USN | | | | | | | | | | |

10EE61

Sixth Semester B.E. Degree Examination, Aug./Sept. 2020
Power System Analysis and Stability

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. ***Missing data, if any, may be suitably assumed.***

PART – A

1 a. Draw the per phase basis, representation of synchronous Generator, synchronous motor, Transformer, Transmission line and static load. **(04 Marks)**

b. Explain the procedure of drawing P.U. reactance diagram from SLD. **(04 Marks)**

c. Obtain the reactance diagram of the power system shown in Fig Q1(c), mark all reactance values in P.U on a base of 50MVA, 138KV in the 40Ω line. The machine ratings are

G_1 : 20 MVA 13.2 KV $x'' = 15\%$ M : 30 MVA 6.9KV $x'' = 20\%$

G_2 : 20 MVA, 13.2 KV $x'' = 15\%$

Three phase Y – Y Transformers : 20MVA, 13.8/138 KV, x = 10%

Three phase Y - Δ Transformers : 15MVA, 138/6.9KV, x = 10%

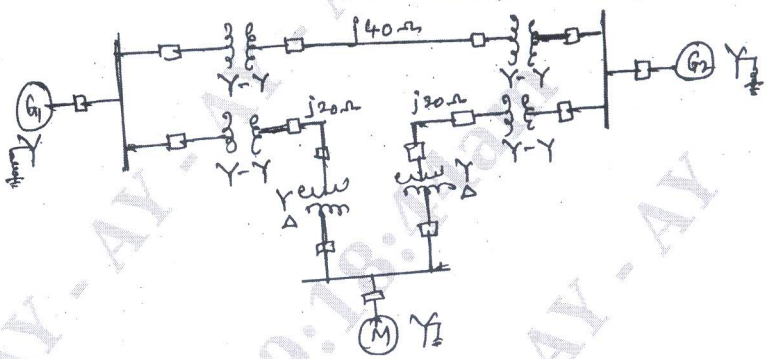

Fig Q1(c) **(12 Marks)**

2 a. Define the term fault in a system. What are the common causes for faults? **(04 Marks)**

b. With the help of oscillogram of S.C. current of a synchronous generator operating on no load show that $x''_d < x'_d < x_d$. **(06 Marks)**

c. For the radial network shown in Fig Q2(c). A three phase fault occurs at point F. Determine the absolute value of fault current.

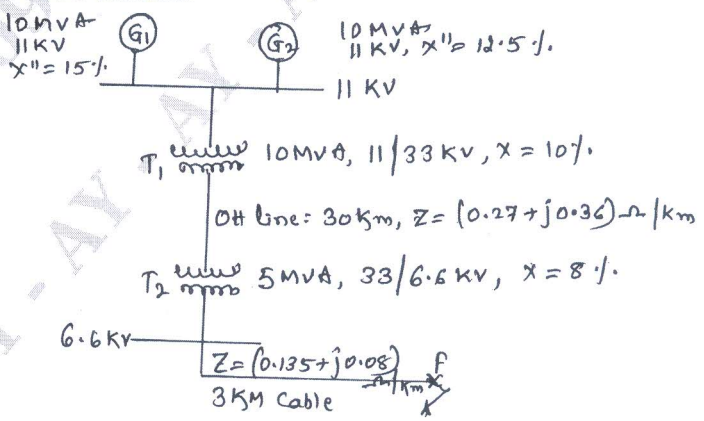

Fig Q2(c) **(10 Marks)**

3 a. Prove that a balanced set of 3-phase voltage will have only positive sequence components of voltage only. **(06 Marks)**

b. Derive an expression for the 3ϕ complex power in terms of symmetrical components. **(06 Marks)**

c. A balanced star connected load takes 30A from a balanced 3-phase, 4 wire supply. If the fuses in two line are removed. Find the symmetrical components of the line currents before and after the fuses are removed. **(08 Marks)**

4 a. What are sequences impedance and sequence network. **(04 Marks)**

b. Draw the zero sequence impedance network of a transformer for the following connections. **(10 Marks)**

i) $Y-\Delta$ ii) $\Delta-Y$ iii) $Y-Y$ iv) $\Delta-\Delta$

c. A 250MVA, 11KV, 3 phase generators is connected to a large system through a transformer and a line as shown in Fig Q4(c)

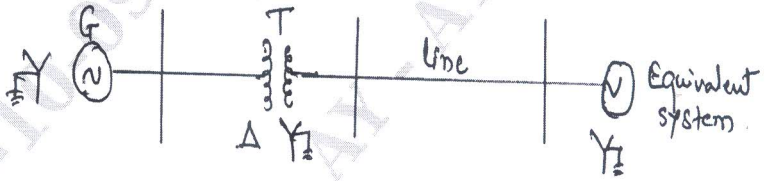

Fig Q4(c)

The parameters on 250MVA base are as follows :

Generator	:	$x_1 = x_2 = 0.15$P.U, $x_0 = 0.1$ PU
Transformer	:	$x_1 = x_2 = x_0 = 0.12$ PU
line	:	$x_1 = x_2 = 0.25$ PU, $x_0 = 0.75$ PU
Equivalent system	:	$x_1 = x_2 = x_0 = 0.15$ PU

Draw the sequence network diagrams for the system and indicat all per unit values. **(06 Marks)**

PART – B

5 a. What are unsymmetrical faults? Explain various types of unsymmetrical faults. **(05 Marks)**

b. Derive an expression for fault current, when Single Line to Ground fault (SLG) occurs on an un loaded generator. Draw the connection of sequence network. **(08 Marks)**

c. A three phase generator with line to line voltage of 400V is subjected to an LLG fault. If $z_1 = j2\Omega$, $z_2 = j0.5\Omega$ and $z_0 = j0.25\Omega$. Determine the fault current. **(07 Marks)**

6 a. Derive expression for fault current, if Line – Line – Ground (LLG) fault occurs through fault impedance z_f in power system. Show the connection of sequence network to represent the fault. **(10 Marks)**

b. Derive an expression for fault currents for

i) One conductor open fault

ii) Two conductor open fault and draw the sequence network diagrams. **(10 Marks)**

7 a. Explain steady state stability and transient stability as applicable to a power system. **(04 Marks)**

b. Derive the power angle equation of an non salient pole synchronous machine and draw the power angle curve. **(08 Marks)**

c. A turbo generator, 6 poles, 50Hz, 80mW capacity working at 0.8 p.g has an intertia of 10mJ/MVA.
   i) Calculate the energy stored in the rotor at synchronous speed
   ii) Find the rotor acceleration, if the mechanical input is suddenly raised to 75mW for an electrical load of 60mW.
   iii) Supposing the above acceleration is maintained for duration of 6 cycles, calculate the change in torque angle and the rotor speed at the end of 6 cycles. **(08 Marks)**

8 Write short notes on :
a. Selection of circuit breakers
b. Impedance and reactance diagram
c. Equal area criterion for transient stability
c. Analysis of 3ϕ induction motor with one line open. **(20 Marks)**

* * * * *