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Question Paper Code : 40492

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Fifth Semester

Electrical and Electronics Engineering

EE 8501 – POWER SYSTEM ANALYSIS

(Regulations 2017)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. How the base values are chosen in per unit representation of a power system?

2. Define bus admittance matrix.

3. What is a bus?

4. What is P-Q bus in power flow analysis?

5. What are the reactances used in the analysis of symmetrical faults on the synchronous machines as its equivalent reactance?

6. What is the need for short circuit analysis?

7. Name any two methods of reducing short circuit current.

8. What are unsymmetrical faults?

9. Define power angle.

10. What is the use of swing curve?

PART B — (5 × 13 = 65 marks)

11. (a) Obtain the per unit impedance (reactance) diagram of the power system shown in Figure 11(a).

Generator No. 1 : 30 MVA, 10.5 kV, X" = 1.6 Ohm

Generator No. 2 : 15 MVA, 6.6 kV, X" = 1.2 Ohm

Generator No.3 : 25 MVA, 6.6 kV, X" = 0.56 Ohm

Transformer T1 (3phase) : 15 MVA, 33/11 kV, X = 15.2 Ohm per phase on HT side

Transformer T2 (3phase) : 15 MVA. 33/6.2 kV, X = 16 Ohm per phase on HT side

Transmission line : 20.5 Ohm/phase

Load A : 15MW, 11kV, 0.9 p.f. lagging

Load B : 40 MW, 6.6 kV. 0.85 lagging p.f.

Figure 11 (a)

Or

(b) The parameters of a four system are as under:

Line No.	Line Starting No.	Line Ending No.	Line Impedence (pu)	Line Charging Admittance (pu)
1	1	2	0.2 + j0.8	j0.02
2	2	3	0.3 + j0.9	j0.03
3	2	4	0.25 + j1.0	j0.04
4	3	4	0.2 + j0.8	j0.02
5	1	3	0.1 + j0.4	j0.01

Draw the network and find bus admittance matrix.

12. (a) Derive the load flow algorithm using Newton Rapson method with flow chart and discuss the advantages of the method.

Or

(b) In the power system network shown in Figure 12 (b), bus 1 is slack bus with V_1= 1.0+j0.0 per unit and bus 2 is a load bus with S_2 = 280MW+j60MVAR. The line impedance on a base of 100MVA is Z = 0.02+j0.04 per unit. Using Gauss — Seidal method, give V_2. Use an initial estimate of $V_2^{(10)}$ = 1.0+j0.0 and perform four iterations. Also find S_1 and the real, reactive power loss in the line, assuming that the bus voltages have converged.

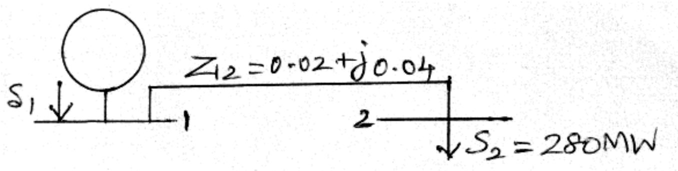

Figure 12 (b)

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

Or

(b) Two synchronous machines are connected through three phase transformers to the transmission line shown in Figure 13 (b) the ratings and reactance of the machines and transformers are

Machine 1 and 2: 100 MVA, 20kV; $X_d'' = X_1 = X_2$ = 20%, X_0 = 4%, X_n = 5%
Transformers T_1 and T_2 = 100 MVA, 20Δ/345Y kV; X = 8%.

On a chosen base of 100 MVA, 345 kV in the transmission line circuit the line reactances are $X_1 = X_2$ = 15% and X_0 = 50%. Draw each of the three sequence networks and find the zero sequence bus impedance matrixes by means of Z bus building algorithm.

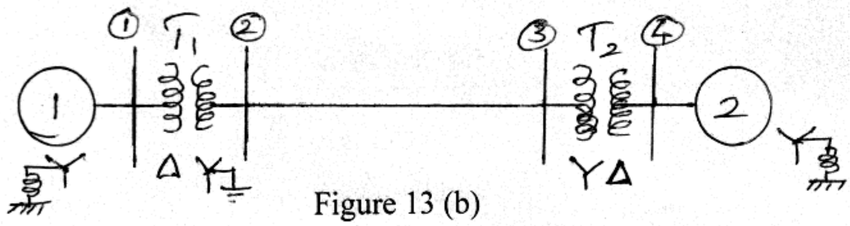

Figure 13 (b)

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

Or

(b) The one-line diagram of a power system is shown below in Figure 14 (b).

