Kafrelsheikh University
Faculty of Engineering
Department: Electrical Power and Machines
Year: 4th (2007) /2018-2019
Subject: Power system analysis (2)
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Date: 14-1-2019
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_** Steady state stability and **_Explain_** its limit.   [8Mark/a13.1 and b.13.4]

b) **_Derive_** an expression for the critical clearing angle and the transient stability limit of the system shown in Fig. 1 when a three phase short-circuit is occurred at point P on the short transmission line. **_Sketch_** the derived relation.   [7Mark/a.15.2, and b.13.2]
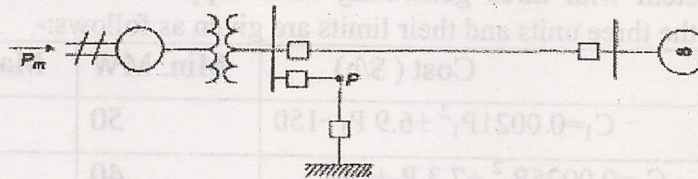

Fig. 1: One-line diagram

c) In the power system shown in Fig. 2, a three-phase static capacitor of 0.5 p.u. reactance per phase is connected through a switch S at point P on the short transmission line. **_Determine:_** The steady state stability limit and **_commen_**t on your results when:-

   (i). The switch S is open
   (ii). The switch S is closed   [10Mark/a.15.2,b.13.2, and c.17.1]
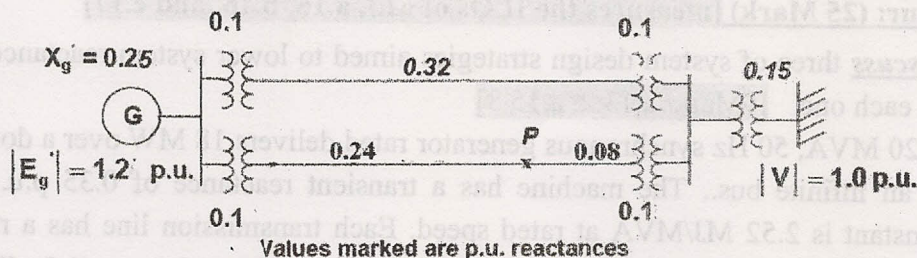

Fig. 2: One-line reactance diagram

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. 3, both the terminal voltage and infinite bus voltages are 1.0 p,u, and the generator is delivering 0.9 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.   [15Mark/a.15.2, b.13.1, b.13.2, andc.17.1]
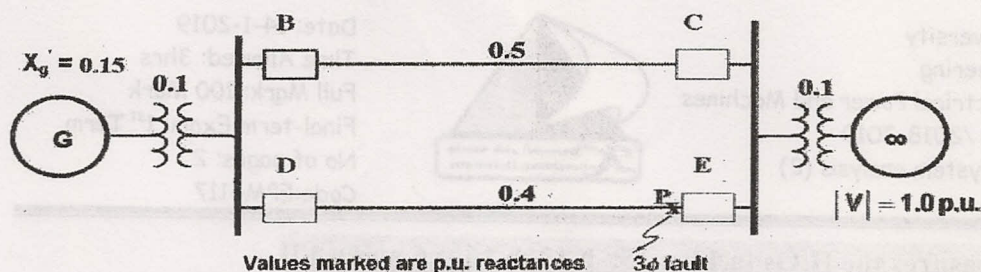
Fig. 3: One-line reactance diagram

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

a) *Plot* the nose (P-V) curves for different power factor of the load for voltage stability analysis, then *state* four methods can be used to prevent voltage collapse. [10Mark/b.16.2, and c.17.2]

b) A power system with three generating units supplies a total load of 750MW. The cost functions of the three units and their limits are given as follows:-

Cost ($/h)	Min. MW	Max. MW
$C_1=0.0021P_1^2 +6.9 P_1+150$	50	300
$C_2=0.0025P_2^2 +7.3 P_2+140$	40	300
$C_3=0.003P_3^2 +6.7 P_3+160$	40	350

i). *Find* the optimal economic dispatch using Lagrange multiplier method.

ii). *Evaluate* the saving obtained compared to equal load sharing between three units.
[15Mark/a.13.2,and c.6.1]

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

a) *Discuss* three of system design strategies aimed to lower system reactance and *comment* on each one. [9Mark/ a.13.2, a.15.3]

b) A 20 MVA, 50 Hz synchronous generator rated delivers 18 MW over a double circuit line to an infinite bus.. The machine has a transient reactance of 0.35 p.u. and its inertia constant is 2.52 MJ/MVA at rated speed. Each transmission line has a reactance of 0.2 p.u. on a 20 MVA base. Take the infinite bus voltage as reference (1.0 $\angle 0^\circ$), and EMF of the generator as 1.1 p.u. A three phase fault took place at one end of transmission line 2. This fault was later cleared by opening the faulty line after 0.08 second. *Demonstrate* the swing curve over a period of 0.1 second *using 4th-order Runge-Kutta* method. Use time interval of 0.02 second. [16Mark/ a.15.2, b.16.2, and c.17.1]

Best wishes   Committee of corrections and Testers

                               Dr. Amlak Abaza