Electrical and Electronics Engineering Department

Power System Design

Semester VIII

1. The per unit impedance Z(pu) is given by
   a. $Z_\Omega * (kVA)_b/(KV)^2_b$
   b. $Z_\Omega * (MVA)_b/((KV)^2_b * 100)$
   c. $Z_\Omega * (MVA)_b * 100/(KV)^2_b$
   d. $Z_\Omega * (MVA)_b/(KV)^2_b$
2. The per unit value of a 2 ohm resistor at 100 MVA and 10 kV base voltage is
   a. 4 pu
   b. 2 pu
   c. 0.5 pu
   d. 0.2 pu
3. The per unit impedance of a circuit element is 0.30. If the base kV and base MVA are halved, then the new value of the per unit impedance of the circuit element will be
   a. 0.30
   b. 0.60
   c. 0.0030
   d. 0.0060
4. Explain the advantages of per unit form of representation.
5. A bank of three single-phase transformers is star-star connected and has a % reactance of 10%. The same bank is then converted to satisfy rated star-delta connections. The per cent reactance of the transformer will now be
   a. $10/\sqrt{3}$ %
   b. $10\sqrt{3}$ %
   c. 10 %
   d. None of the above
6. Define the per unit value of a quantity. How will you change the base impedance from one set of base values to another set?
7. A 75MVA, 10kV synchronous generator has X_d =0.4pu. The X_d value (in pu) to a base of 100MVA, 11kV is
   a) 0.578 b) 0.279 c) 0.412 d) 0.44
8. The pu parameters for a 500MVA machine on its own base are

   Inertia=20pu, Reactance= 2pu

   The pu values of inertia and reactance on 100MVA common base, respectively are

   a) 4, 0.4 b) 100,10 c) 4,10 d) 100,0.4
9. A generator is connected through a 20 MVA, 13.8/138 kV step up transformer, to a transmission line. At the receiving end of the line a load is supplied through a step down transformer of 10 MVA, 138/69 kV rating. A 0.72 p.u. load, evaluated, on load side transformer ratings as base values of 10 MVA

and 69 kV in load circuit, the value of the load (in per unit) in generator circuit will be

a) 36 b) 1.44 c) 0.72 d) 0.18

10. A new generator having Eg=1.4∠30∘pu and synchronous reactance 'Xs′ of 1.0 pu on the system base, is to be connected to a bus having voltage Vt in the existing power system. This existing power system can be represented by Thevenin's voltage Eth=0.9∠0∘pu in series with Thevenin's impedance Zth=0.25∠90∘pu. The magnitude of the voltage Vt,, of the system in pu will be

a) 0.990 b) 0.973 c) 0.963 d) 0.900

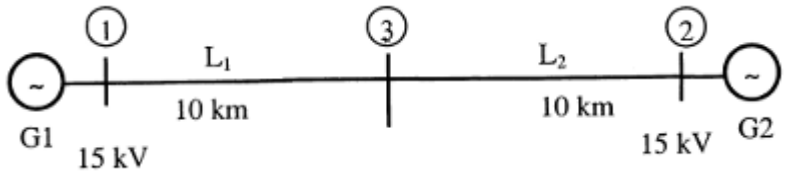
11. Differentiate between actual impedance and base impedance.
12. A single phase star connected load is drawing power at a voltage of 0.9pu and 0.8 power factor lagging. The three phase base power and base current are 100MVA and 437.38 A respectively. The line to line load voltage in kV is

