COLLEGE OF ENGINEERING & TECHNOLOGY

Department : Electrical & Control Engineering

Lecturers : Prof.Dr. Amany Hanafy

Course : Power System II

Course Code : EE 441 - N **Marks: 40**

Date : 5/ 1 / 2015 **Time : 2 hours**

Final Exam

Answer the following questions:

1] A 30000 kVA, 11 kV generator with X_d'' = 0.15 per unit is connected to a bus through a circuit breaker as shown in figure 1. Connected through the circuit breakers to the same bus are three identical synchronous motors with subtransient reactance X_d'' = 0.2 per unit on a base of 5000 kVA, 11 kV. The motors are operating at rated voltage. Neglecting the pre-fault current:

a) Draw the impedance diagram with the impedance marked in per unit on a base of 30000 kVA, 11 kV.

b) Find the symmetrical short circuit current in amperes which must be interrupted by breakers A and B for a three phase fault at point P.

c) Repeat part (b) for a three phase fault at point Q.

d) Repeat part (b) for a three phase fault at point R.

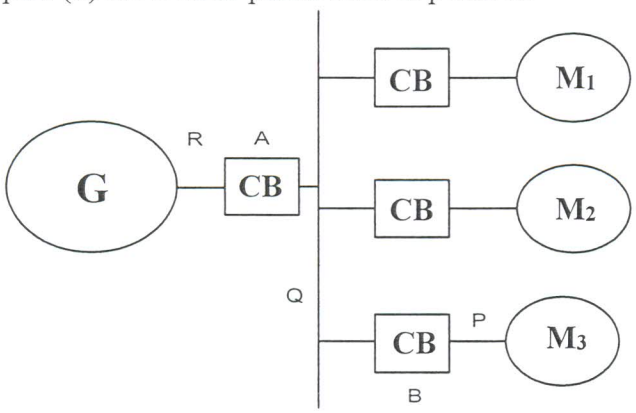

Figure 1

(10 Marks) [A.4 – A.18]

2] a) A three phase star connected balanced load consists of phase impedances of Z=3+j4 Ω, connected to three phase unbalanced voltages; The line voltages are $V_{ab}=380\angle 0^0$ V, $V_{bc}=370\angle -115^0$ V, and $V_{ca}=390\angle 125^0$ V. Determine the symmetrical components of the line voltages, the symmetrical components of the phase voltages and the line currents.

b) In a power system, an unsymmetrical fault occurred which resulted in the following symmetrical components of line currents. Determine the type of fault.

$I_a^{(0)} = j\ 0.6579$ pu

$I_a^{(1)} = -j\ 2.6017$ pu

$I_a^{(2)} = j\ 1.9438$ pu

(10 Marks) [B.11]

Members of course Examination Committee:	Signature:	Date:
Lecturer: Prof.Dr. Amany Hanafy		30 / 12 / 2014
Course Coordinator : Prof.Dr. Amany Hanafy		30 / 12 / 2014
Head of Department: Prof.Dr. Hamdy Ashour	Hamdy	30 / 12 / 2014

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3] For the power system shown in Figure 2, draw the positive, negative and zero sequence circuits. Data of the system are shown in the following table.

Item	X^1	X^2	X^0
G1	0.1	0.1	0.05
G2	0.1	0.1	0.05
T1	0.15	0.15	0.15
T2	0.15	0.15	0.15
L1	0.6	0.6	0.8
L2	0.3	0.3	0.5

If a single line to ground occurs at bus **1** at phase a, find the fault current.

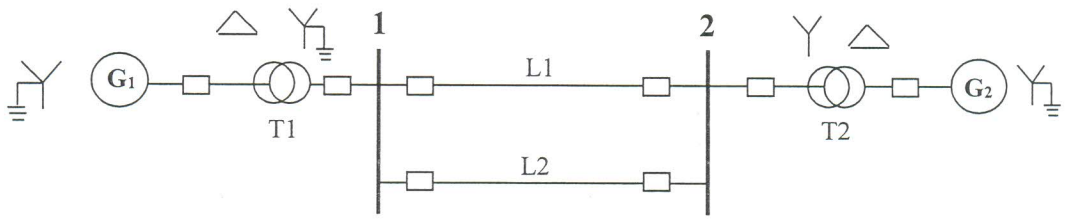

Figure 2

(10 Marks) [A.18 – B.2]

4] a) A 60 Hz, 4 poles generator is rated 45 MVA, 22 kV has an inertia constant H=7.5 MJ/MVA. Find:

i- The kinetic energy stored in the rotor at synchronous speed.

ii- The angular acceleration if the electrical power developed is 350 MW when the input power is 740000 hp (neglect rotational losses).

iii- The speed in revolution per minute after 20 cycles assuming that the acceleration is constant for that period.

b) A 60 Hz generator having H= 6 MJ/MVA is delivering power of 1 per unit to an infinite bus through a purely reactive network and the maximum power that could be delivered is 2.1 per unit. During the occurrence of a fault the maximum power that could be delivered was reduced to 0.808 per unit. When the fault is cleared, the maximum power that could be delivered was raised to 1.5 per unit. Determine the critical clearing angle and the critical clearing time. Repeat the problem if during the fault the generator output power is reduced to zero.

(10 Marks) [B.2 – B.11]

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