



CBCS SCHEME

21EE53

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2026

Power System Analysis – I

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Explain how the single line diagram, impedance diagram and reactance diagrams are drawn with one example. (10 Marks)
- b. Draw the per unit reactance diagram for the power system shown in Fig.Q1(b), selecting the generator rating as the base, find the generator terminal voltage.

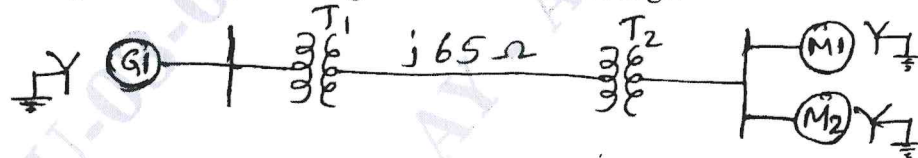


Fig.Q1(b)

The ratings of the various components are :

G_1 : 13.8 KV, 25 MVA, $X'' = j0.15$ p.u

T_1 : 13.2/69 KV, 25 MVA, $X = j0.11$ p.u

T_2 : 69/13.2 KV, 25 MVA, $X = j0.11$ p.u

M_1 : 13 KV, 15 MVA, $X'' = j0.15$ p.u

M_2 : 13 KV, 10 MVA, $X'' = j0.15$ p.u

Determine the generator terminal voltage when both the motors operate at 12 KV 75% full load and unity power factor.

(10 Marks)

OR

- 2 a. Explain the significance of power transformer in any power system. (10 Marks)
- b. Draw a per unit reactance diagram for the power system shown in Fig.Q2(b).

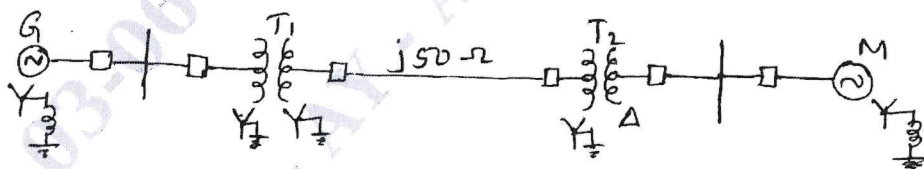


Fig.Q2(b)

Use a base of 100 MVA, 220 KV in 50Ω line.

The ratings are

Generator : 40 MVA, 25 KV, $X'' = 20\%$

Motor : 50 MVA, 11 KV, $X'' = 30\%$

Y – Y transformer : 40 MVA, 33 Y/220 Y KV, $X = 15\%$

Y - Δ transformer : 30 MVA, 11Δ/220 Y KV, $X = 15\%$.

(10 Marks)

Module-2

- 3 a. Explain the different types of fault with respect to power system. (10 Marks)
- b. A synchronous generator and motor are rated as 30MVA, 13.2 KV, both have subtransient reactance of 20%. The line connecting them has a reactance of 10% on the base of machine rating. The motor is drawing 20 MW at 0.8 p.f (lead). The terminal voltage of motor is 12.8 KV, when a symmetrical fault occurs at motor terminals, find subtransient current in generator, motor and at the point of fault. (10 Marks)

OR

- 4 a. Explain how the circuit breakers are selected. (10 Marks)
- b. A 25 MVA, 13.2 KV synchronous generator is connected to a synchronous motor of same rating. Both have a transient reactance of 15%. The line connecting them has a reactance of 10% on the machine base. The motor is drawing a power of 18MW at 0.8 p.f lead, at 12.9 KV, when a short circuit occurs at its terminals, find the subtransient current in the motor, generator and at the fault points. (10 Marks)

Module-3

- 5 a. Explain symmetrical component method used for unbalanced three phase circuit analysis. (10 Marks)
- b. A balanced delta connected load is connected to a symmetrical supply. The line currents are each 10A in magnitude. If fuse in one of the lines blows out, determine the sequence components of the line current. (10 Marks)

OR

- 6 a. Explain the operator 'a' and state its properties. (10 Marks)
- b. Across a star connected symmetrical impedance load of $10\ \Omega$ and a neutral impedance of $(10/3)\Omega$, an unbalanced three phase supply with $V_a = 220\angle 0^\circ$ volts, $V_b = 220\angle -110^\circ$ volts and $V_c = 180\angle -110^\circ$ volts is applied. Determine the line currents using symmetrical components. [Refer Fig.Q6(b)].

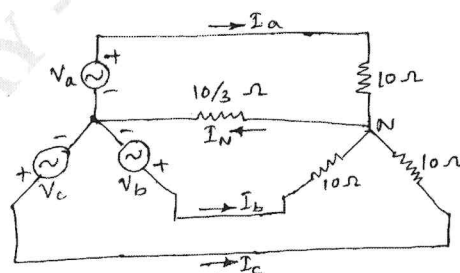


Fig.Q6(b)

(10 Marks)

Module-4

- 7 a. Explain single line to ground fault and hence prove that

$$\bar{I}_{R_0} = \bar{I}_{R_1} = \bar{I}_{R_2} = \frac{1}{3} \bar{I}_R$$
 (10 Marks)
- b. A 30 MVA, 11 KV generator has $Z_1 = Z_2 = j0.21$ p.u and $Z_0 = j0.05$ p.u. If a line to line fault occurs on the terminals of the generator, find the line currents and line to neutral voltages under fault conditions. (10 Marks)

OR

- 8 a. Explain double –line to ground fault and hence prove that

$$\bar{I}_R = \bar{I}_{R_0} - \bar{I}_{R_1} = \bar{I}_{R_2} = 0A$$
 . (10 Marks)
- b. A 30 MVA, 6.6KV, 3 - ϕ alternator was subjected to different types of faults. The fault currents were 3 - ϕ fault 1122 A, line to line fault 1554 A, single line to ground fault 2478A. The alternator neutral is solidly grounded. Find the per unit values of the three sequence reactances of the alternator. (10 Marks)

Module-5

- 9 a. Define stability as applied to power system studies and distinguish between steady state stability and transient stability. (10 Marks)
- b. A 50 Hz, 4P, turbogenerator rated 100MVA, 11 KV, has an inertia constant of 8 MJ/MVA.
- Find the stored energy in the rotor at synchronous speed
 - If the mechanical input is suddenly raised to 80 MW for an electrical load of 50 MW, find rotor acceleration not neglecting mechanical and electrical losses
 - If the acceleration calculated in part(ii) is maintained for 10 cycles, find the change in torque angle and rotor speed in revolution per minute at the end of this period.
- (10 Marks)

OR

- 10 a. State the assumptions made while carrying out transient stability study and explain the steps to be followed in a stability study for a single machine connected to an infinite bus bar system. (10 Marks)
- b. A 3- ϕ power system consists of a synchronous generator connected to a infinite bus bar through a loss less double circuit transmission line. A fault occurs on the transmission line. The maximum power transfer for the system when unfaulted is 5 p.u. and immediately prior to the instant of the fault the power transfer is 2.5 p.u. The power angle curves during fault and post fault conditions have peak values of 2 p.u. and 4. p.u respectively. Determine the critical clearing angle. (10 Marks)