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Question Paper Code : 90521

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

Fifth Semester

Electrical and Electronics Engineering

EE 8501 – POWER SYSTEM ANALYSIS

(Regulations 2017)

Time : Three hours Maximum : 100 marks

(Codes/Tables/Charts to be permitted, if any, may be indicated)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is the bus admittance matrix?

2. What are the data required for a load flow study?

3. What is the need for slack bus in power flow analysis?

4. Define voltage-controlled bus.

5. What are the assumptions made in short circuit studies of large power system network?

6. Define fault level.

7. Write boundary conditions for single line to ground faults.

8. Define short circuit capacity.

9. Define steady state stability limit.

10. What is power system stability?

PART B — (5 × 13 = 65 marks)

11. (a) Draw the PU impedance diagram for the system shown in Fig. 11(a). Choose Base MVA as 100 MVA and Base KV as 20KV.

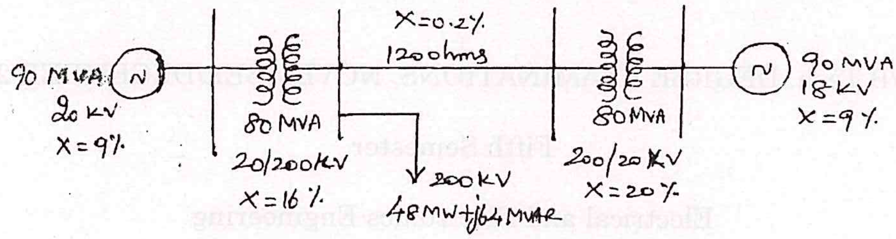

Fig. 11 (a)

Or

(b) The single line diagram of a simple power system is shown in Fig 11(b). The rating of the generators and transformers are given below:

Generator 1: 25MVA, 6.6KV, X = 0.2p.u

Generator 2: 5MVA, 6.6KV, X = 0.15p.u

Generator 3: 30MVA, 13.2KV, X = 0.15p.u

Transformer 1: 30MVA, 6.9Δ/115Y KV, X = 10%

Transformer 2: 15MVA, 6.9Δ/115Y KV, X = 10%

Transformer 3: Single phase units each rated 10MVA, 6.9/69KV, X = 10%

Examine the impedance diagram and mark all values in p.u choosing a base of 30MVA, 6.6KV in the generator 1 circuit.

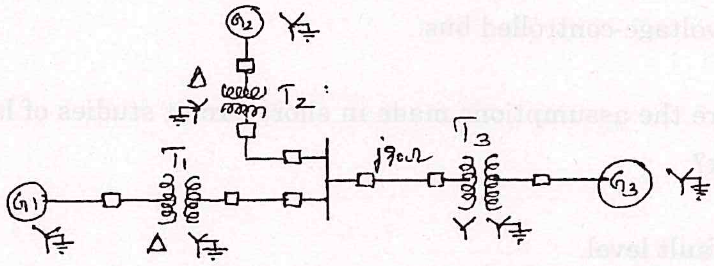

Fig. 11 (b)

12. (a) Derive N-R method of load flow algorithm and explain the implementation of this algorithm with the flowchart.

Or

(b) The Fig. 12 (b) shows the one line diagram of a simple 3 bus system with generation at buses 1 and 3. Line impedance are marked in p.u on a 100 MVA base. Determine the bus voltages at the end of second iteration using Gauss seidal method.

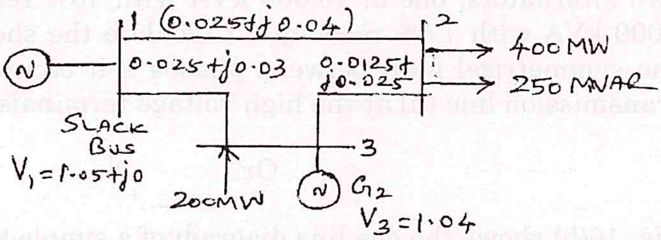

Fig. 12 (b)

13. (a) A 3-phase 6MVA, 6.6 KV alternator with a reactance of 12% is connected to a feeder of series impedance (0.10 + j0.5) ohm/phase/Km through a step up transformer. The transformer is rated at 3 MVA, 6.6 KV/33KV and has a reactance of 7%. Determine the fault current supplied by the generator operating under no load with a voltage of 6.9 KV when a three phase symmetrical fault occurs at a point 16 Km along the feeder.

Or

(b) Explain the step by step procedure for systematic fault analysis for a three phase fault using bus impedance matrix.

14. (a) Examine the sequence network for a double line to ground (LLG) fault.

Or

(b) A 30MVA 11KV 3phase synchronous generator has a direct sub transient reactance of 0.25pu. the negative and zero sequence reactance are 0.35 and 0.1 pu respectively. The neutral of the generator is solidly grounded. Find the sub transient currents and the line to line voltages at the fault under sub transient conditions when a line to line fault occurs at the terminals of the generator. Assume that the generator is unloaded and operating at rated terminal voltage when the fault occurs.

15. (a) A generator rated 75 MVA is delivering 0.8 pu power to a motor through a transmission line of reactance j 0.2 p.u. The terminal voltage of the generator is 1.0 p.u and that of the motor is also 1.0 p.u. Determine the generator e.m.f behind transient reactance. Find also the maximum power that can be transferred.

Or

(b) Explain the modified Euler method of analyzing multi machine power system for stability, with neat flow chart.

PART C — (1 × 15 = 15 marks)

16. (a) A 3-phase transmission line operating at 33 kV and having a resistance of 5 Ω and reactance of 20 Ω is connected to the generating station through 15,000 kVA step-up transformer. Connected to the bus-bar are two alternators, one of 10.000 kVA with 10% reactance and another of 5000 kVA with 7.5% reactance. Calculate the short - circuit kVA fed to the symmetrical fault between phases if it occurs (i) at the load end of transmission line (ii) at the high voltage terminals of the transformer.

Or

(b) Fig. 16(b) shows the one line diagram of a simple three bus power system with generation at buses at 1 and 2. the voltage at bus 1 is V = 1+j0.0 V per unit. Voltage magnitude at bus 2 is fixed at 1.05 p.u. with a real power generation of 400 MW. A Load consisting of 500MW and 400 MVAR base. For the purpose of hand calculation, line resistance and line charging susceptances are neglected.

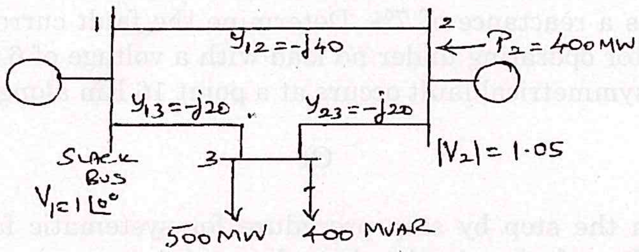

Fig. 16 (b)

Using Newton-Raphson method, start with the initial estimates of $V20 = 1.05 + j0.0$ and $V30 = 1.05 + j0.0$, and keeping $|V_2| = 1.05$ p.u., examine the phasor values V_2 and V_3. Perform two iterations.