Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 41036

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 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. Define per-unit system and mention its advantages.

2. What is a single-line diagram?

3. State the difference between Gauss-Seidel and Newton-Raphson methods for power flow analysis.

4. Brief the significance of bus classification in power flow studies.

5. List the assumptions made in symmetrical short circuit analysis.

6. Write the expression for post-fault bus voltage in symmetrical fault analysis.

7. What are sequence components?

8. Differentiate between LG and LL faults in terms of their characteristics.

9. Define rotor angle stability in the context of power systems.

10. What is the difference between steady state stability and transient stability in power system?

PART B — (5 × 13 = 65 marks)

11. (a) The single line diagram of a power system is shown in Fig.11. (a) Draw the impedance diagram.

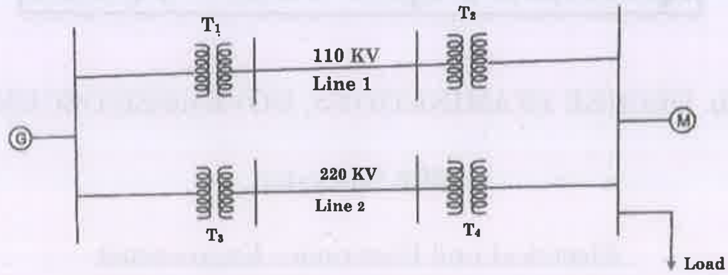

Fig. 11 (a)

G : 90 MVA, 11 kV, X" = 18%

T1 : 70 MVA, 11/110 kV, X = 15%

T2 : 60 MVA, 110/11 kV, X = 10 %

T3 : 30 MVA, 11/220 kV, X = 9%

T4 : 50 MVA, 220/11 kV, X = 12%

Line 1 : 110 kV, Z = 80Ω

Line 2 : 220 kV, Z = 120Ω

M : 85 MVA, 11 kV, X" = 13%

The load absorbs 74 MVA, 0.8 power factor lagging at 6.5 kV. Select a common base of 100 MVA, 11 kV on the generator side.

Or

(b) For the system shown in Fig.11 (b), form the bus impedance matrix using bus building algorithm.

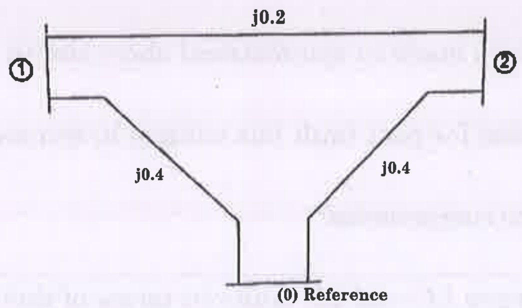

Fig. 11 (b)

12. (a) Explain with detailed flowchart, the computational procedure for Newton Raphson method of load flow analysis.

Or

(b) The Fig. 12 (b) shown below is the one-line diagram of a simple 3-bus power system with generation at bus 1. The voltage at bus 1 is, $V_1 = 1.0 \angle 0°$ per-unit. The scheduled load at buses 2 and 3 are marked on the figure. Line impedances are marked in per- unit on a 100 MVA base. Assuming a flat start using Gauss-Seidel method determine, V_2 and V_3. Perform two iterations by taking the acceleration factor as 1.2.

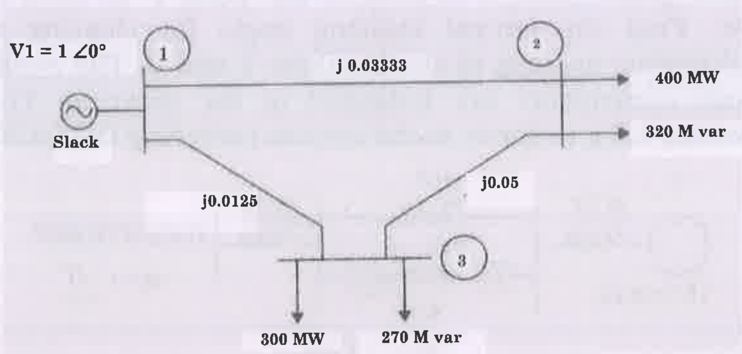

Fig. 12 (b)

13. (a) A 3-phase transmission line operating at 11 kV and having a resistance and reactance of 10 Ω and 25 Ω respectively is connected to a generating station bus bar through a 30 MVA, 6.2/11 kV step-up transformer which has a reactance of 0.12 pu. Two generators, one with 20 MVA, 6.2 kV having 0.8 pu reactance and another generator with 15 MVA, 6.2 kV having 0.65 pu reactance are connected to the bus bar. Calculate the short circuit MVA and the fault current when a three phase short circuit occurs at the high voltage terminals of the transformer. Also draw the single line diagram.

