gradeup

gradeup SUPER

Rajasthan RVUNL

Electrical Engineering

Power System

Top 100 Most Expected Questions

1. Reactive power compensation is applied at the mid-point of transmission line such that voltage at both ends is maintained at 1 p.u. Voltage at mid-point is maintained at 0.96 p.u. If total reactance of the line is 0.2 p.u., then the steady state power transfer limit of the transmission line is

A. 9.6 p.u.　　B. 4.8 p.u.

C. 19.2 p.u.　　D. 2.4 p.u.

Ans. A

Sol.: $P = \frac{V_s V_m}{X/2}$

$V_s \rightarrow$ Sending end voltage

$V_m \rightarrow$ mid-point voltage

$X \rightarrow$ reactance of line $= \frac{1 \times 0.96}{0.2/2}$ = 9.6 p.u.

2. In case of high voltage overhead transmission lines mainly bundled conductors are used because it ?

A. reduce sag

B. reduce corona

C. increase mechanical strength of the line

D. reduce transmission line losses

Ans. B

Sol.: At EHV, corona loss is significant using bundled conductors , GMR increases there by corona starting voltage increases. Hence there is less corona formation and hence less corona loss.

3. AC resistance is more than dc resistance due to which of the following effect.

i. skin effect　　ii. proximity effect

iii. ferrant effect

A. (i) and (ii) only　　B. (i) only

C. (ii) only　　D. (i), (ii) and (iii)

Ans. A

Sol.: AC resistance is more than dc resistance due to the following effects-

1. Skin effect

2. Proximity effect

4.Consider two synchronous generators defined by

P_1 = 100(50 – f) in MW

P_2 = 50(51 – f) in MW

Where, f is _______Hz if total load is 500 MW. (Consider system to be lossless)

A. 46　　B. 47

C. 48　　D. 50

Ans. B

Sol.: $P_1 + P_2 = 500$ MW

100(5 – f) + 50(51 – f) = 500

7550 – 500 = 150f

150f = 7050

f = 47 Hz

5. When a voltage-controlled bus is operating at the maximum limit of reactive power. Then what is the type of that bus?

A. PV Bus

B. PQ Bus

C. Slack Bus

D. None of the above

Ans. B

Sol.: At voltage-controlled Bus, voltage is fixed by varying the reactive power.

When it is operating at its maximum limit, that means the reactive power is fixed.

Hence, it will become PQ Bus.

6. What is the form of the Y_{bus} matrix for carrying out load flow studies by Gauss-Seodal method of a power system having mesh connection of nodes?

A. Symmetric but not diagonal matrix

B. Diagonal matrix

C. Antisymmetric matrix

D. Sparse asymmetric matrix

Ans. A

Sol.: Y_{BUS} is always symmetric matrix.

7. Consider a Y-Y system having load of $Z\angle\theta$. The maximum line to line voltage is 294 V, whereas power factor is 0.6 leading. If total power absorbed by the load is 500W, the |Z| will be-

A. 41.96 Ω

B. 51.96 Ω

C. 14.96 Ω

D. 15.96 Ω

Ans. B

Sol.: ⇒ In balanced system (if not mentioned consider system to be balanced)

P = Active power

$$P = \sqrt{3} VI \cos\phi$$

$$500 = \sqrt{3}\left[\frac{294}{\sqrt{2}}\right] \times I_L \times 0.6$$

$I_L = 2.31 \angle\cos^{-1}(0.6)$ A

So,

$$|Z| = \frac{V_{ph}}{I_{rms}} = \frac{207.89/\sqrt{3}}{2.31} = 51.96\ \Omega$$

8. The line currents of a 3-phase power supply are:

$I_R = 3+j5A$

$I_Y = 2+j2A$

$I_B = -2-j1A$

The zero sequence current will be

A. 1 + j2A B. 5 + j7A

C. 1 + j4A D. -2 - j1A

Ans. A

Sol.: Zero sequence current = $\frac{1}{3}\left[I_R + I_Y + I_B\right]$

Hence, option (a) is correct.

