Kafrelsheikh University
Faculty of Engineering
Department: Electrical Power and Machines
Year: 4th (2007) /2020-2021
Subject: Power system analysis (2)
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Date: 4-3-2021
Time Allowed: 3hrs
Full Mark: 100 Mark
Final-term Exam: 1st Term.
No of pages: 2
Code:EPM4117

This Exam measures the ILOs [a.13, a.15, b.13, b.16, c.6,and c.17]

Answer the Following Questions:

Question One: (25 Mark) [measures the ILOs of a.13, a.15, b.13, and c.17]

a) ***Define*** transient stability and ***discuss*** two methods can be used to improve its limit. [8Mark/a13.1 and b.13.4]

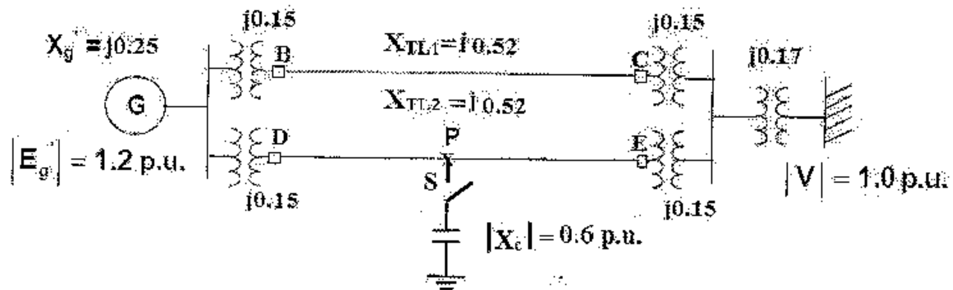
b) ***Derive*** *an* equation for the dynamics of a synchronous generator subjected to a sudden disturbance. [7Mark/a.15.2, and b.13.2]

c) In the power system shown in Fig. 1, a three-phase static capacitor of 0.6 p.u. reactance per phase is connected through a switch S at point P on the short transmission line. ***Determine:*** The steady state stablility limit and ***comment*** on your results when:-

(i). The switch S is open

(ii). The switch S is closed and point P is at mid-point of line two.

[10Mark/a.15.2,b.13.2, and c.17.1]



Values marked are p.u. reactances

Fig. 1: One-line reactance diagram

Question Two: (25 Mark) [measures the ILOs of a13, a.15, b.13, and c.17]

a) ***What*** are coherent machines? ***Explain*** the equivalent swing equation of two coherent machines [10Mark/a.13.2 and b.13.4]

b) In the system shown in Fig. 2, both the terminal voltage and infinite bus voltages are 1.0 p,u, and the generator is delivering 0.85 p.u. power just before a three-phase short-circuit occurred at point P on the short transmission line. ***Determine:***

(i). The power output equations for the pre-fault, during fault and post fault conditions

(ii). Critical clearing **angle** and **time** for clearing the fault with simultaneous openning of breakers D and E. , H= 4 MJ/MVA, f=50 Hz for the generator.

[15Mark/a.15.2, b.13.1, b.13.2, andc.17.1]

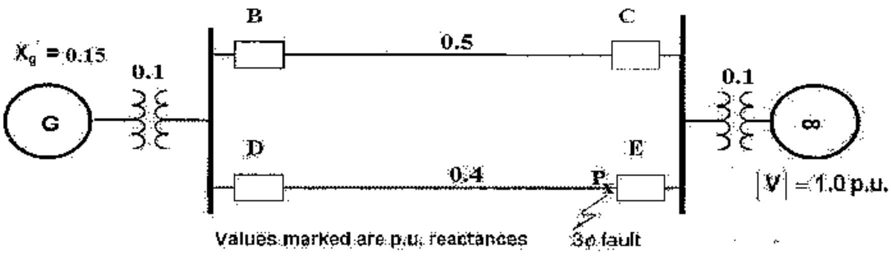


Fig. 2: One-line reactance diagram

Question Three: (30 Mark) [measures the ILOs of a13, b.16, c.6, and c.17]

a) ***Define*** voltage stability and voltage collapse. [8Mark/ a.13.2, a.15.3]

b) ***Discuss*** two methods used to prevent voltage collapse in power system. [7Mark/b.16.2, and c.17.2]

c) In the system shown in Fig. 3, the p.u reactance of each transmission line is 0.2 p.u. A three-phase fault occurred at a point of 25% of line two, from generator side and the faulty line was opened alittle later.If the generator was delivering 0.9 p.u power just befor the fault occurred:

(iii). ***Find*** the power output equations for the pre-fault, during fault and post fault condition

(iv). ***Determine*** the critical clearing angle for transient stabliliy, ***comment*** on your result. [15Mark/a.15.2, b.13.1, b.13.2, andc.17.1]

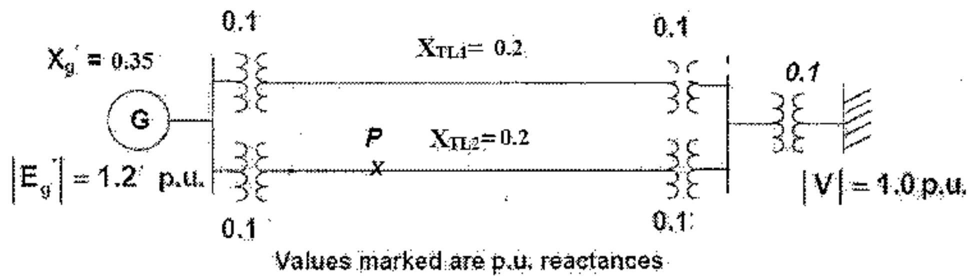


Fig. 3: One-line reactance diagram

Question Four: (20 Mark) [measures the ILOs of a13, a.15, b.16, and c.17]

a) ***Plot*** the nose (P-V) curves for different power factor of the load ***explaining*** stable and unstable regions for voltage stability analysis. [5Mark/b.16.2, and c.17.2]

a) A 20MVA, 50 Hz synchronous generator supplies 18 MW to an infinite bus through a double line. The generator has kinetic energy of 2.52 MJ/MVA at rated speed. The generator has a transient reactance of 0.25 p.u. Each transmission circuit has R = 0 and a reactance of 0.32 p.u. on a 20 MVA base. $|E_g| = 1.2$ p.u. and infinite bus voltage $V = 1.0 \angle 0^\circ$. A three phase fault took place at the mid-point of one of the transmission lines. ***Using 4^th^-order Runge-Kutta*** method, ***demonstrate*** the swing curve over a period of 0.2 second, using time interval of 0.05 second, ***if***:

(i). The fault is **sustained**

(ii). The fault is cleared after **8 cycles**. [15Mark/ a.15.2, b.16.2, and c.17.1]

Best wishes

Committee of corrections and Testers

Dr. Amlak Abaza