Or

(b) The one line diagram of a three phase power system is shown in Fig. 13 (b). All impedances are expressed in per unit in a common base 80 MVA base. Determine the fault current, the bus voltages and the line currents during the fault when a 3 phase balanced fault with a fault impedance $Z_f = 0.18$ p.u occurs on Bus 2.

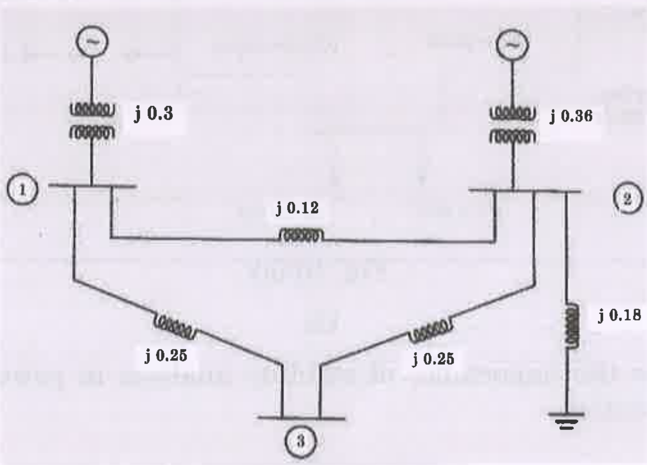

Fig. 13 (b)

14. (a) Derive the relationship for fault currents in terms of symmetrical components when there is a line-to-line (L-L) fault between phase b and c. Also draw the diagram showing interconnection of sequence networks for L-L fault.

Or

(b) A three phase fault is applied at the point P as shown in Fig. 14 (b) 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.

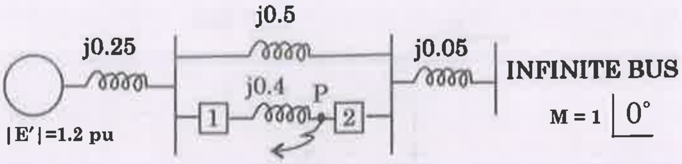

Fig. 14 (b)

15. (a) What is equal area criterion? Using equal area criterion, derive an expression for critical clearing angle and critical clearing time for a system having a generator feeding a large system through a double circuit line with a temporary three-phase bolted fault on one of the line at the sending end.

Or

(b) Discuss the procedure for solving the swing equation using modified-Euler method.

PART C — (1 × 15 = 15 marks)

16. (a) Fig. 16 (a) shows the one-line diagram of a simple three-bus power system with generation at bus 1. The line impedances are marked in per unit on a 100 MVA base. Find out the bus voltages after two iterations using Gauss Seidel method.

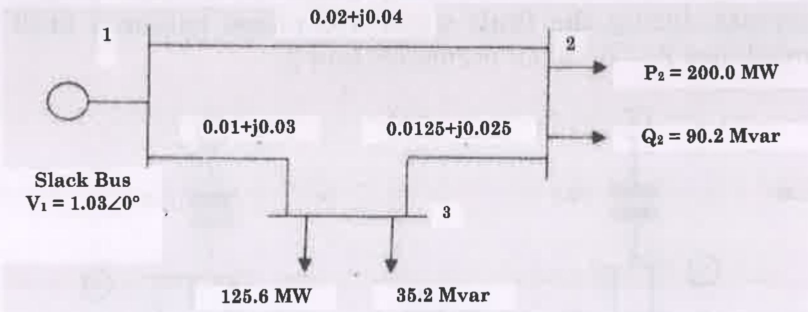

Fig. 16 (a)

Or

(b) Describe the importance of stability analysis in power system planning and operation.