9. Which one of the following fuels is used by fast thermal nuclear reactor for power generation –

A. U^{235} B. U^{238}

C. Th^{232} D. Pu^{239}

Ans. C

Sol.: Fast thermal reactor uses Th^{232}

Whereas medium thermal reactor uses U^{238} and slow thermal reactor uses Pu^{239}

10. The method adopted for improving the steady-state stability of power system are

1) Quick response excitation system

2) Higher excitation voltages

3) Maximum power transfer by use of series capacitor or reactor

A. 1 and 2 only B. 1 and 3 only

C. 2 and 3 only D. 1, 2 and 3

Ans. C

Sol.: The methods for improving the steady-state stability of power systems are as follows:

• Higher excitation voltages

• Maximum power transfer by use of a series capacitor or reactor

The quick response excitation system is used for improving transient state stability.

11. A polyphase synchronous machine excited with DC exciter is known as –

A. Alternator B. Three phase induction machine

C. Single phase induction motor D. DC Machine

Ans. A

Sol.: An alternator is a polyphase synchronous machine and it is excited with DC exciter. Also called as doubly excited machine.

12. A 3-phase generator with a phase emf of 1.0 p.u. and with positive, negative and zero sequence reactance's of 0.2 p.u., 0.15 p.u., respectively. It has a grounding reactance of 0.05 p.u. If a single line to ground fault occur at the terminal of generator, then fault current is:

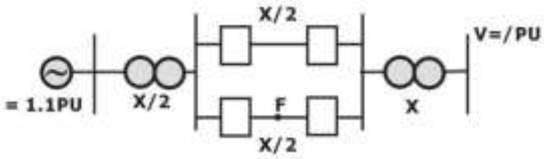
A. 4.28 p.u.
B. 5 p.u.
C. 5.45 p.u.
D. 3 p.u.

Ans. A

Sol.: For a single line to ground fault

$$I_f = \frac{3E}{z_1 + z_2 + z_3 + 3z_n} = \frac{3\times 1}{0.2 + 0.2 + 0.15 + (0.05)\times 3} = \frac{3}{0.7} = 4.28\text{p.u.}$$

13. In the transmission network shown, the steady state transmission limit is 10 p.u. If a small fault occurs and respective C.B opens, then new steady state transmission limit is



A. 8 p.u.
B. 8.75 p.u.
C. 7.5 p.u.
D. 8.25 p.u.

Ans. B

Sol.: Steady state limit = $\frac{EV}{X_{+r}}$

$$10 = \frac{1.1\times 1}{\frac{x}{2} + \frac{x}{4} + x}$$

$$10 = \frac{1.1\times 4}{7x} \Rightarrow x = \frac{4.4}{70}\text{Pu}$$

Now one transmission line opens due to fault.

$X_{tr} = 2X$

New limit, $P_{max} = \frac{EV}{2x} = \frac{1.1\times 1}{2\times \frac{4.4}{70}} = 8.75\text{p.u.}$

14. Which of the following statements is/are correct?

1) In radial system, separate feeders radiate from a single substation and feed the distributors at one end only
2) In ring main system, the arrangement is similar to two feeders in parallel on different routes.

A. 1 only
B. 2 only
C. Both 1 and 2
D. Neither 1 nor 2

Ans. C

Sol.: Both the statements are correct regarding ring main and distribution system.

Hence, option C is correct.

15. A 3-φ, 400 KV transmission line has Z_S = 400 Ω. If the line is compensated with series capacitor and shunt reactor of 30% and 20% respectively, then the new values of surge impedance and surge impedance loading are:

A. 324.62 ohm & 327.23 MW
B. 374.15 ohm & 427.61 MW
C. 315.28 ohm & 627.32 MW
D. 374.15 ohm & 528.37 MW

Ans. B

Sol.: ∴ Line voltage V = 400 KV

Initial Z_S = 400 Ω

So now surge impedance

$$Z_{NS} = Z_S\sqrt{\left(\frac{1-k_{se}}{1-k_{sh}}\right)}$$

where k_{se} → compensation factor of series capacitor = 0.30

k_{sh} → Compensation factor of shunt reached = 0.20

$$\text{So, } Z_{NS} = 400\sqrt{\left(\frac{1-0.3}{1-0.2}\right)} = 374.1657\Omega$$

$$\text{Now, new surge impedance loading } = \frac{V^2}{Z_{NS}} = \frac{(400kV)^2}{374.1657} = 427.61MW$$

16. A 3-φ transmission line is supported by a 3-unit suspension insulator string. The voltage across the unit nearest to the line is 20 kV and that across the adjacent unit is 15 kV. Find the string efficiency?

