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Question Paper Code : 51015

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024.

Fifth Semester

Electrical and Electronics Engineering

EE 3501 — POWER SYSTEM ANALYSIS

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Mention the significance of per unit quantities.

2. Define the terms 'twigs' and 'links' in graph theory.

3. Write the reasons for selecting one of the buses as slack bus.

4. Write the known and unknown parameters of each type of bus.

5. List out the assumptions made in short circuit studies.

6. Mention the need for current limiting reactors.

7. What are the different types of faults in power system and specify the typical percentage of occurrence of each fault?

8. Name the types of symmetrical components and their importance in fault analysis.

9. Define power system stability.

10. Define critical clearing angle.

PART B — (5 × 13 = 65 marks)

11. (a) A three phase power system is represented as single line diagram as shown in Figure 11 (a) supplies a load of 88 MW and 30 MVAR at 11 kV. The ratings of the components are given in Table 11 (a) The load may be assumed as the equivalent impedance load. Draw the single-line impedance diagram representing the impedance in per unit of each component to common base values of 130 MVA and 11 kV, which are the ratings of the generator.

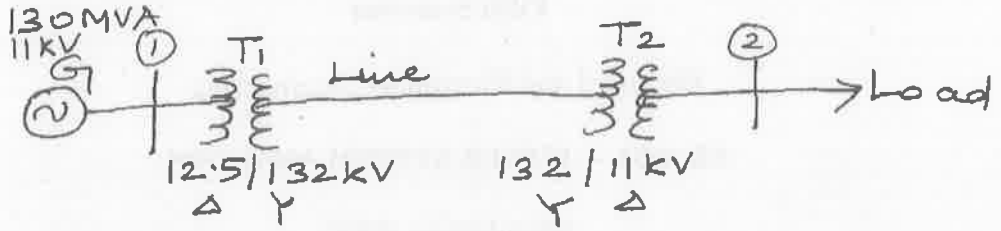

Figure 11 (a) Single line diagram

Table 11 (a) Ratings of the components.

Component	MVA	KV	Impedance
Generators (total)	130	11	J 0.17 p.u
Step-up transformer	3 × 55	12.5 Δ/132 Y	J 0.15 p.u referred to 12.5 kV
Line	150	132	(4 + j 12) Ω
Step-down transformer	150	132 Y/11 Δ	J 0.115 Ω (total reactance referred to 11 kV side)

Or

(b) Explain the algorithm for computing bus admittance matrix using singular transformation.

12. (a) The following is the system data for a load flow solution in the table 12 (ai), (aii). Find the bus voltages at the end of first iteration using Gauss-seidel method.

Table 12 (ai) Line admittances

Bus code	Admittance
1-2	-j 5.0
1-3	-j 5.0
1-4	-j 5.0
2-3	-j 10.0
3-4	-j 10.0

Table 12 (aii) Schedule of active and reactive powers

Bus code	P	Q	V	Remarks
1	-	-	1+j0	Slack bus
2	1	0.1	-	PQ bus
3	3.5	0.3	-	PQ bus
4	1	0.2	-	PQ bus

Or

(b) Draw the flowchart for the solution of power flow analysis using Newton Raphson method.

13. (a) Explain the procedure for Z bus building algorithm without mutual coupling.

Or

(b) Explain the algorithm for symmetrical fault analysis using bus impedance matrix.

14. (a) The original set of voltage phasors are given by $V_a = 4.0$, $V_b = 3\angle -90°$ and $V_c = 8\angle 143.1°$. Find all of the voltage components for the positive, negative and zero-sequence systems.

Or

(b) The circuit diagram of a simple power system network is given in Figure 14 (b). Draw the positive, negative and zero sequence networks.

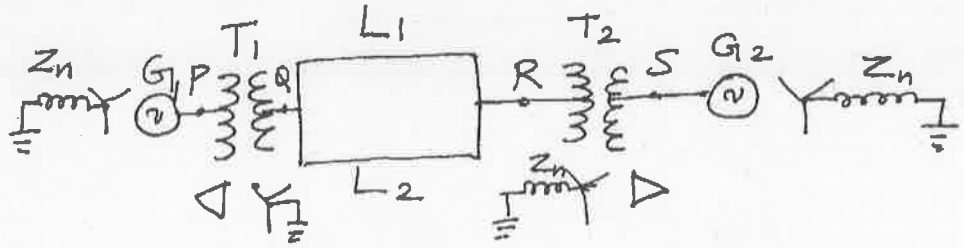

Figure 14 (b)

15. (a) Explain the stability analysis of multi-machine system.

Or

(b) Explain the step-by-step method of solving swing equation.

PART C — (1 × 15 = 15 marks)

16. (a) (i) Find the bus incidence matrix A for the four-bus system shown in Figure 16 (a). Take ground as the reference. (5)

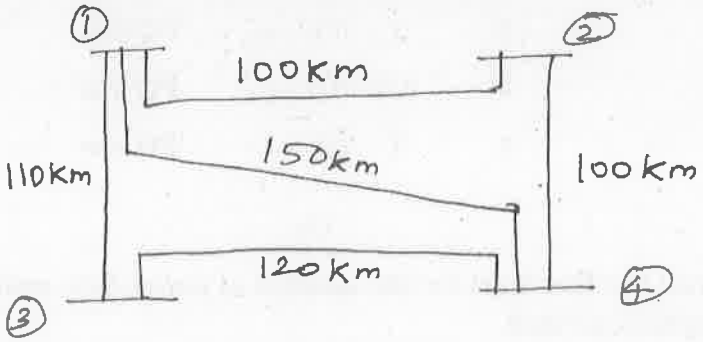

Figure 16 (a)

(ii) Find the primitive admittance matrix for the system. It is given that all the lines are characterized by a series impedance of $0.1 + j\ 0.7\ \Omega$/km and a shunt admittance of $j\ 0.35 \times 10^{-5}$ mho/km. Lines are rated at 220 kV. (5)

(iii) Find the bus admittance matrix for the system. Use the values of 220 kV and 100 MVA as base quantities. Express all impedance and admittance per unit. (5)

Or

(b) An importing power area has a total demand of 25 MW from an infinite bus via an inter connector. The steady state power limit is 80 MW. Estimate using the equal area criterion the maximum additional area load that could be suddenly switched on without the system losing stability.

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