EE 1352 POWER SYSTEM ANALYSIS

QUESTION AND ANSWERS

1. What are the main divisions of power system?

The generating system,transmission system,and distribution system

2. What are the adv. Of interconnected power system?

1.less no. of generators are required as areserve for operation at peak loads.Hence the reserve capacity of the generating station gets reduced.

2.less no. of generators which are running without load are required for meeting the sudden unexpected increase in load.

3. it allows the use of most economical sources of power depending on time.

3.What are the problems of interconnection?

1.it increase the amount of current which flows when a short circuit occurs on a system and thereby requires the installation of breakers which are able to interrupt a larger current‘

2. synchronism must be maintained between of all the interconnected systems .

4.Define one line diagram.

A simplified diagram by omiting the completed circuit through the neutral and by indicating the components of the power system by standard symbols rather than by their equivalent circuits.

5.What is meant by impedance diagram.

The equivalent circuit of all the components of the power system are drawn and they are interconnected is called impedance diagram.

6.What is meant by reactance diagram.

Omitting all static loads ,all resistance. The magnetizing components of each transformer and the capacitance of the transmission line are reduced from the impedance diagram is called reactance diagram.

7.Define per unit value.

Per unit of any quantity is defined as the ratio of the quantity ti its base value is expressed as a decimal.

8. Need for per unit value

the per unit impedance referred to either side of a single phase transformer is the same.

The chance of confussion b/n line and phase quantities in a three phase balanced system is greatly reduced.

The manufacturers usually produce the impedance values in per unit.

9.Define base current.

Ratio of base MVA to base KV

10.What is the need for short circuit study.

To determine the current interrupting capacity of the circuit breakers so that the faulted equipments can be isolated.

To establish the relay requirements and settings to detect the fault and cause the circuit breaker to operate when the current flowing through it exceeds the max. value.

11. Define stability study.

Stability studies are performed in order to ensure that the system remains stable following a severe fault or disturbance.

12. What are the eliments of y bus matrix.

short circuit driving point adm. Short circuit transfer admittance.

13. What are the eliments if Z bus matrix.

Open circuit driving point impedance, open circuit transfer impedances.

14.What are the methods to determine the Ybus$Z bus matrices.

Primitive n/w, n/w grafh theory , incidence matrix

15.What is primitive n/w

Primitive network is a set of unconnected elements which provides information regardin.

Primitive n/w is a set of unconnected eliments which provides information regaurding the characteristics of individual eliments only.

16.what is meant gy grafh of a n.w.

Agrafh shows the geometrical interconnection of the elements of a n/w.

17. Define sub graph?

Asub graph is any subset of elements of a graph.

18 What is meant by path of a n/w?

Apath is a subgraph of connected elements with not more than two elements connected to any one nide.

19.What is meant by connected oriented graph?

Agraph is connected if and only if there is a path b/n every pairs of nodes.If each element of the connected graph is assigned a direction it is called oriented graph.

20.What are the properties of a graph.

Tree is a sub graph connecting all the nodes of the oriented graph.

Tree is a connected subgraph.

21.Define basic cutest?

Acutset is the minimum set of elements in the graph, which when removed, divide a connected graph inti two connected subgraph.

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22. What are the quantities whose base values are required to represent the power system by reactance diagram.

The base values of voltage, current, pwer and impedance are required to represent the power system by reactance diagram. Selection of base valuesfor any two of them determines the base values of the remaining two.

23.What is the need for base values?

The components of power system may operate at different voltage and power levels. It will be convenient for analysis of power system if the voltage, power, current ratings of the components of the power system is expressed with referance to a common value called base value.

24.What is impedance and reactance diagram?

The impedance diagram is the equivalent circuit of power system in which the various components of power system are represented by their approximate equivalent circuits. The impedance diagram is used for load flow studies.

The reactance diagram is the simplified equivalent circuit of the power system in which the various components are represented by their reactance. The reactance ddiagram can be obtained from impedance diagram if all the resistive components are neglected.

25. What are the approximations made in impedance diagram?

The neutral reactances are neglected.

The shunt branches in equivalent circuit of induction motor are neglected.

26. What are the approximations made in reactance diagram?

The neutral reactances are neglected.

The resistances are neglected.

All static loads and induction motors are neglected.

27. What is a bus?

The meeting point of various components in a power system is called a bus. The bus is a conductor made of copper having negligible resistance. The buses are considered as a points of constant voltage in a system.

28. What is bus admittance matrix?

The matrix consisting of the self and mutual admittances of the network of a power system is called bus admittance matrix.

29. Name the diagonal and off diagonal elements of bus admittance matrix.

The diagonal elements of bus admittance matrix are called self admittances of the buses and off diagonal elements are called mutual admittances of the buses.

30. What is bus imbedance matrix?

The matrix consisting of driving point impedances and transfer impedances of the network of a power system is called bus impedance matrix.

31. Name the diagonal elements and off diagonal elements of bus impedance matrix.

The diagonal elements of bus impedance matrix are called driving point impedances of the buses and off diagonal elements of bus impedance matrix are called transfer impedances of the buses.

