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10EE61

Sixth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Power System Analysis and Stability

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Define per unit quantity? What are the advantages of PU systems? **(06 Marks)**

b. Show that the per unit impedance of a transformer is the same irrespective of the side of which it is calculated. **(04 Marks)**

c. Obtain the impedance diagram of the electrical power system shown in the Fig.Q1(c). The one line diagram of an unloaded generator is as shown in the Fig.Q1(c) choose a base of 50MVA, 13.8KV in the circuit of generator G_1.

The generators and transformers ratings are :

G_1 : 20MVA, 13.8KV, x″ = 0.2p.u

G_2 : 30MVA, 18 KV, x″ = 0.2p.u

G_2 : 30MVA, 20 KV, x″ = 0.2p.u

T_1 : 25MVA, 220KV, Y/13.8ΔKV, x = 10%

T_2 : three single phase units each rated 10MVA, 127/18 KV, x = 10%

T_3 : 35MVA, 220KV Y/22KV, x = 10%. **(10 Marks)**

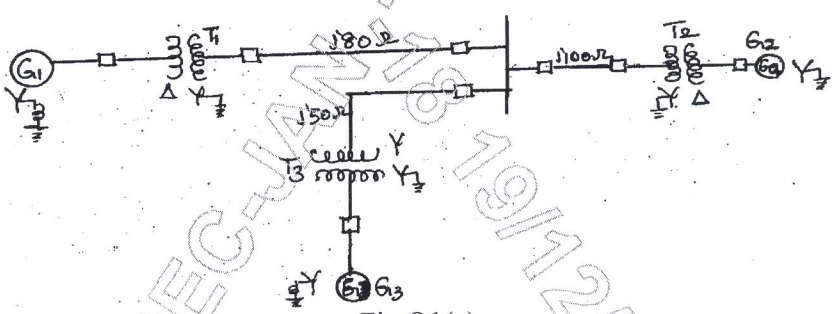
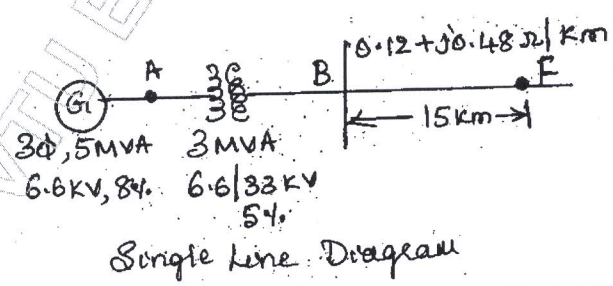


Fig.Q1(c)

2 a. With the oscillogram of the short circuit current of synchronous machine, define direct axis synchoronous reactance, transient and subtransient reactance. **(08 Marks)**

b. A 3-phase, 5MVA, 6.6KV alternator with a reactance of 8% connected to a feeded of series impedance of 0.12 + j0.48Ω/phase/km. The transformer is rated at 3MVA, 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 6.9KV, when a 3-phase symmetrical fault occurs at a point 15km from the feeder. **(12 Marks)**



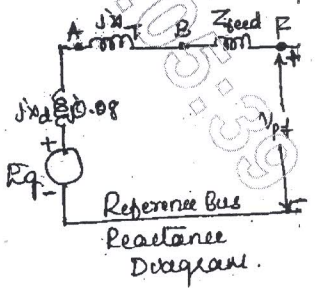


Fig.Q2(b)

3 a. Prove that a balanced set of three phase voltages will have only positive sequence components of voltages only. **(06 Marks)**

b. A balanced delta connected load is connected to a symmetrical supply. The line currents are each 10A in magnitude. If fuse in one of the lines blows out, determine the sequence components of line current. **(08 Marks)**

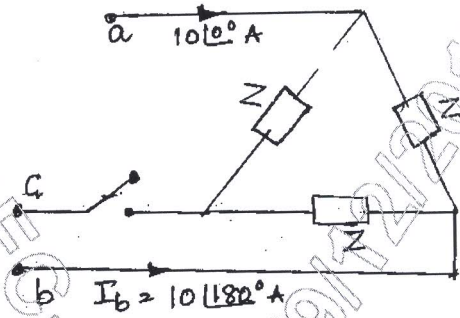


Fig.Q3(b)

c. Derive an extraction for complex power interms of the symmetrical components. **(06 Marks)**

4 a. Draw the zero sequence equivalent circuit for the following conditions of transformer. **(10 Marks)**