A. 68.3%
B. 79.5%
C. 83.8%
D. 62.7%

Ans. B

Sol.: No. of units = 3

Voltage across the second unit = 15 kV

Voltage across the third unit = 20 kV

Let assume voltage across the first unit is = V_1

Then V_2 = 15 kV V_3 = 20 kV

$V_3 = (m^2 + 3m + 1) V_1$

$V_2 = (1 + m) V_1$

$$\frac{V_3}{V_2} = \frac{(m^2+3m+1)V_1}{(1+m)V_1}$$

$$\frac{20}{15} = \frac{(m^3 + 3m + 1)V_1}{(m+1)}$$

20m + 20 = 15m² + 45m + 15

$15m^2 + 25m - 5 = 0$

On solving, we get,

m = 0.18

So, $V_2 = (1 + m) V_1$

$$\frac{15}{1+0.18} = V_1$$

V_1 = 12.71 kV

So, voltage across the string

$V = V_1 + V_2 + V_3$

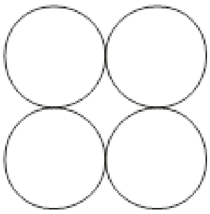
V = 12.71 + 15 + 20 = 47.71 kV

So, the string efficiency is

$$\%\eta = \frac{\text{voltage across the string}}{3 \times \text{voltage across the nearest unit of conductor}} \times 100$$

$$\%\eta = \frac{47.71}{3 \times 20} \times 100 = 79.51\%$$

17. A four solid conductors of equal radius is made from a solid conductor of 8 cm radius without changing net current rating. The four solid conductors are used to form a stranded conductor as follows



GMR (in cm) of stranded conductor is

A. 3.44

B. 6.88

C. 8

D. 10

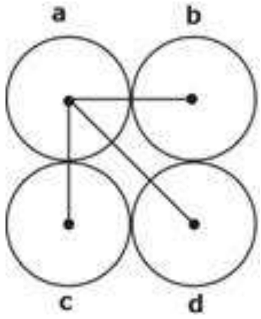
Ans. B

Sol.: Each stand radius,

$$r_1 = \frac{r}{\sqrt{n}}$$

r = 8cm, n = 4

$$\therefore r_1 = \frac{8}{\sqrt{4}} = 4 \text{ cm}$$



$D_{ab} = 2r_1$, $D_{ac} = 2r_1$

$D_{ad} = \sqrt{(2r_1)^2 + (2r_1)^2} = 2\sqrt{2}r_1$

$GMR = \sqrt[4]{0.7788r_1 \times 2r_1 \times 2r_1 \times 2\sqrt{2r_1}} = 1.722\, r_1 = 1.722 \times 4 = 6.88$ cm

18. A 3-Φ Transmission line has A = D = 0.85 ∠0° and B = 170∠90° Ω. Both sending and receiving end voltages are maintained at 220 kV and power flow is 150 MV. What will be the P.F. of the load _?

A. 0.99 lag
B. 0.5 lag
C. 0.99 lead
D. 0.5 lead

Ans. C

Sol.: $\Rightarrow P_r = \frac{|V_s||V_r|}{|B|}\sin\delta$

$\Rightarrow \sin\delta = \frac{150 \times 170}{220 \times 220} = 0.5269$

δ = 31.79°

$Q_r = \frac{|V_s||V_r|}{|B|}\cos\delta - \frac{|A|}{|B|}|V_r|^2 = \frac{220 \times 220}{170}\cos(31.79^\circ) - \frac{0.93}{170}(220)^2$

= 284.705 × 0.85 – 246.77 = – 4.77 MVAR

$\cos\phi_1 = \frac{P_r}{Pr^2 + Qr^2} = \frac{150}{\sqrt{(150)^2 + (4.77)^2}} = 0.999$ lead

19. A generator is delivering 60 % 0f the capacity to the load through a tranmssion line the power received by the load is 50 % of generator capacity . the incremental tramission loss of the plant ?

A. 5/6
B. 1/3
C. 1/6
D. 2/3

Ans. C

Sol.: $P_D = 0.5\, P_{max}$

Generated power $P_G = 0.6\, P_{MAX}$

Power loss $P_L = P_G - P_D = 0.6 - 0.5 = 0.1\, P_{max}$

Incremental total loss = $P_L / P_G = (0.1P_{MAX})/(0.6\, P_{MAX}) = 1/6$

20. Fault in a power system is a

A. high frequency and highly leading phenomenon

B. high frequency and highly lagging phenomenon

C. low frequency and highly leading phenomenon

D. low frequency and highly lagging phenomenon

Ans. B

Sol.: In fault analysis, transmission lines are represented by series reactance only. Synchronous machines are represented by induced e.m.f in series with reactance. Since, fault current is limited by reactance only, fault current becomes highly lagging.