32.What are the methods available for forming bus impedance matrix.

1. Form the bus impedance matrix and then take its inverse to get bus impedance matrix.
2. Directly form the bus impedance matrix from the reactance diagram. This method utilizes the techniques of modifications of existing bus impedance matrix due to addition of new bus.

32. Write the four ways of adding an impedance to an existing system so as to modify bus impedance matrix.

1. Adding a branch of impedanceZb from a new bus p to the referance bus.
2. Adding a branch of impedance Zb from a new busp to an existing bus.
3. Adding a branch of impedance Zb from an existing busq to the referance bus.
4. Adding a branch of impedance Zb between two existing buses h and q.

33.What are symmetrical components?

An unbalanced system of N related vectors can be resolved into N systems of balanced vectors. The N sets of balanced vectors are called symmetrical components.

33. Write the symmetrical components of three phase system.

1.positive sequence components

3. negative sequence components.
4. zero sequence components.

34. What are positive sequence components?

The positive sequence components of a three phase unbalanced vectors consists of three vectors of equal magnatude, displased from each other by 120 in phase and having the same phase sequence as the original vectors.

35. What are negative sequence components?

The negative sequence components of a three phase unbalanced vectors consists of three vectors of equal magnitude displaced from each other by 120 degree in phase and having the phase sequence opposite to that of the original vectors.

36.What are zero sequence components?

The zero sequence components of a three phase unbalanced vectors consists of 3 vectors of equal magnitude and with zero phase displacement from each other.

36. What are sequence impedance and sequence networks?

The sequence impedances are the impedances offered by the devices for the like sequrnce component of the current.

The single phase equivalent circuit of a power system consists of impedances to current of any one sequence is called sequence network.

37.What is meant by positive, negative and zero sequence impedance.

The impedance of the circuit element for positive, negative and zero sequence component currents are called positive, negative and zero sequence impedances resp.

38.What is meant by positive, negative and zero sequence reactance.

The reactance diagram of a power system, when formed using positive, negative and zero sequence reactances are called positive, negative and zero sequence reactance diagram resp.

39.What is load flow or power flow study?

The study of various methods of solution to power system network is reffered to as load flow study. The solution provides the voltages at various buses, power flowing in various lines and line losses.

40.What are the information that are obtained from a load flow study.

The information obtained from a load flow study are magnatude and phase of bus voltages,real and reactive power flowing in each line and the line losses. T he load flow solution also gives the initial conditions of the system when the transient behaviour of the system to be studied.

41.What is the need for load flow study.

The load flow study of a power system is essential to decide the best operation existing system and for planning the future expansion of the system. It is also essential for designing the power system.

42. What are the quantities associated with each bus ina system?

Each bus in a power system is associated with four quantities and they are real power, reactive power, magnitude of voltage, and phase angle of voltage.

43. What are the different types of buses.

Load bus,generator bus,slack bus.

44.Define voltage controlled bus?

A bus is called voltage controlled bus if the magnitude of volte\age and real power are specified for it. In a voltage controlled bus the magnitude of the voltage is not allowed to change.

45. What is PQ bus?

A bus is called PQ bus when real and reactive components of power are specified for the bus. In a load bus the voltage is allowed to vary within permissible limits.

46. What is swing bus?

Abus is called swing bus when the magnitude and phase of the bus voltage are specified for it. The swing bus is the referance bus for load flow solution and it is required for accounting line losses. Usually one of the generator bus is selected as swing bus.

47.What is the need for slack bus?

The slack bus is needed to account for transmission line losses. In a power system the total power generated will be equal to sum of power consumed by loads and losses. In a power system only the generated power and load power are specified for buses. The slack bus is assumed to generate the power required for losses. Since the losses are unknown the real and reactive power are not specified for slack bus.

48.What are the operating constraints imposed in the load flow studies?

The operating constraints imposed in load flow studies are reactive power limits for generator buses and allowable change in magnitude of voltagefor load buses.

49What are the iterative methods mainly used for solution of load flow study.

The Guass sedal method and Newton Raphson method are the two iterative methods.

50.Discuss the effect of acceleration factor in load flow study.

The acceleration factor is a real quantity and it modify the magnitude of voltage alone.

