Reg. No. :

Question Paper Code : 80573

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

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 × 2 = 20 marks)

1. Define steady state operating condition.

2. Mention the advantages of per unit method over percent method.

3. Define voltage controlled bus (generator bus/PV bus).

4. Write the effects of acceleration factor in the load flow solution algorithm.

5. Why faults occur in a power system?

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

7. What is the significance of subtransient reactance and transient reactance in short circuit studies?

8. What are symmetrical components?

9. Define steady state ability.

10. What is meant by infinite bus?

[redacted]

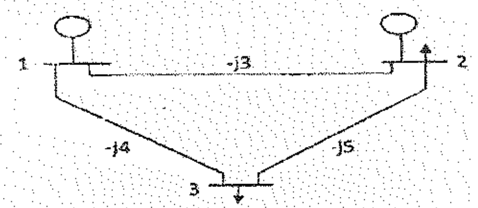
PART B — (5 × 13 = 65 marks)

11. (a) Define the per unit value of a quantity. How will you change the base impedance from one set of base values to another set?

Or

(b) With neat diagrams, explain the transformer model used for per–phase analysis.

12. (a) A three bus power systems is shown. Determine the voltages at buses 2 and 3 after 1st iteration using Gauss-Seidal method. Take the acceleration factor $\alpha = 1.6$.



Bus No.	Type	Generation		Load		Bus Voltage	
		P_G	Q_G	P_L	Q_L	V	δ
1	Slack	–	–	–	–	1.02	0
2	PQ	0.25	0.15	0.5	0.25	–	–
3	PQ	0	0	0.6	0.3	–	–

Or

(b) Consider a small power system with the following parameters:

Bus 1: Voltage magnitude = 1.05 pu, Voltage angle = 0 degrees

Bus 2: Voltage magnitude = 1.00 pu, Voltage angle = 0 degrees

Line 1–2 : Admittance (Y12) = 0.02 + j0.04 pu

Line 2-3: Admittance (Y23) = 0.03 + j0.06 pu

Line 3-1: Admittance (Y31) = 0.04 + j0.08 pu

Using the Newton Raphson method, determine the bus voltages and line flows after one iteration. Assume that the initial values for bus voltages are 1.05 pu and 1.00 pu for buses 1 and 2, respectively.

13. (a) An earth fault occurs on one conductor of a 3–conductor cable supplied by a 10MVA, 3-phase alternator has positive negative and zero sequence impedance of (0.5+j4.7') Ω, (0.2+j0.6) Ω and j0.43 Ω per phase. The corresponding line to neutral values for the cable upto fault position are (0.36+j0.25) Ω, (0.36+j0.7) Ω and (2.5+j0.95) Ω per phase.

Find fault currents and sequence components of currents. The generator is excited to give 6.6kV between lines on an open circuit.

Or

(b) With the help of a detailed flow chart, explain how a symmetrical fault can be analysed using ZBus.

14. (a) Derive the expression for fault current for a double line to ground fault in an unloaded generator in terms of symmetrical components.

Or

(b) (i) Explain the procedure for making short circuit studies of a large power system (7)

(ii) using digital computer. Illustrate the answer by considering a symmetrical fault. (6)

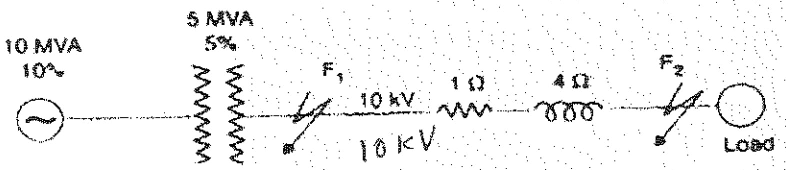
15. (a) Derive the swing equation for a single machine connected to infinite bus system. State the assumptions if any and state the usefulness of this equation. Neglect the damping.

Or

(b) Explain the solution of swing equation by Runga Kutta Method with necessary expressions.

PART C — (1 × 15 = 15 marks)

16. (a) A 3–phase transmission line operating at 10 kV and having a resistance of 1 Ω ad reactance of 4 Ω is connected to the generating station bus-bars through 5 MVA step-up trans-former having a reactance of 5%. The bus-bars are supplied by a 10 MVA alternator having 10% reactance. Calculate the short-circuit kVA fed to 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) Consider a balanced three–phase fault occurring at Bus 2 in a power system represented by the following bus impedence matrix:

$$Z_{bus} = \begin{bmatrix} 0.1 + j0.3 & -j0.02 & -j0.1 \\ -j0.2 & 0.15 + j0.4 & -j0.25 \\ -j0.1 & -j0.25 & 0.2 + j05 \end{bmatrix} pu$$

Assume that the base MVA of the system is 100 MVA and the system voltage is 10 kv. Determine the fault current at Bus 2 for a three–phase fault using the bus impedance matrix.