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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; June - 2017

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. Show that per unit impedance of a transformer is the same irrespective of the side on which it is calculated. 6

b. With the help of typical electric power system explain :

i) A balanced system ii) A symmetrical system

iii) One line diagram iv) Impedance and reactance diagram. 10

c. Enumerate the advantages of per unit system. 4

2 a. With the help of circuit diagrams explain :

i) Equivalent circuit of synchronous machine ii) Equivalent circuit of two winding transformer

iii) Equivalent circuit of two transmission line. 6

b. Fig. (2.b) shows the schematic diagram of a radial transmission system. The ratings and reactance of the various components are shown therein. A load of 60 MW at 0.9 p.f. lagging is tapped from 66 kV substation which is to be maintained at 60 kV. Calculate the terminal voltage of the machine. Represent the transmission line and transformer by series reactances only.

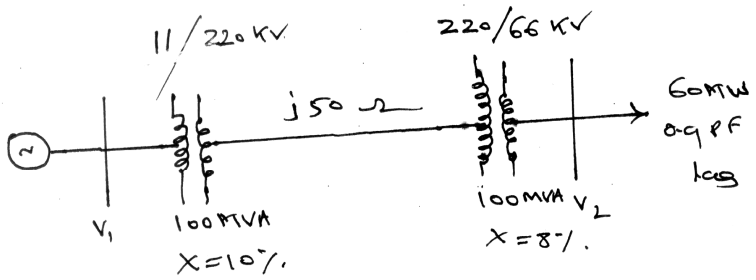

Fig (2.b) 14

UNIT - II

3 a. Two generators are connected in parallel to the low voltage (LV) side of a 3-phase, Δ-Y transformer. The ratings of the machines are Generator G_1: 50 MVA, 13.8 kV, $X_d'' = 25\%$ Generator G2: 25 MVA, 13.8 kV, $X_d'' = 25\%$, Transformer T: 75 MVA, 13.8Δ-69Y kV, X = 10%. Before the fault occurs, the voltage on the high voltage (HV) side of transformer is 66 kV. The transformer is unloaded and there is no circulating current between the generators. Find the sub-transient current in each generator when a 3-phase fault occurs on the high voltage side of transformer. 14

Contd…2

b. Write short note on selection of circuit brakers. 6

4 a. For the radial network, shown in Fig. Q 4(a), a 3-phase, fault occurs at F. Determine the fault current and the voltage at 11 kV bus under fault conditions. 12

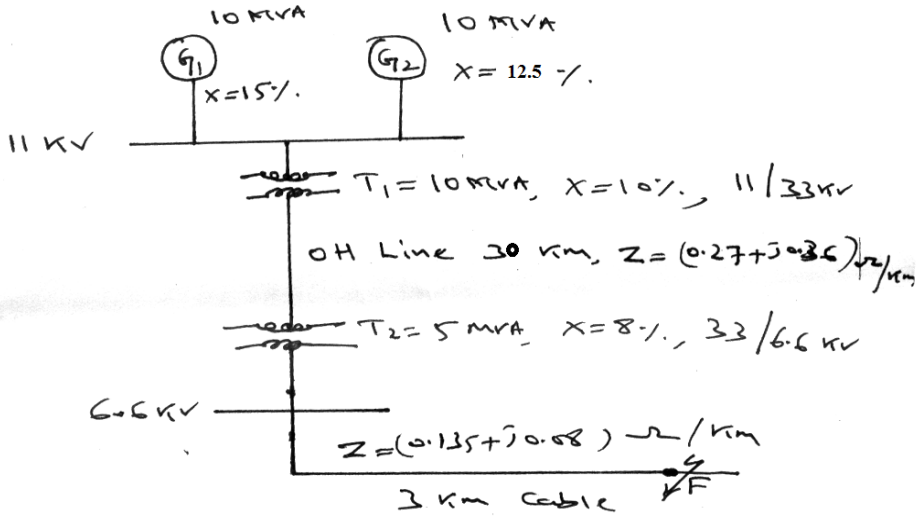

Fig. Q4(a)

b. Explain clearly the variation of current and impedance of an alternate when 3-phase sudden short circuit occurs on its terminals on no load condition. 8

UNIT - III

5 a. Derive expressions for the phase voltage of a system in terms of symmetrical components. 8

b. The voltage of the terminals of a 3-phase balanced load consisting of three (10+j8)Ω, connected in Y are $V_{ab} = 100\angle 0^0 V$, $V_{bc} = 90\angle 240^0 V$, $V_{ca} = 90\angle 120^0 V$. Find the power consumed in load using symmetrical components. 12

6 a. Prove that a balanced set of 3-phase voltage will have only positive sequence components of voltages only. 8

b. Obtain the expression for the 3-phase complex power in terms of sequence components. 8

c. The positive, negative and zero sequence components of line current are $20\angle 10^0$, $6\angle 60^0$ and $3\angle 30^0$ A respectively. Determine Line current. 4

UNIT - IV

7 a. A 3-phase regenerator with an open circuit voltage of 400 V is subjected to an LG fault through a fault impedance of 2 Ω. Determine the fault current, if Z_1 = j4 Ω, Z_2 = j2 Ω, Z_0 = j1 Ω. Repeat the problem for LL and LLG fault. 12

b. An unsymmetrical single line to ground fault occurs on unloaded generator with fault impedance Z_f. Derive the expression for the fault current I_f and draw the equivalent circuit which simulates the fault. 8

Contd…3

8 a. Obtain the inter connection of sequence networks for the following types of open conductor faults on power systems : 10

i) One conductor open ii) Two conductor open.

b. A line to line fault occurs at the terminals of an unloaded generator. Derive the expression for the fault. Derive the expression for the fault current. Also draw the inter connection of the sequence networks to simulate the fault. 10

UNIT - V

9 a. Derive the expression for the swing equation and draw the swing curves for unstable and stable conditions. 10

b. A turbo generator 6 pole, 50 Hz of capacity 80 MW working at 0.8 p.f. has an inertia of 10 MJ/mVA.

i) Calculate the energy stored in rotor at synchronous speed

ii) Find rotor acceleration, if the mechanical input is suddenly raised to 75 MW for an electrical load of 60 MW 10

iii) Supporting the above acceleration is maintained for a duration of 6 cycles, calculate the change in torque angle and rotor speed at the end of 6 cycles.

10a. Derive the power angle equation, for the non salient pole synchronous machine connected to an infinite bus. Draw the power angle diagram. 10

b. What is equal area criterion and discuss about sudden change in input. 10

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