a) 204.376 b) 118.8 c) 132kV d) none

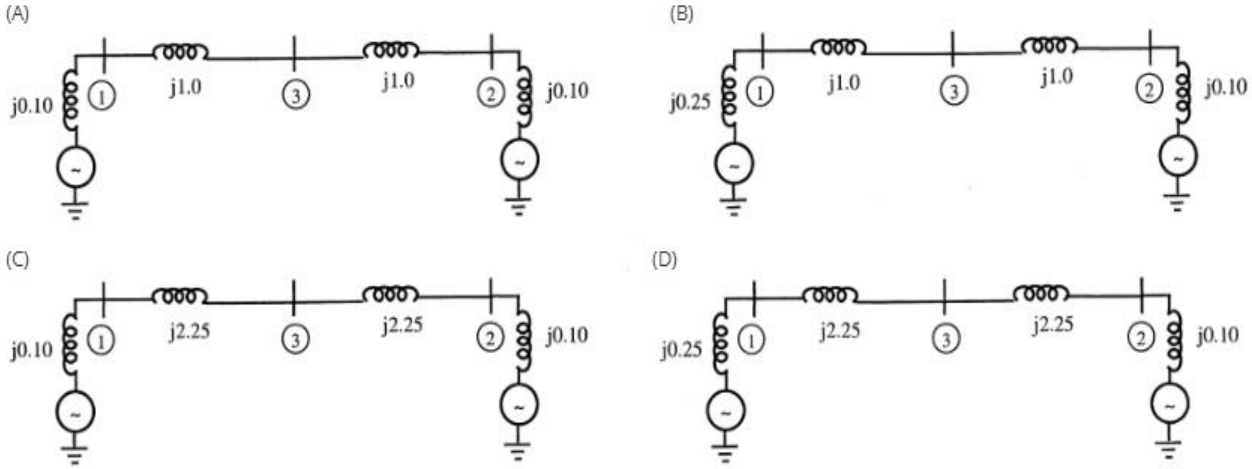
13. Why per unit impedance referred to either side of transformer is same? Explain it with derivation.
14. What is power flow or load flow study?
15. What are the information that are obtained from a load flow study?
16. What is the need for load flow study?
17. What are the works involved in a load flow study?
18. What are the different types of buses in a power system? Explain each of them in detail.
19. List the quantities specified and the quantities to be determined from load flow study for various types of buses.
20. Write the load flow equation of Gauss and Gauss-Seidel method.
21. Write the load flow equation of Newton-Raphson method.
22. Discuss the effect of acceleration factor in the load flow solution algorithm.
23. Why do we go for iterative methods to solve load flow problems?
24. What are the advantages and disadvantages of Guass Siedel method?
25. How approximation is performed in Newton-Raphson method?
26. What is Jacobian matrix? How the elements of Jacobian matrix are computed?
27. What are the advantages and disadvantages of Newton-Raphson method?
28. Compare G-S method and N-R methods of load flow solutions.
29. How the convergence of N-R method is speeded up?
30. What is a bus?
31. What is bus admittance matrix? Write the equation for the bus admittance matrix.
32. Mention the advantages of bus admittance matrix, Ybus.
33. The per-unit power output of a salient-pole generator which is connected to an infinite bus, is given by the expression, $P = 1.4 \sin \delta + 0.15 \sin 2\delta$, where δ is the load angle. Newton-Raphson method is used to calculate the value of δ for $P = 0.8$ pu. If the initial guess is 30∘, then its value (in degree) at the end of the first iteration is

a) 15 b) 28.48 c) 31.20 c) 28.74

34. For a power system network with n nodes, Z33 of its bus impedance matrix is j0.5 per unit. The voltage at mode 3 is $1.3\angle -10^0$ per unit. If a capacitor having reactance of −j3.5 per unit is now added to the network between node 3 and the reference node, the current drawn by the capacitor per unit as
    a) $0.325\angle -100^0$ b) $0.325\angle -80^0$ c) $0.375\angle -100^0$ d) $0.433\angle -80^0$
35. What are symmetrical components? Explain each of the component with the help of phasor diagram.
36. Express the unbalanced voltages in terms of symmetrical components.
37. In an unbalanced three phase system, phase current $I_a = 1\angle(-90^o)$ pu, negative sequence current $I_{b2} = 4\angle(150^o)$ pu, zero sequence current $I_{c0}\ 3\angle 90^o$ pu. The magnitude of phase current I_b in pu is
    a) 1.00 b) 7.81 c) 11.53 d) 13
38. The sequence components of the fault current are as follows: $I_{positive}$ = j1.5 pu, $I_{negative}$ = –j0.5 pu, I_{zero} = –j1 pu. The type of fault in the system is
    a) LG b) LL c) LLG d) LLLG
39. Two generator units G1 and G2 are connected by 15 kV line with a bus at the midpoint as shown below



G1 = 250MVA, 15 kV, positive sequence reactance X=25% on its own base ,G_2 = 100MVA, 15 kV, positive sequence reactance X=10% on its own base L_1 and L_2 = 10 km, positive sequence reactance X = 0.225 Ω/km. For the above system, positive sequence diagram with p.u values on the 100 MVA common base is



