U.S.N

P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Sixth Semester, B.E. - Electrical and Electronics Engineering

Semester End Examination; May/ June - 2019

Power System Analysis and Stability

Time: 3 hrs Max. Marks: 100

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. What are the single line diagrams? Explain the procedure of finding the reactance diagrams. List the assumptions made. 10

b. Draw the reactance diagram of the system shown in Fig. Q1(b). The ratings of the components are :

G: 15 MVA, 6.6 kV, X" = 12%, T_1 = 20 MVA, 6.6/66 kV, X = 8%; T_2: 20 MVA, 66/6.6 kV, X = 8%; M_1 and M_2: 5 MVA, 6.6 kV, X" = 20%. Select generator rating as base value. 10

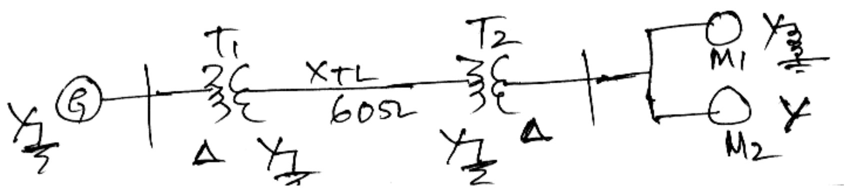

Fig. Q.1b

2 a. Define the per-unit value of a quantity. List the advantages of per unit method of calculation. 5

b. The primary and secondary sides of 1-ϕ, 1 MVA 4/2-kV transformer have a leakage reactance of 2 Ω each. Find the pu reactance of the transformer referred to primary and secondary. 5

c. For the single line diagram shown in Fig. Q2(c) draw the reactance with all reactances marked in per-unit. Select the generator rating as base in the generator circuit. The rating of the components are:

G: 30 MVA, 13.8 kV, X" = 15%; T_1 (3-ϕ): 35 MVA, 13.2Δ/115Y kV, X = 10%, T_2 (3, 1-ϕ); 10 MVA, 12.5/67 kV, X = 10%; M_1 and M_2: 20 MVA and 10 MVA, both 12.5 kV with X" = 20%. 10

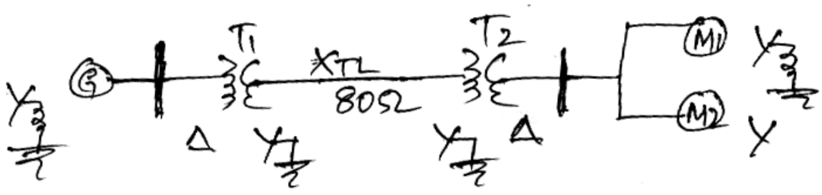

Fig. Q 2C.

UNIT - II

3 a. Explain briefly the transients in a transmission line with suitable waveforms. 10

b. For the circuit of Fig. Q3(b), per-unit reactance values of components are based on their own base. The tie line is 50 km long. Each conductor has a reactance of 0.848 Ω/km. The three phase fault takes place at F, 20 km from generator 1. Find the short circuit current, Reactance values at own MVA base. 10

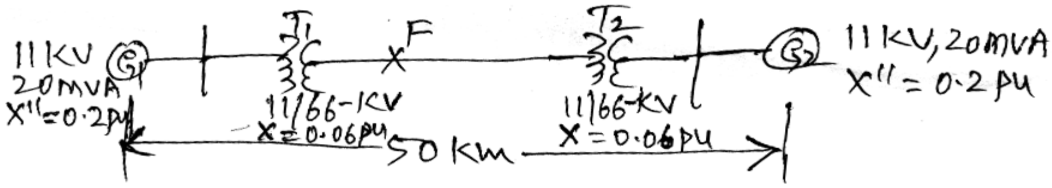

Fig. Q3(b)

4 a. Explain clearly the variation of current and impedance of an alternator when a 3-phase sudden short circuit takes place at its terminals. 10

b. The far end of transmission line shown in Fig. Q3(b) is suddenly short circuited at $t = 0$. If the source voltage is $v = 100\sin(100\pi + 15)$, obtain the following :

i) Expression for short circuit current

ii) Maximum momentary current

iii) Instant of SC at which DC-offset current is zero

iv) Instant at which DC-offset current is maximum 10

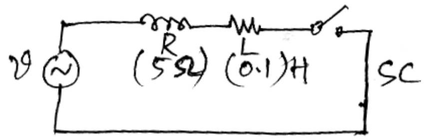

Fig. Q 4 b

UNIT - III

5 a. What are symmetrical components? Obtain the relationship between symmetrical components and unbalanced 3-ϕ phasors. 10

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

6 a. Prove that only in power system having balanced impedances of the current of a given sequence produce voltage drop of the same sequence. 10

b. Draw the positive and zero sequence networks for the power system shown in Fig. Q6(b). Chose a base of 50 MVA, 220 kV in the 50 Ω transmission lines and mark all reactances in pu. The ratings of the generators and transformers are:

Gen 1 and 2:25 MVA, 11 kV, X" = 20%, 3-ϕ Transformer (each): 20 MVA, 11Y/220Y-kV, X = 15%. X_n = 5% of machine-1 and 2 rating. 10

The negative sequence reactance of each machine is equal to the sub-transient reactance. The zero sequence reactance of each machine is 8%. Assume that the zero sequence reactance of lines are 250% of their positive sequence reactance.

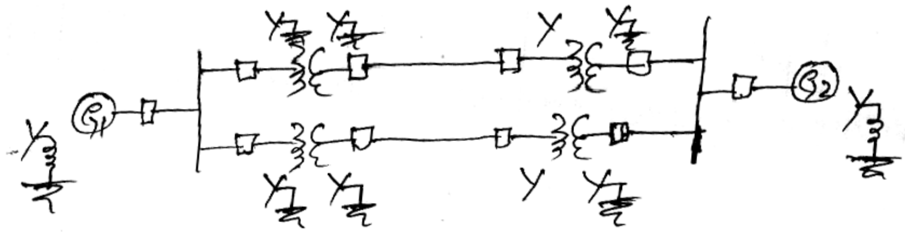

Fig. Q6(b)

UNIT - IV

7 a. A single line to ground fault occurs at the terminals of an unloaded generator. Drive an expression for fault current. Draw the connection of sequence networks. 10

b. A 3-ϕ generator with line-to-line voltages of 400 V is subjected to an LLG fault. If Z_1 = j2 Ω, Z_2 = j0.5 Ω and Z_0 = j0.25 Ω, determine the fault current and terminal voltages. 10

8 a. A double line to ground fault occurs at the terminals of an unloaded alternator. Derive an expression for the fault currents. Also draw the interconnection of the sequence network to simulate the fault. 10

b. A 3-ϕ generator with constant internal voltages gave the fault current of: 1.4 kA for L-L fault and 2.2 kA for an L-G fault. If Ea1 = 2 kV, X1 = 2 Ω, determine the reactances X2 and X0. 10

UNIT - V

9 a. With usual notations derive an expression for swing equation. 8

b. A 60 Hz, 4 pole turbo generator rated 500 MVA, 22 kV has an inertia constant of H = 7.5 MJ/MVA. Find;

i) KE stored in the rotor at synchronous speed 6

ii) The angular acceleration if the electrical power developed is 400 MW when the input minus rotational losses is 740 kHP.

c. Define the terms steady state stability, and transient stability and dynamic stability with reference to electric power systems. 6

10 a. Derive power angle equation of a non-salient pole synchronous machine connected to an infinite bus. Draw power angle curve. 10

b. Discuss the methods of improving steady state and transient stability of a power system. 10

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