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MINOR – II Examination

ELL – 303 (Power Engineering - I)

Time : 1 Hour **Full Marks : 20**

1(a) Prove that although the equivalent impedance of a transformer referred to either LV side or HV side are different, the pu value of impedance is independent of LV or HV side. [2]

(b) What are the assumptions considered for Decoupled load flow? [1]

(c) Why do we perform short circuit studies? [1]

(d) A 100 MVA, 13.8 kV, Y-connected, 3 phase 50 Hz synchronous generator is operating at the rated voltage and no load when a 3 phase fault occurs at its terminals. Its reactances in per unit to the machine's own base are x'' = 0.125 pu, x' = 0.25 pu and xs = 0.5 pu. Find the subtransient, transient and steady state fault current in ampere. [1.5]

(e)Why the subtransient, transient and steady state reactances of an alternator are different ? [1]

2. A linearized system showing relation between mismatches and corrections for a 30 bus system is given as :

$$\begin{bmatrix} \Delta P \\ \Delta Q \end{bmatrix} = \begin{bmatrix} J_{11} & J_{12} \\ J_{21} & J_{22} \end{bmatrix} \begin{bmatrix} \Delta \delta \\ \Delta V \end{bmatrix}$$

Where notations have usual meanings. Bus 1 is a slack bus. Bus no. 2 to10 are PV buses and bus no.11 to 30 are PQ buses.

(a) Write down size of each of the submatrix for this system. [2]

(b) If bus no.10 is made PQ bus rather than a PV bus, indicate which of the above submatrices will experience change in their size (only indicate the submatrices/vectors). [2]

3. The bus admittance matrix of a 3-bus system is given as: [4]

$$Y_{bus} = \begin{bmatrix} 20 - j50 & -10 + j20 & -10 + j30 \\ -10 + j20 & 26 - j52 & -16 + j32 \\ -10 + j30 & -16 + j32 & 26 - j62 \end{bmatrix}$$

Bus 1: Slack Bus
$|V_1|^{spec}$=1.05 p.u
δ_1^{spec}=0

Bus 2: PQ bus
P_2^{spec}= -4 p.u.
Q_2^{spec}=-2.5 p.u.

Bus 3: PV bus
$|V_3|^{spec}$=1.04 p.u
P_3^{spec}= 2 p.u.

Output for 5th iteration is δ_2=-0.047665 δ_3=-0.008713 $|V_2|^{spec}$=0.973116 p.u

Calculate the output for the 6th iteration using FDLF.

4. An electric power system is shown in Figure below with the parameters as specified below. [4+1.5]
G1 : 90 MVA 20 kV, *X* = 9% T1 : 80 MVA 20/200 kV , X = 16%
G2 : 90 MVA 18 kV , X = 9% T2 : 80 MVA 200/20 kV , X = 20%
Line: 200 kV *X* = 120 ohms Load: 200 kV *S* = 48 MW +*j* 64 Mvar

Draw the impedance diagram in pu (Assume base MVA as 100 and 20 kV as the voltage base for generator) If there is a three-phase fault at the middle of the line find the fault current (just before fault the voltage at the middle of the line is 190 kV)