7E7042

Roll No.

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B. Tech. VII Sem. (Main/Back) Exam., Nov. – Dec. - 2017

Electrical & Electronics Engineering

7EX2A Power System Analysis

EE, EX

Time: 3 Hours

Maximum Marks: 80

Min. Passing Marks: 26

Instructions to Candidates:

*Attempt any **five questions**, selecting **one question** from **each unit**. All questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly.*

Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

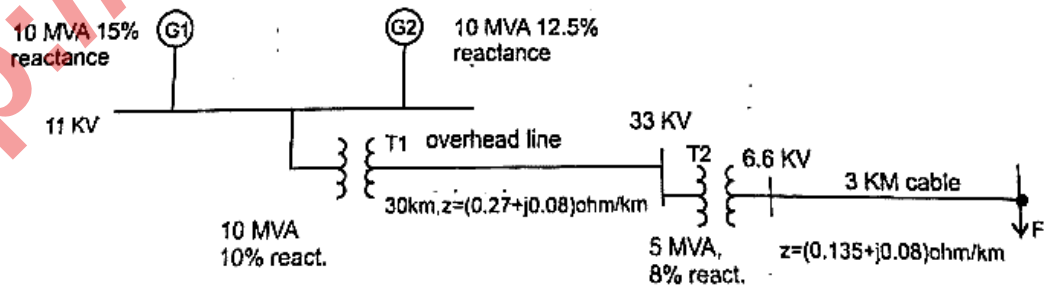
1. NIL 2. NIL

UNIT-I

Q.1 (a) What is per unit system? How are the base quantities selected? Give advantages and disadvantages of per unit system. [6]

(b) Choosing transformer rating as base value, prove that the equivalent impedance of transformer in p. u. referred to LV and HV sides is the same. [4]

(c) For the radial network shown in figure draw the impedance diagram. [6]



OR

Q.1 (a) Why the admittance metrics is more suitable for load flow study? Explain the procedure for formulation of admittance matrix. Also explain the modification in admittance matrix. [8]

(b) The parameters of a 4-bus system are as under - [8]

Bus Code	Line Impedance (pu)	Charging Admittance (pu) $Y_{pq}/2$
1-2	0.2 + j0.8	j0.02
2-3	0.3 + j0.9	j0.03
2-4	0.25 + j1	j0.04
3-4	0.2 + j0.8	j0.02
1-3	0.1 + j0.4	j0.01

Draw the network and find bus admittance matrix.

UNIT-II

Q.2 (a) How is an existing impedance matrix modified? Discuss the possible condition. [8]

(b) Figure 1 shows a system having 4 alternators each rated at 11KV, 50 MVA and each having a sub transient reactance of 15%. Find - [8]

(i) Fault level for a fault on one of the feeder (near the bus) with zero value reactance X.

(ii) The reactance of current limiting reactor X to limit the fault level to 800 MVA for a fault on one of the feeders (near the bus).

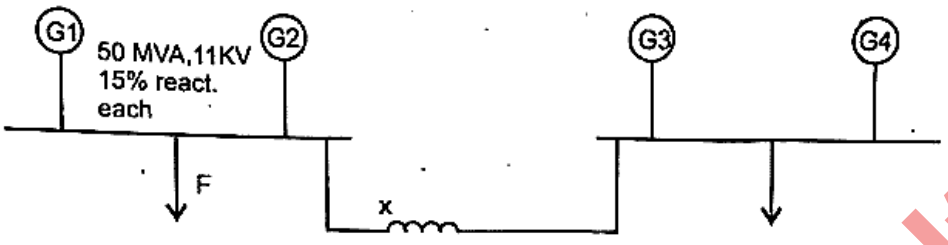


Figure 1

OR

Q.2 (a) What happens when a sudden transient occurs in a transmission line? Discuss the transient on a transmission line and also explain doubling effect. [8]

(b) A synchronous generator and a synchronous motor each rated 25 MVA, 11kV having 15% sub - transient reactance are connected through transformers and a transmission line as shown in figure 2. The transformers are rated 25 MVA, 11/66 kV and 66/11kV with leakage reactance of 10% each. The line has a reactance of 10% on a base of 25 MVA, 66 kV. The motor is drawing 15 MW at 0.8 power factor leading at a terminal voltage of 10.6 KV. When a symmetrical three - phase fault occurs at the motor terminals, find the sub - transient current in the generator, motor and fault. [8]

