Kafrelsheikh University
Faculty of Engineering
Department: Electrical Power and Machines
Year: 4th (2007) /2019-2020
Subject: Power system analysis (2)
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Date: 13-1-2020
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 expression for critical clearing time of the system shown in Fig. 1 when a three phase short-circuit is occurred at point P on the short transmission line.

[7Mark/a.15.2, and b.13.2]

c) In the power system shown in Fig. 1, both the terminal voltage of the generator and infinite bus voltage are 1.0 p.u. The p.u. reactance of each part of the system is given as:
Generator: $X_d' = 0.25$; Transformer: $X_t = 0.15$; Each transmission line: $X_{TL} = 0.32$
The generator delivered 0.9 p.u. power just before a three-phase short-circuit occurred at the point P on the short transmission line. ***Determine:***

(i). Critical clearing angle for transient stablility

(ii). Critical clearing time using the result from part b) , f = 50Hz, H= 4 MJ/MVA for the generator.
[10Mark/a.15.2,b.13.2, and c.17.1]

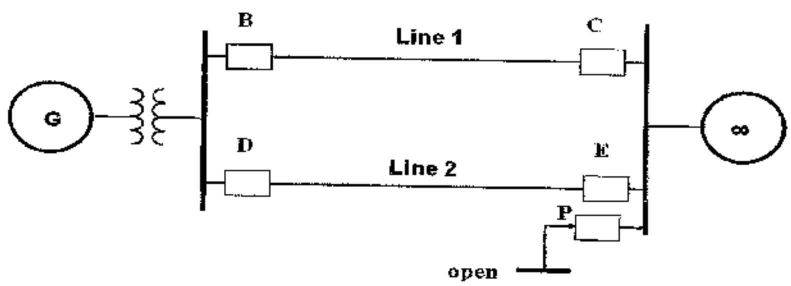

Fig. 1: One-line reactance diagram

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

a) ***Define*** voltage stability, voltage instability, and voltage collapse. [6Mark/ a.13.2, a.15.3]

b) ***Explain*** in details ***two*** effective methods used to improve rotor angle stability in electrical power system.
[8Mark/ a.13.2, a.15.3]

c) In the system shown in Fig. 2, the p.u reactance of each transmission line is 0.52 p.u.. A three-phase fault occurred at a point of 30% of line two, from generator side and the faulty line was opened alittle later.If the generator was delivering 1.0 p.u power just befor the fault occurred :

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

(ii). ***Determine*** the critical clearing angle for transient stablility, ***comment*** on your result.
[11Mark/a.15.2, b.13.1, b.13.2, andc.17.1]

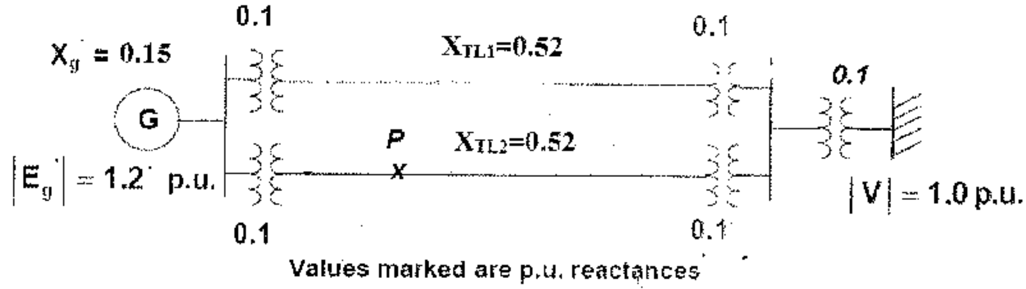

Fig. 2: One-line reactance diagram

Question Three: (25 Mark) [measures the ILOs of a13, b.16, c.6, and c.17]

a) ***Discuss*** two methods used to prevent voltage collapse in power system. [8Mark/b.16.2, and c.17.2]

b) ***Plot*** the nose (P-V) curves for different power factor of the load ***explaining*** stable and unstable regions for voltage stability analysis. [7Mark/b.16.2, and c.17.2]

c) In the power system shown in Fig.3, a synchronous motor, 50 Hz, inertia constant of 3 MJ/MVA at rated speed, is drawing 30 % of the maximum steady state power from an infinite bus bar. If the load on the motor is suddenly increased by 50%, would the synchronism be lost? ***If yes, what*** is the allowable sudden load that can be increased without loss of stability? [10Mark/a.13.2,and c.6.1]

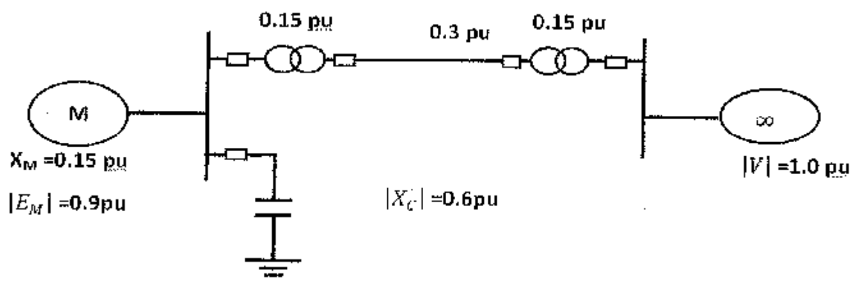

Fig. 3: One-line reactance diagram

Question Four: (25 Mark) [measures the ILOs of a13, a.15, b.16, and c.17]

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 0.35 p.u. Each transmission circuit has R = 0 and a reactance of 0.52 p.u. on a 20 MVA base. $|E| = 1.1$ p.u. and infinite bus voltage $V = 1.0 \angle 0°$. 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 0.04 second, ***if***:

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

(ii). The fault is cleared after **8.5 cycles**. [16Mark/ a.15.2, b.16.2, and c.17.1]

b) ***Determine*** the critical clearing angle and time in the problem in part (a) then ***evaluate*** the cleared time used in ***ii).*** [9Mark/ a.15.3 and c.17.1]

Best wishes

Committee of corrections and Testers

Dr. Amlak Abaza