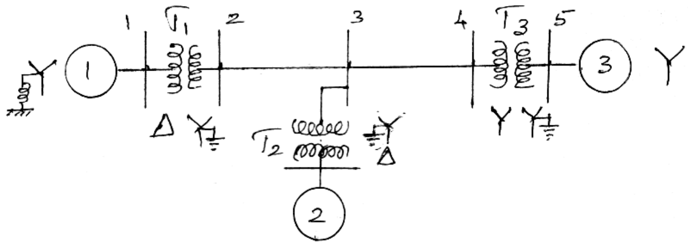

Figure 14 (b)

The following are the p.u. reactances of different elements on a common base

Generator 1 X_{g_0} = 0.075; X_n = 0.075; X_1 = X_2 = 0.25

Generator 2: X_{g_0} = 0.15; X_n = 0.15; X_1 = X_2 = 0.2

Generator 3: X_{g_0} = 0.072; X_1 = X_2 = 0.15

Transformer 1: X_0 = X_1 = X_2 = 0.12

Transformer 2: X_0 = X_1 = X_2 = 0.24

Transformer 3: X_0 = X_1 = X_2 = 0.1276

Transmission line 2—3 X_0 = 0.5671; X_1 = X_2 = 0.18

Transmission line 3—5 X_o = 0.4764; X_1 = X_2 = 0.12

Prepare the three sequence networks and determine reactances Z_{bus0}, Z_{bus1} and Z_{bus2}.

15. (a) Describe the equal area criterion for transient stability analysis of a system.

Or

(b) (i) A 2pole, 50 Hz, 11kv turbo alternator has a ratio of 100 MW, power factor 0.85 lagging. The rotor has a moment of inertia of 10,000 kgm². Calculate H and M.

(ii) A three phase fault is applied at the point P as shown in Figure 15(b) (ii) below. Find the critical clearing angle for clearing the fault with simultaneous opening of the breakers 1 and 2. The reactance values of various components are indicated in the diagram. The generator is delivering 1.0 p.u. power at the instant preceding the fault.

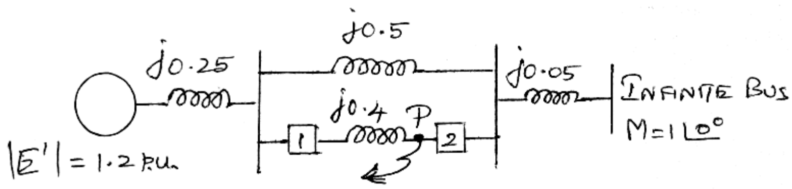

Figure 15 (b) (ii)

PART C — (1 × 15 = 15 marks)

16. (a) Figure 16 (a) 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 pu. 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.

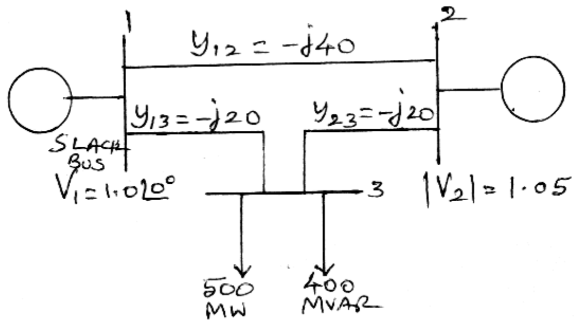

Figure 16 (a)

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

Or

(b) In the power system shown in figure 16(b) phase fault occurs at point P and the faulty line was opened a little late. Find the power output equations for the pre-fault during fault and post fault calculation. values are marked in p.v. reactances.

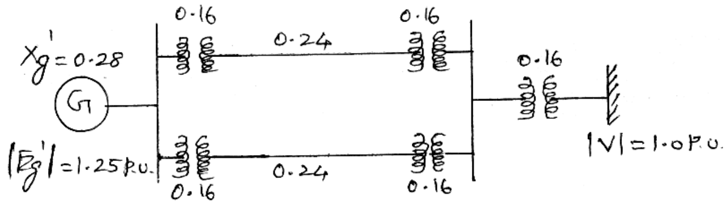

Figure 16(b)
