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Question Paper Code : 91491

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019

Fifth Semester

Electrical and Electronics Engineering

EE 6501 – POWER SYSTEM ANALYSIS

(Regulations 2013)

(Also Common to PTEE 6501 – Power System Analysis – For B.E. (Part-Time) – Fifth Semester – Electrical and Electronics Engineering – Regulations – 2014)

Time : Three Hours   Maximum : 100 Marks

Answer ALL questions

PART – A   (10×2=20 Marks)

1. What is the need for base values ?

2. What are the approximations made in impedance diagram ?

3. Compare Newton Raphson and Gauss Seidal methods of load flow solutions.

4. Write the quantities, that are associated with each bus in a system,

5. Define Short Circuit capacity.

6. The Z-bus method is very suitable for fault studies on large systems. Why ?

7. What are the symmetrical components of a three phase system ?

8. What is the sequence operator ?

9. Define Voltage Stability.

10. State few techniques to improve the stability of the power system.

PART – B (5×13=65 Marks)

11. a) The data for the system whose single-line-diagram is shown in Fig. 11(a) is as follows :
G1 : 50 MVA, 11kV, X″ = 1.6 Ω
G2 : 20 MVA, 6.6 kV, X″ = 1.2.Ω
G3 : 25 MVA, 6.6 kV, X″= 0.56 Ω
T1 : 50 MVA, 33/11 kV, X = 15.2 Ω/phase on HT side
T2 : 50 MVA, 33/6.2 kV, X = 16.0 Ω/phase on HT side
Transmission Line : X = 20.5 Ω/phase
Loads : A : 40 MW, 11 kV, 0.9 p.f lagging;
B : 40 MW, 6.6 kV, 0.85 p.f. lagging.
Choose the base power as 50 MVA, base kV as 33 kV. Draw the reactance diagram. Indicate pu reactances on the diagram. (13)

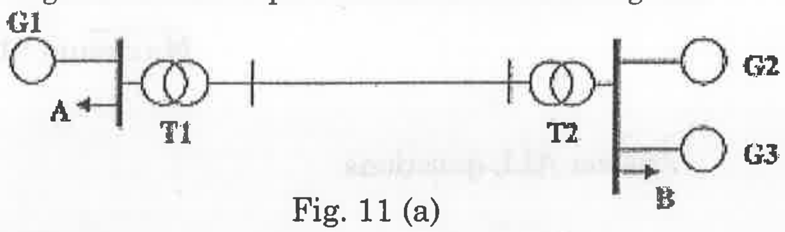


Fig. 11 (a)

(OR)

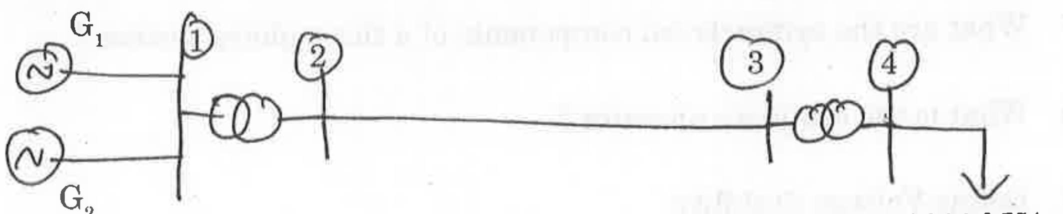
b) i) Starting from first principles show that a diagonal element of Y-bus equals the sum of admittances connected to that bus and an off diagonal element equals the negative of the sum of admittances directly connected between the buses. (6)

ii) Prove that [Y-bus] = $[A]^T[y][A]$. (7)

12. a) With a neat flow chart, explain the computational procedure for load flow solution using Newton Raphson iterative method when the system contains all types of buses.

(OR)

b) Given: Rating of each machine 1200 kVA, 600 V with $X' = X_2 = 10\%$ $X_0 = 5\%$. Each three-phase transformer is rated 1200 kVA, 600/3300V (Delta/Star) with leakage reactance of 5%. The reactances of the transmission line are $X_1 = X_2 = 20\%$ and $X_0 = 40\%$ on a base of 1200,kVA, 3300 V. The reactances of the neutral grounding reactors are 5% on the kVA and voltage base of the machine. (13)



Perform power flow analysis employing Gauss Seidal method.

13. a) A 3 phase, 5 MVA, 6.6 kV alternator with a reactance of 8% is connected to a feeder series impedance (0.12 + j0.48) ohm/phase/km through a step up transformer. The transformer is rated at 3 MVA, 6.6 kV/33 kV and has a reactance of 5%. Determine the fault current supplied by the generator operating under no load with a voltage of 6.9 kV, when a 3 phase symmetrical fault occurs at a point 15 km along the feeder. **(13)**

(OR)

b) A 100 MVA, 11 kV generator with X" = 0.20 p.u is connected through a transformer and line to a bus bar that supplies three identical motor as shown in Fig. and each motor has X" = 0.20 p.u and X'= 0.25 p.u on a base of 20 MVA,33 kV, the bus voltage at the motors is 33 kV when three phase balanced fault occurs at the point F. Calculate (i) Sub transient current in the fault (ii) Sub transient current in the circuit breaker B (iii) Momentary current in the circuit breaker B (iv) The current to be interrupted by C.B B in 5 cycles.

