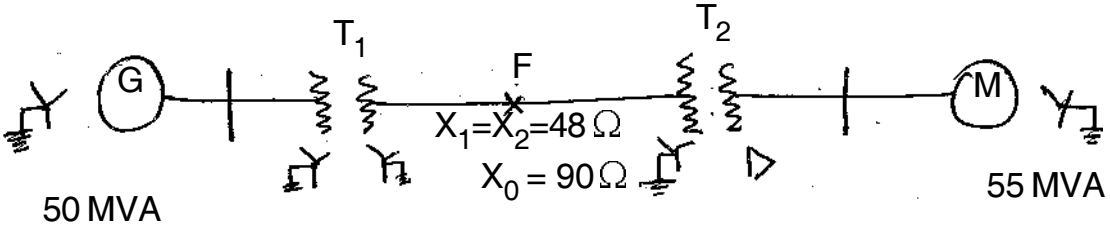

Fig. 5(b)

50 MVA
11.5 kV
$X_1 = 0.3$
$X_2 = 0.2$
$X_0 = 0.1$ pu

45 MVA
11/110-kV
$X_l = 0.1$ pu.

3 – 1 ϕ transformer
20 MVA each
66/6.6-kV
$X_l = 10\%$

55 MVA
6 kV
$0.4 = X_1$
$0.3 = X_2$
$0.2 = X_0$
pus

6. a) What are open conductor faults ? Establish the connection of sequence networks for the two common types of open conductor faults. **10**

   b) A synchronous generator has an open circuit voltage of 1.1 pu behind its transient reactances. The magnitude of fault currents for various faults occurred at its terminals are.

   3 phase fault – 5 pu ; LL fault 4.55 pu and LG fault 3.3 pu. Determine the sequence impedances of the generator in pu and find the fault current when 2 L-G fault occured. **10**

7. a) What is stability ? Explain the methods of improving stability in power system. **6**

   b) Derive the expression of swing equation with usual notations. **6**

   c) Find the steady state power limit of a two machine system, consisting of a synchronous generator with an equivalent reactance of 0.5 pu to an infinite bus through a reactance of 1 pu. The terminal voltage is held at 1.2 pu and the voltage of the infinite bus is 1 pu. **8**

8. a) Obtain the block diagram representation of turbine, generator, governor and load. Using this obtain the complete block diagram representation of load frequency control of an isolated power system. **12**

   b) Find the static frequency drop if the load is suddenly increased by 25 MW on a system, having the following data :

Rated system capacity	Pr = 500 MW
Operating load	PD = 250 MW
Inertia constant	H = 5 seconds
Governor, regulation	R = 2 Hz/ pu MW
Frequency	f = 50 Hz

   Assume frequency characteristic of load is linear. Also find additional generation. **8**
