تحليل نظم القوى   رابعة كهرباء
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... UNIVERSITY   B.SC. COURSE: POWER SYSTEM ANALYSIS

ELECTRICAL ENGINEERING DPT.

TOTAL MARKS: 100 ,   DATE: 6 /1/2014,   TIME: 3 HOURS

ANSWER THE FOLLOWING QUESTIONS:

1) Give a neat sketch of the utility and the Generator terminals short circuit current wave forms. Describe briefly what causes the main differences between these two current wave forms. Give a curve fitting equation for the short circuit current on the terminals of unloaded synchronous generator. Discuss how the direct axis sub transient, Transient short circuit time constants and the armature time constant can be determined from the Oscillogram of the synchronous generator short circuit current waveforms. (10 MARKS)

2) The bus impedence matrix of a four-bus network with values in per unit is

$$Z_{bus} = \begin{pmatrix} J0.15 & j0.08 & j0.04 & j0.07 \\ J0.08 & j0.15 & j0.06 & j0.09 \\ j0.04 & j0.06 & j0.13 & j0.05 \\ j0.07 & j0.09 & j0.05 & j0.12 \end{pmatrix}$$

Generators connected to buses 1 and 2 have their subtransient reactances included in Z_{bus}. If prefault current is neglected, find the subtransient current in per unit in the fault for a three-phase fault on bus 3. Assume the voltage at the fault is 1.0 per unit before the the fault occurs. Find also the per-unit current from generator 2 whose subtransient reactance is 0.2 per unit.
(10 Marks)

3) Derive the connection of the sequence network for line to line fault through fault impedance Z_f on the terminals of solidly grounded unloaded synchronous generator. Derive expressions which relate the magnitude of the sequence voltages at the fault point with fault impedance to that associated with solid fault for a line- to -line fault. (10Marks)

4) A 3-phase synchronous generator is connected via a 4-wire feeder to a 10-MW 11-KV balanced heating load at unity power factor. The generator and feeder together have impedances of (0+j o.4), (0+j0.2) , (0+j0.2) p.u. to positive , negative , and zero-sequence currents respectively on a base of 11 kv, 10 MVA. A break occurs in the R conductor at the load. Determine (a) the voltage across the break, and (b) the currents in the Y,B, and neutral conductors. Assume the generator's e.m.f.s remain constant. (10 Marks)

5) A 20-km-long cable connects two overhead lines A and B of surge impedance 400 Ohms. The inductance and capacitance of the cable are 0.01 Henary and 1.78 Microfarad. A 10-KV rectangular surge of 350 Microseconds duration is approaching from line A. Calculate the total voltage at the junction point of the cable and the line B, 410 and 500 Microseconds after the initial surge reaches the junction of the line A and the cable. (10 Marks)

3 – a) Discuss each of the following: A power system load flow definition --- Classification of a power system buses --- A regulating transformer for controlling the voltage angle.

3 – b) Consider the simple six-bus power system, shown in Fig.(a).

i- Use the *GAUSS-SEIDEL METHOD* ...

1- The voltage regulation at bus "1".

2- Rated reactive power of the capacitor needed to be connected at bus "2".

ii- Use the ***FAST-DECOUPLED NEWTON-RAPHSON METHOD*** and find(take $|V^o| = 1.08;\ \delta^o = -7.0$):

1- Rated power of the sub-station connected to bus "3".

2- When the power factor at terminals of the sub-station connected to bus "4", is equal to 0.95 lag, find the needed capacitive reactance at that bus.