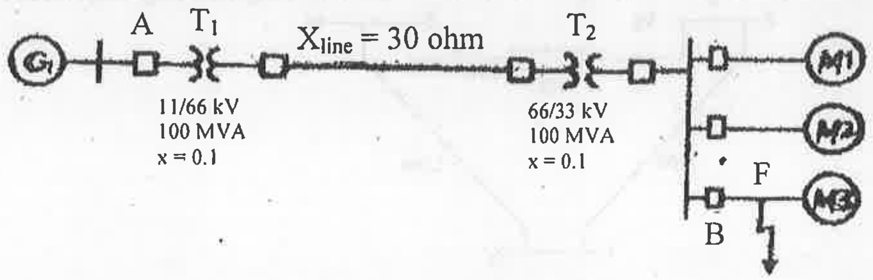


Fig. 13 (b)

14. a) Derive an expression for fault current as line-to-line fault on an unloaded generator. **(13)**

(OR)

b) A single line to ground fault (on phase a) occurs on the bus I of the system of Figure shown Figure. 5

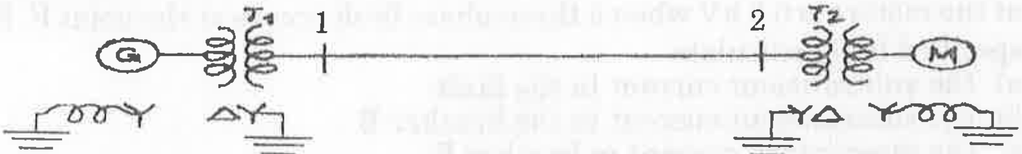


Fig. 5

Using bus impedance (Z_{BUS}) method. Find

i) Current in the fault. **(4)**

ii) SC current on the transmission line in all the three phases. **(4)**

iii) SC current in phase 'a' of the generator. **(2)**

iv) Voltage of the healthy phases of the bus I. **(3)**

15. a) Derive the expression for swing equation. **(13)**

(OR)

b) A synchronous motor is receiving 30% of the power that it is capable of receiving from an infinite bus. If the load on the motor is doubled, calculate the maximum value of δ during the swinging of the motor around its new equilibrium position. **(13)**

PART – C **(1×15=15 Marks)**

16. a) Consider the three-bus system of fig. 16 (a). Assume negligible shunt admittances of the lines. Each line admittance is – j10 pu. 'a' is the complex turns ratio of the regulating transformer, RT, i.e.

$a = |a| \angle\alpha$

a) Determine Y_{BUS} for $a = 1.05 \angle -2.5° = 1.049 - j\,0.046$.

b) Determine the changes in real and reactive power flows ΔP_{23} and ΔQ_{23} when 'a' changes from $1 \angle 0°$ to $1 \angle -2.5°$.

c) Repeat (b) when 'a' changes from $1\angle 0°$ to $1.05 \angle 0°$. Given $|V_2| = 1.05$ pu, $|V_3| = 0.95$ pu, $\delta_2 = -3°$, $\delta_3 = +2°$, without the regulating transformer RT.

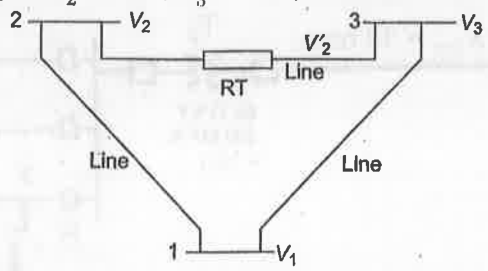


Fig. 16 (a)

(OR)

b) A 25 MVA, 11 kV generator with $X''_d = 20\%$ is connected through a transformer, line and a transformer to a bus that supplies three identical motors as shown in Fig. 16 (b). Each motor has $X''_d = 25\%$ and $X'_d = 30\%$ on a base of 5 MVA, 6.6 kV. The three-phase rating of the step-up transformer is 25 MVA, 11/66 kV with a leakage reactance of 10 per cent and that of the step-down transformer is 25 MVA, 66/6.6 kV with a leakage reactance of 10 per cent. The bus voltage at the motors is 6.6 kV when a three-phase fault occurs at the point F. For the specified fault, calculate

a) the subtransient current in the fault

b) the subtransient current in the breaker B

c) the momentary current in breaker B

d) the current to be interrupted by breaker B in five cycles

Given : Reactance of the transmission line = 15% on a base of 25 MVA, 66 kV. Assume that the system is operating on no load when the fault occurs.

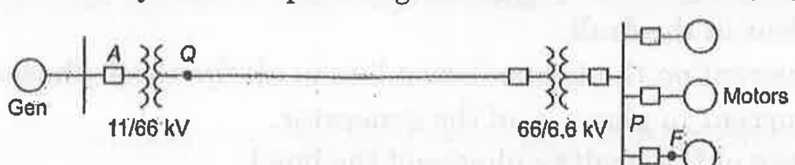


Fig. 16 (b)