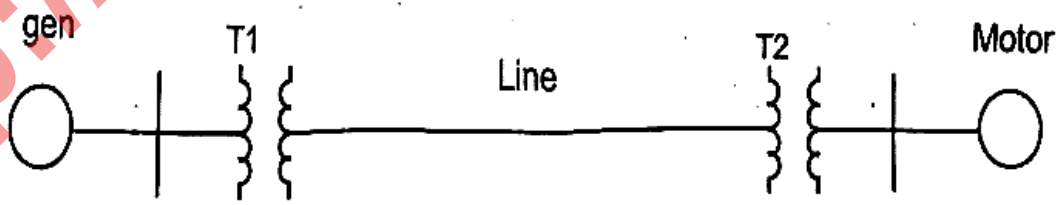


Figure 2

UNIT-III

Q.3 (a) Why the sequence networks are needed in power system? Discuss the Fortescue theorem. Derive the necessary equation to convert. [8]

(i) Phase quantity in symmetrical components.

(ii) Symmetrical components in phase quantities.

(b) A 25 MVA, 11KV, 3 - phase alternator has a sub transient reactance of 20%. The generator supplies to two motors over a transmission line with transformers at both end as shown in one line diagram of fig. 1. The motors have rated inputs of 15 and 7.5 MVA, both 10KV with 25% sub transient reactance. The three phase transformer are both rated 30 MVA, 10.8/121 KV connection delta – star with leakage reactance of 10% each. The series reactance of line is 100 ohm. Draw the positive and negative sequence network of the system with reactance mark with reactance marked in per unit.

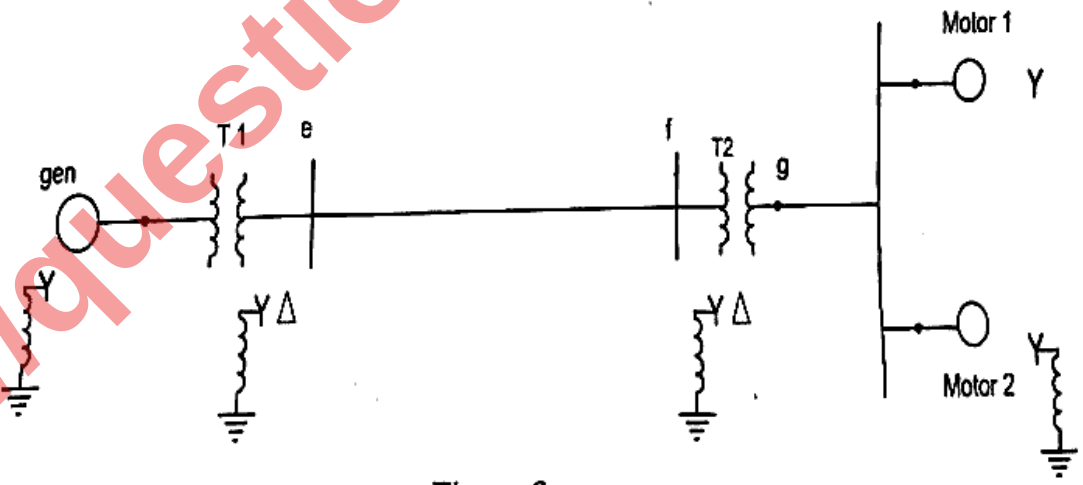


Figure 3

[10200]

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Assume that the negative sequence reactance of each machine is equal to its sub transient reactance. Omit resistances. Select generator rating as in the generator circuit. [8]

OR

Q.3 (a) Derive the expression for sequence impedances and draw sequence networks of a synchronous machine. [8]

(b) Two 11KV, 20MVA, three - phase, star connected generators operate in parallel as shown in figure 4, the positive, negative and zero sequence reactance of each being, respectively j0.18, j0.15, j0.10 pu. The star point of one of the generator is isolated and that of the other is earthed through a 2.0 ohm resistor. A single line to ground fault occurs at the terminals of one of the generators. Estimate- [8]