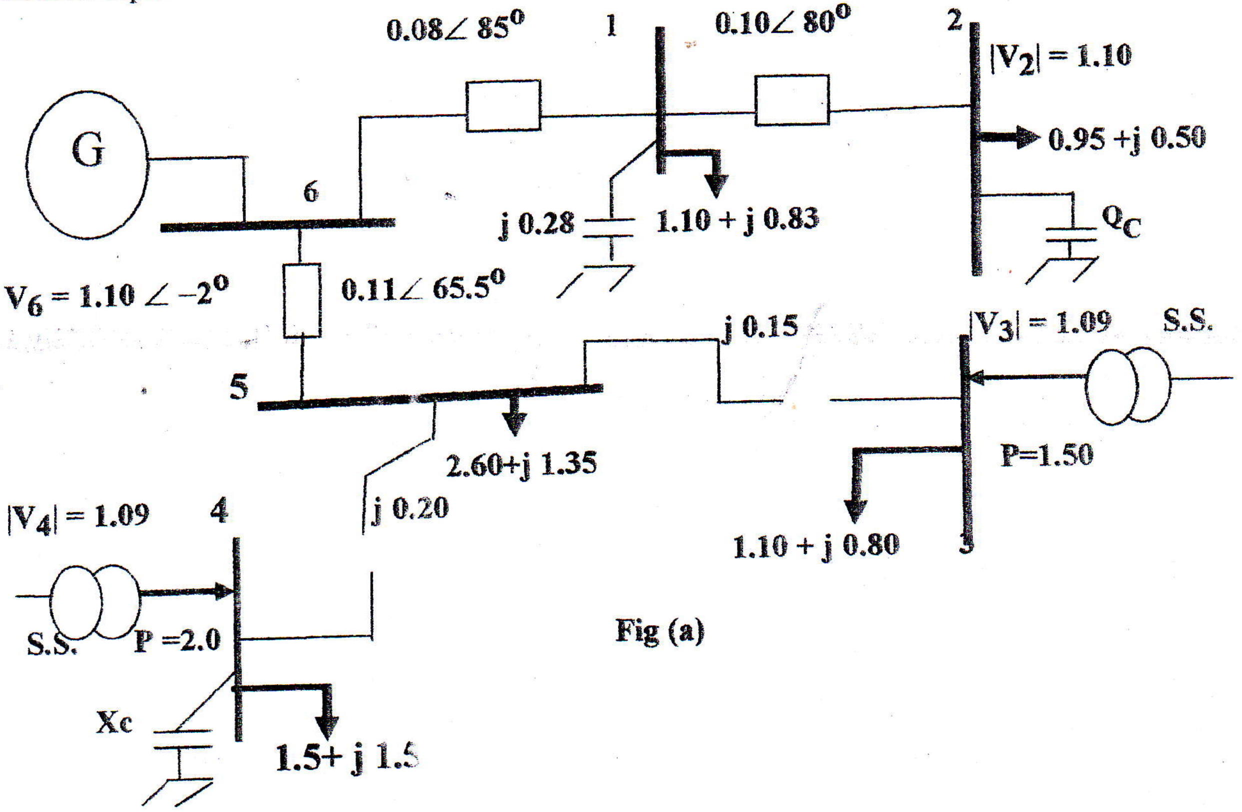

Fig (a)

4 –) Consider the two-machine equivalent power system, shown in Fig.(b).

1- Determine the received power margin at the motor terminals,when the generator delivers a power of **1.8** pu.

2- Due to a routine maintenance, the capacitor is removed when the motor mechanical load equals **1.1** pu. Prove that the motor will not maintain its synchronous operation.

Now, neglect the transmission lines resistances and carry out the following transient stability studies:

1- When the motor operates at **no load**, find the maximum mechanical load that can be suddenly connected with the motor shaft and the system maintains its synchronous stability.

2- When the generator input power equals **0.60** pu, and its internal angle equals **30** deg. a 3-phase short circuit fault occurs across the capacitor terminals. Isolating the bus "A" by using **5-cycle** C.Bs, clears the fault. The open C.Bs. are successfully reclosed (the fault is removed) after elapsing **0.05** sec. Prove that the system stability will be lost.

In order to improve the system stability, a new capacitor is assumed to connect, at the reclosing instant of the open C.Bs. in shunt with that connected at bus "A". Find the new connected capacitive reactance for which the relative angle δ_{gm}, can swing to the value 140 deg.(take $\Delta t = 0.05$ sec, $f = 50$Hz)

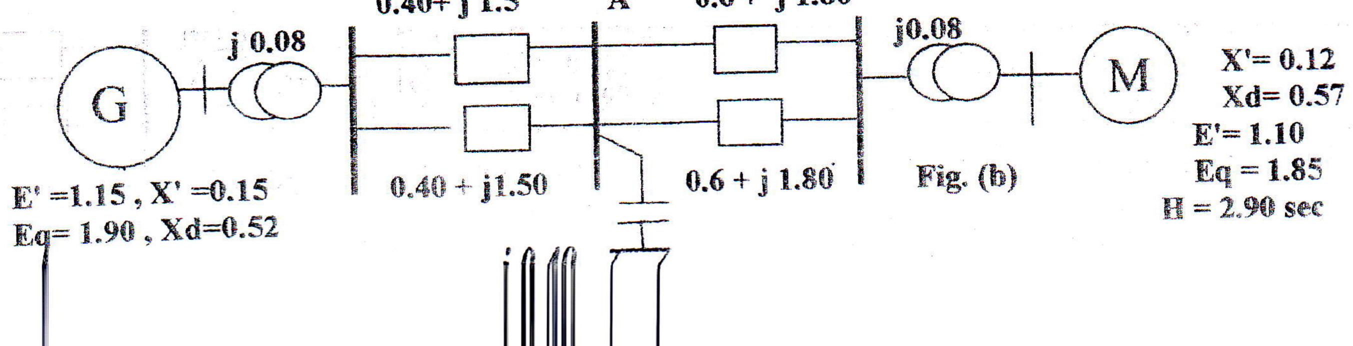

Fig. (b)