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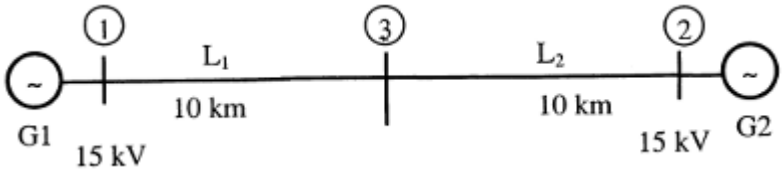

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a) 82.55 MVA b) 85.11MVA c) 170.91MVA d) 181.82 MVA

41. What is the need for short circuit studies or fault analysis?
42. What is the reason for transients during short circuits?
43. What is meant by a fault?
44. Why faults occur in a power system?
45. Write down the classification of faults occurring in power system.
46. What are the assumptions made in short circuit studies of a large power system network?
47. For a fault at the terminals of a synchronous generator, the fault current is maximum for a
    a) Three phase b) LG c) LL d) LLG
48. The rating of circuit breakers are generally decided on the basis of
    a) unsymmetrical fault current b) symmetrical fault currents
    c) normal circuit currents d) none
49. The most common fault in a overhead transmission line is
    a) LG b) LL c) LLG d) Three phase
50. Reactors are used in various locations in power system to
    a) Increase short circuit current
    b) Avoid short circuit current
    c) Limit short circuit current
    d) None
51. The most severe fault on the power system is
    a) Three phase b) LL c) LLG d)LG
52. Reactors are connected in
    a) Series b) Parallel c) Series-parallel d) None of these
53. In a balanced three phase system
    a) Only negative sequence current is zero
    b) Only positive sequence current is zero
    c) Only zero sequence current is zero
    d) Both a & c
54. The vector sum of positive sequence current is
    a) Infinite b) low c) Zero d) None of these
55. The use of reactors permits the installation of circuit breakers of
    a) Lower rating b) higher rating c) same rating d) None of these
56. If the percentage reactance of a system upto the fault point is 20% and base kVA is 10000, then short circuit kVA is

a) 10000 b) 50000 c) 2000 d) 500

57. The short circuit in a system may lead to
    a) Fire and explosion b) voltage dip c)excessive current d) all of these
58. The positive and negative sequence impedance of a transmission line are
    a) Equal b) Zero c) Different d) infinite
59. Unsymmetrical faults
    a) Introduce unbalance in the system
    b) are more frequent than symmetrical faults
    c) both a & b
    d) None of these
60. What is synchronous reactance?
61. Define subtransient reactance.
62. Define transient reactance.
63. What is the significance of subtransient reactance and transient reactance in short circuit studies?
64. Write down the equation determining fault current in a generator when its reactance is known.
65. Write the equation for subtransient and transient internal voltage of the generator.
66. How symmetrical faults are analyzed?
67. Define doubling effect and DC off-set current.
68. Differentiate between subtransient and transient reactance.
69. Define Stability of a power system.
70. Explain steady state stability and transient stability in power system
71. Write any three assumptions upon transient stability
72. Write any three assumptions upon transient stability.
73. What is meant by steady state stability limit and transient stability limit?
74. How to improve the transient stability limit of power system?
75. Give the expression for swing equation. Explain each term along with their units
76. What are the assumptions made in solving swing equation?
77. State equal area criterion.
78. Give the expression for critical clearing time.
79. Define critical clearing angle.
80. How can we improve the steady state stability of the synchronous generator for a better performance?
    a) Increasing the excitation
    b) Increasing reactance
    c) Decreasing moment of inertia
    d) Increasing moment of inertia
81. There is 2-machine model having losses too, with their transfer impedance being resistive. The maximum value of sending power P_{1max} and maximum receiving end power P_{2max} will take place with power angle ‘δ’ such that
    a) Both P_{1max} and P_{2max} will occur at $\delta<90$
    b) Both P_{1max} and P_{2max} will occur at $\delta>90$
    c) P_{1max} occurs at $\delta > 90$ and P_{2max} will occur at $\delta<90$