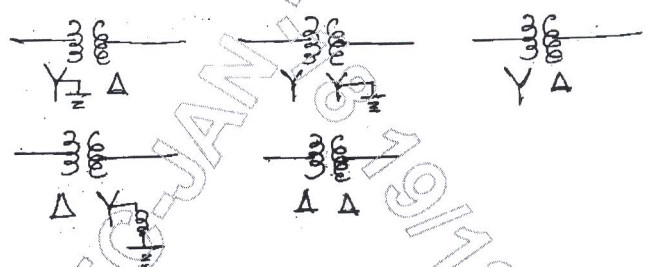


Fig.Q4(a)

b. The one-line diagram of a power system is as shown is the Fig.Q4(b). The ratings of the devices are as follows :

G_1 and G_2 : 104MVA, 11.8V, $x_1 = x_2 = 0.2$p.u, $x_0 = 0.1$p.u

T_1 and T_2 : 125MVA, 11Y – 220YKV, $x_1 = x_2 = x_0 = 0.1$p.u

T_3 and T_2 : 120MVA, 230Y – 6.9YKV, $x_1 = x_2 = x_0 = 0.12$p.u

M_1 : 175MVA, 6.6KV, $x_1 = x_2 = 0.3$p.u $x_0 = 0.15$ p .u

M_2 : 50MVA, 6.9KV, $x_1 = x_2 = 0.3$p.u $x_0 = 0.1$p.u

Transmission line reactance : $x_1 = x_2 = 30\Omega$ $x_0 = 60\Omega$.

Draw the sequence impedance diagram in p.u on a base of 200MVA, 220KV in transmission **(10 Marks)**

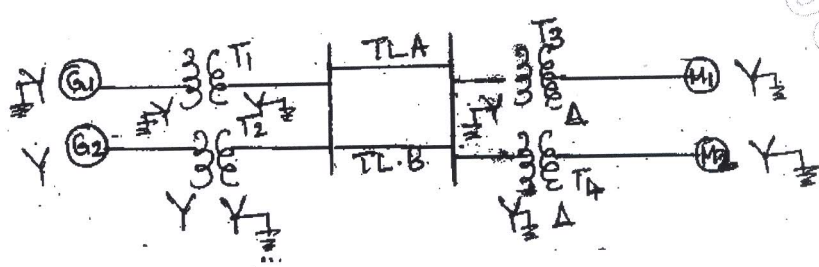


Fig.Q4(b)

PART – B

5 a. Derive an expression for fault current when an line to line (LL) fault occurs on the terminals of an unloaded generator. **(08 Marks)**

b. A synchronous motor is receiving 10MW of power at 0.8pu. lag at 6KV. An LG fault takes place at the middle point of the transmission line as shown in the Fig.Q5(b). Find the fault current. The ratings of the generator, motor and transformer are as given :

Generator : 20MVA, 11KV, $x_1 = 0.2$p.u, $x_2 = 0.1$p.u, $x_0 = 0.1$ p.u
Transformer : T_1 : 18MVA, 11.5Y – 34.5YKV, x = 0.1p.u
Transmission line : $x_1 = x_2 = 5\Omega$, $x_0 = 10\Omega$
Transformer T_2 : 15MVA, 6.9Y – 34.5YKV, x = 0.1p.u
Motor : 15MVA, 6.9KV, $x_1 = 0.2$p.u, $x_2 = x_0 = 0.1$p.u. **(12 Marks)**

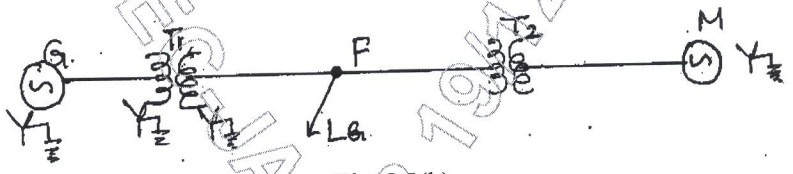


Fig.Q5(b)

6 a. Discuss "open conductor faults". **(10 Marks)**

b. Derive an expression for L–L–G fault occurs through fault impedance (z_f) in a power system. Show the inter connection of sequence networks. **(10 Marks)**

7 a. Derive the expression for swing equation. **(06 Marks)**

b. Explain equal area concept when a power system is subjected to sudden increase in load. **(06 Marks)**

c. A turbo alternator, 6-pole, 50Hz of capacity 80MW working at 0.8p.f has an inertia of 10MJ/MVA. Calculate :
   i) The energy stored in the rotor at synchronous speed
   ii) Find rotor acceleration if the mechanical input is suddenly raised to 75MW for an electrical load of 60MW
   iii) Suppose the above acceleration is maintained for a duration of 6 cycles. Calculate the change in torque angle and the rotor speed at the end of 6 cycles. **(08 Marks)**

8 Write short notes on :
a. Power angle equation of a non salient pole synchronous machine
b. Classification of stability
c. Single phasing of 3 phase induction motor
d. Critical clearing angle and critical clearing time. **(20 Marks)**

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