51What is meant by flat voltage start.
In iterative methods of load flow solution, the initial voltages of all buses exept slack bus are assumed as 1+j0 pu.This is reffered as flat voltage profile.
52.When the generator buses are treated as load bus.
If the reactive power constraints of a generator bus violates the specified limits then the generator is treated as load bus.
53. What will be the reactive power and bus voltage whan the generator bus is treated as load bus.
When the generator bus is treated as load bus, the reactive power of the bus is equated to the limit it has violated, and the previous iteration value of bus voltage is used for calculating current iteration value.
54. What are the advantages of Guass sedal methoa?
Calculations are simple and so the programming task is lesses.
The memory requirement is less
Useful for small systems
55 What are the disadvantages of Guass seidal method?
Requires large no. of iterations to reach converge
Not suitable for large systems
Convergence time increases with size of the system
56. How approximations is performed in Newton Raphson method?
In N-R method, the set of nonlinear simultaneous equations are approximated to a set of linear simultaneous equations using tailors series expansion and the terms are limited to first order approximation.
57.What is Jacobian matrix? How the elements of Jacobian matrix are computed.
The matrix formed from the first derivatives of load flow equations is called Jacobian matrix.
The elements of Jacobian matrix will change in every itration. In each iteration the elements of the jacobian matrix are obtained by partially differentiating the load flow equations w.r. t a unknown variable and then evaluating the first derivatives using the solution of previous iteration
58.What are the adv. Of N-R method?
The N-R method is faster, more reliable and the results are accurate.
Requires less no. of iterations
Suitable for large size system
59. What are the disadv. Of N-R method?
The programming is more complex
The memory requirement is more
60 What is off nominal turns ratio?
When the voltage or turns ratio of a transformer is not used to decide the ratio of base KV then its voltage ratio is called off nominal turns ratio. Usually the voltage ratio of regulating transformer will be off nominal ratios.
61 What is meant by a fault?
A fault in a circuit is any failure which interferes with the normal flow of current. The faults are associated with abnormal change in current, voltage and frequency of the power systwm. The faults may cause dan\mage to the equipments if it is allowed to persit for a long time. Hence every part of the system has been protected by means of relays and circuir breakers to sence the faults to isolate the faulty part from the healthy part in the event of fault.
62Why fault accurs in a power system?
The fault occur in a power system due to insulation failure of equipments, flashover of lines initiated by a lightning stroke, due to permanent damage to conductors and towers

63. How are faults are classified?
The faults are classified as shunt and series faults. The shunt faults are due to short circuits in conductors and the series faults are due to oped conductors.
64.List the various types of series and shunt fault?
Shunt faults are,
Line to ground fault line to line fault, double line to ground fault, three phase fault.
Series faults are,
One open conductor fault
Two open conductor fault
64 What is symmetrical and unsymmetrical fault?
The fault is called symmetrical fault if the fault current is equal in all the phases. The fault is called unsymmetrical fault if the fault current is not equal in all the phases.
65. Name any two methods of reducing short circuit current/
By providing neutral reactance.
By introducing a large value of shunt reactance between buses.
66. What is meant by fault calculations/
The fault condition of a power system can be dived into subtransient, transient and steady state periods. The currents in the various parts of the system and in the fault are different in these periods. The estimation of these currents for various types of faults at various locations in the system are commenly reffered as fault calculations.
67.Define stability?
The stability of a system is defined as the ability of power system to return to stable operation when it is subjected to a disturbance.
68. Define steady state stability
The stady statenstability is defined as the ability of a system to remain stable for small disturbance.
69. Define transient stability?
The transient stabilitymis defined as the abilitymof a system to remain stable for large disturbance.
70What is steady state state stability limit?
The steady state stability limit is the max. power that can be transferred by a machine toa receving system without loss of synchronism.71 Define swing curve? What is the use of swing curve.
The swing curve is the plot between the power angle and time. It is usually plotted for a transient state to stydy the nature of variation in angle for a sudden large disturbance.
71.Define power angle/
The power angle is defined as the angular displacement of the rotor from synchronously rotating referance frame.
72Define critical clearing time and critiacal clearing angle
The critical clearing angle is the max. allowable change in the power angle before clearing the fault, without loss of synchronism.
The critical clearing time can be defined as thw max. time delay that can be allowed to clear a fault without loss of synchronism.
73.Define equal area criterion?
The equal area criterion for stability states that the system is stable if the area under pvs angle curve reduces to zero at some value of angle.
74.What is transient state stability limit?
The transient state stability limit is the max. power that can be transmitted by a machine to a receiving system without loss of synchronism.In steady state the power transferred by synchronous machine is always less than the steady state stability limit.

75.what is transient stability limit ?

The transient stability limit is the max power that can be transmitted by a machine to a fault or a receiving system during a transient state without loss of synchronism.The transient stability limit is always less than the steady state stability limit.

16 Mark questions

1.Explain the methods adopted in utilities for planning the operation of power system.

2Give some general aspects relating to power flow , short circuit and stability studies

3A 100 mva, 33kv three phase generator has a subtransient reactance of 15%. The generator is connected to 3 motors through a transmission line and 2 transformers. The motors have rated inputs of 30 mva,20mva,anm50mva at 30kv with 20%subtransient reactance. The three phase transformer are ratted at 110mva,32kv/110kv with leakage reactance8%.Selecting the generator rating as the base quantities in the generator circuit,determine the base quantities in other partsof the system and evaluate the corresponding p.u values.

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

5.Explain the modellingof generator,transformer,transmission line,load,shunt capscitor,and shunt reactor for sc ,power flow and stability studies.

6Asynchronous generator and asynchoronous motor each rated 25 MVA, 11KV HAVING 15% SUBTRASIENT REACTANCE ARE CONNECTED through transformers and a line as shown in fig. THE TRANSFORMERS are rated 25 MVA, 11/66 KV WITH LEAKAGE REACTANCE OF 10% EACH. The line has a reactance of 10% ona base of 25 MVA,66