(i) The fault current

(ii) Current in grounding resistor

(iii) The voltage across grounding resistor

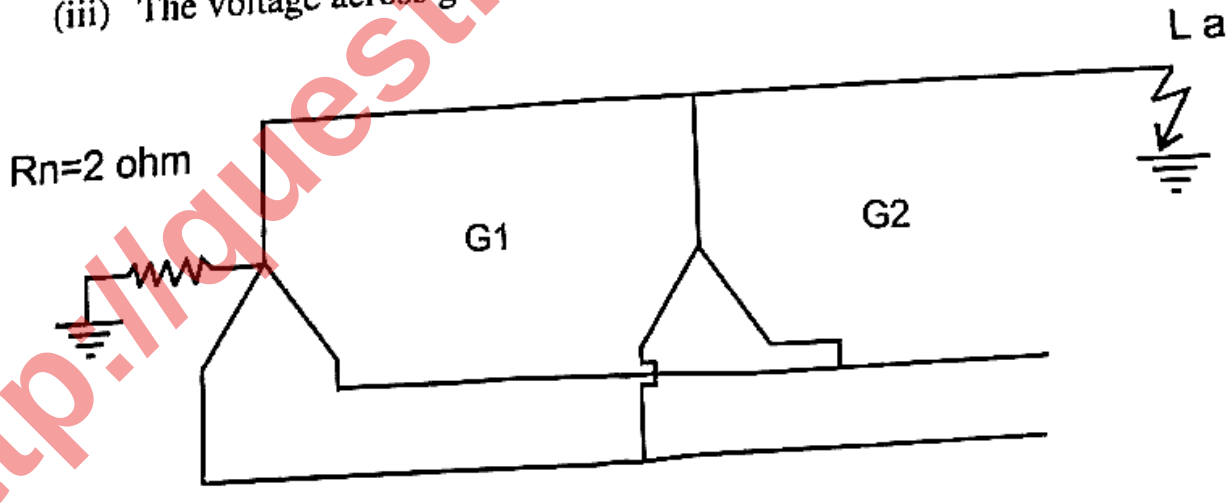

Figure 4

[10200]

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UNIT-IV

Q.4 (a) Derive the necessary equation to determine the fault current for a line to line fault. Draw the diagram showing the inter connection of sequence networks. [8]

(b) A 20 MVA, 3 - phase alternator, having its neutral solidly grounded is operating at no load, its voltage rating 11kV between lines. It has reactance to positive sequence current of 2.5 ohm. The reactances to negative and zero sequence current are 80% and 30% of the positive sequence value respectively. For a double line to ground fault, determine - [8]

(i) The current in the fault lines

(ii) The current through ground

(iii) The voltage of healthy phase to neutral.

OR

Q.4 (a) Give reason: [8]

(i) For a fault at generator terminals, a single line to ground fault is generally more severe than a 3 - phase fault.

(ii) For a fault on transmission line, a 3 - phase fault is more severe than other faults.

(iii) The natural grounding impedance Zn appears as 3Zn in the zero sequence equivalent network.

(b) A 50 MVA, 11kV three phase alternator was subjected to different types of faults. The fault currents are as under - [8]

3 - Phase fault = 2000 A,

Line to Line fault = 2600 A

Line to Ground fault = 4200 A

The generator neutral is solidly grounded. Find the value of three sequence reactances of the alternator. Ignore resistance.

UNIT-V

Q.5 (a) Why the load flow study is needed in power system? Explain the G-S method for solution of load flow study. [8]

(b) Discuss the importance of slack bus in load flow study and selection criteria of slack bus in power system. Give the comparison of the different methods used for load flow study. [8]

OR

Q.5 (a) Give reasons: [2+2=4]

(i) A majority of buses in power system are load buses.

(ii) An acceleration factor is commonly used in load flow study.

(b) For a four bus power system the generator are connected at all four busses. While the load are at busses 2 and 3. Values of real and reactive power are listed in table 1 and values of impedance between the busses are listed in table 2.

Assuming a flat voltage start, find the voltage and phase angle at the three busses at the end of first GS iteration. The shunt admittance is neglected. [12]

Table 1

Bus No.	Pi (pu)	Qi (pu)	Vi (pu)	Remark
1	-	-	1.04 Lu	Stack Bus
2	0.5	-0.2	-	PQ Bus
3	-1.0	0.5	-	PQ Bus
4	0.3	-0.1	-	PQ Bus

Table 2

Line Code	Impedance
1 – 2	0.05 + j0.15
1 – 3	0.10 + j0.30
2 – 3	0.15 + j0.45
2 – 4	0.10 + j0.30
3 – 4	0.05 + j0.15