d) P_{1max} occurs at $\delta < 90$ and P_{2max} will occur at $\delta > 90$

82. What does the steady state stability of a power system signify?
    a) Maintaining the rated voltage
    b) Maintaining rated frequency
    c) Maintaining a synchronism between machines and tie-lines
    d) All of the mentioned
83. The stability of the power system is not affected by
    a) Generator reactance
    b) Line reactance
    c) Excitation of generators
    d) Line losses
84. Transient disturbances are caused by
    a) Sudden load changes
    b) Switching operations
    c) Fault in power system
    d) All of the above
85. The transient stability limit of a power system can be appreciably I
    Increased by introducing
    a) Series inductance
    b) Shunt inductance
    c) Series capacitance
    d) Shunt capacitance
86. What are the common assumptions made for the equal area criterion?
    a. The transmission line and machine resistances are neglected.
    b. Rotor speed of the machine is constant
    c. Mechanical input remains constant.
    d. All of these
    e. None of these
87. The inertia constant of 100 MVA, 50 Hz, 4 pole generator is 10 MJ/MVA. If the mechanical input to the machine is suddenly raised from 50 MW to 75 MW, the rotor acceleration will be equal to
    a) 12.5 electrical degrees/s^2
    b) 125 electrical degrees/s^2
    c) 225 electrical degrees/s^2
    d) 22.5 electrical degrees/s^2
88. If a generator of 250 MVA rating has an inertia constant of 6 MJ/MVA, its inertia constant on 100 MVA base is
    a) 6 MJ/MVA
    b) 15 MJ/MVA
    c) 2.5 MJ/MVA
    d) 10.5 MJ/MVA
89. The inertia of two group of machines which swing together are M1 and M2. The inertia constant of the system is:
    a) M1-M2
    b) M1+M2

c) M1M2/(M1+M2)
d) M1/M2

90. Equal area criteria gives the information regarding
    a) Stability region
    b) Absolute Stability
    c) Relative Stability
    d) Swing Curves
91. Which one of the following is true
    a) Steady State Stability limit is greater than Transient Stability limit
    b) Steady State Stability limit is equal to Transient Stability limit
    c) Steady State Stability limit is lee than Transient Stability limit
    d) None of the above
92. What is the range of 'δ' for stable operation?
    a. $0° < \delta < 45°$
    b. $45° < \delta < 90°$
    c. $0° < \delta < 90°$
    d. $0° < \delta < 120°$
93. For a 3 phase 400V alternator having 0.5pu of synchronous reactance and its excitation voltage of 1.2pu and Vt of 1pu. Then the power delivered to the infinite bus is
    a) 2.4pu
    b) 4.8pu
    c) 1.44pu
    d) 1pu
94. For a 3 phase 400V alternator supplying a load of 0.8 pf lagging at an armature current of 1.1pu. The power delivered to load is
    a) 0.88pu
    b) 0.8pu
    c) 0.66pu
    d) 1.375pu
95. If the synchronous machine is connected to an infinite bus of constant voltage Vt, through a transformed, a transmission line of reactance 'X'. then power for a cylindrical machine is
    a) $P = (Ef*Vt \sin\delta)/(Xs + X)$
    b) $P = (Ef*Ef \sin2\delta)/(Xs + X)$
    c) $P = (Ef*Vt \sin\delta)/(Xs – X)$
    d) $P = (Vt*Vt \sin\delta)/(Xs + X)$
96. A synchronous generator is operating with a Ef=1.40pu. This machine having Xs of 1.2pu, is delivering a synchronous power of 0.5pu to the bus. If the prime-mover torque is increased by 1%, by how much will the synchronous power P change?
    a)1%
    b)10%
    c)-1%
    d) 4%

97. A synchronous generator is running over excited with a Ef=1.40pu. This machine, with a synchronous reactance of 1.2pu, is delivering a synchronous power of 0.5pu to the bus. If the prime-mover torque is increased by 1%, by how much will the reactive power, Q change?

    a)-0.475%
    b)0.475%
    c)4.75%
    d) -4.75%

98. The phasor addition of stator and rotor mmfs in a cylindrical rotor synchronous machine, is possible because
    a) mmfs are rotating in opposite direction
    b) mmfs are rotating in same direction at different speeds
    c) mmfs are stationary with respect to each other
    d) one mmf is stationary and the other mmf is rotating

99. For the effective electromechanical energy conversion in the device, the developed torque depends upon
    a) stator field and torque angle
    b) stator field and rotor field
    c) stator field and rotor field and the torque angle
    d) stator field only

100. In a synchronous machine, hunting is predominantly damped by
    a) mechanical losses in the rotor
    b) iron losses in rotor
    c) copper losses of stator
    d) copper losses of rotor