The electrical load of the machine reduces during a fault whereas the prime mover input remains same. The speed of machine increases during fault which increase the system frequency.

21. In Equal area criterion for the determination of transient stability of the synchronous machine connected to an infinite bus, which of the following is the correct statement?

A. Ignores line as well as synchronous machine resistances and shunt capacitances.

B. Assume accelerating power acting on the rotor as constant

C. Ignores the effect of voltage regulator and governor but consider the inherent damping present in the machine.

D. Takes into consideration the possibility of machine losing synchronism after it has survived during the first swing.

Ans. A

Sol.: Some of the assumptions in equal area criterion :

1) ignores line as well as synchronous machine resistance and shunt capacitances.

2) Damping term contributed by synchronous machine damper winding is ignored.

3) Rotor speed is assumed constant.

4) Voltage behind transient reactance is assumed to be constant.

Hence option A is correct.

22. Which of the following HVDC link has more than one conductor and the polarity of all the conductors is similar.

A. Monopolar link

B. Bipolar link

C. Homopolar link

D. None of the above

Ans. C

Sol.: Monopolar link has only one conductor

Bipolar link has two conductors of opposite polarity.

Homopolar link has two or more conductors with same polarity.

23. Which of the following elements together form the series impedance of the transmission line?

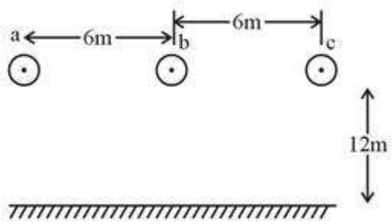
A. Resistance and Inductance
B. Inductance and Capacitance
C. Resistance and Capacitance
D. Capacitance and Conductance

Ans. A

Sol.: The performance of a transmission line is affected by four parameters, namely, resistance, inductance, capacitance, and conductance.

The series line parameters, Resistance and Inductance, are uniformly distributed along the line, and hence, they together form the series impedance of the transmission line. Capacitance and Conductance, forms the shunt admittance of the transmission line.

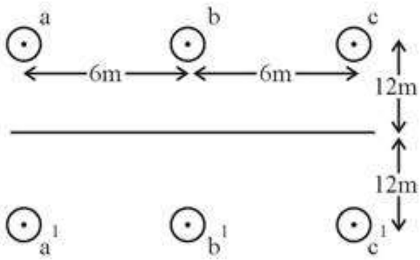
24. Find the capacitance per km (per phase) to neutral of 3 – φ line as shown in fig by taking effect of earth. The line is completely transposed and the diameter of each conductor is 3 cm



A. 9.01×10^{-9} F/km
B. 9.01×10^{-12} F/km
C. 9.01×10^{-6} F/km
D. 4.51×10^{-9} F/km

Ans. A

Sol.: When the effect of earth is taken, the mirror image is drawn



$h_{aa^1} = h_{bb^1} = h_{cc^1} = 12 + 12 = 24$ m

$h_{ab^1} = h_{bc^1} = \sqrt{(24)^2 + (6)^2} = 24.739$ m

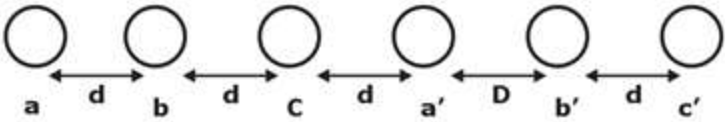
$h_{ca^1} = h_{ac^1} = \sqrt{(24)^2 + (12)^2} = 26.83$ m

To calculate capacitance per phase to neutral, apply the relation

$$C_n = \frac{2\pi\varepsilon}{\ln\frac{Dm}{r} - \ln\sqrt[3]{\frac{h_{ab^1}h_{bc}{}_{ca^1}h_{ca}}{\sqrt{h_{aa^1}h_{bb^1}h_{cc^1}}}}} \text{ f/m} \quad = \frac{10^{-6}}{\left[\ln\left(\frac{7.560}{0.015}\right) - \ln\frac{\sqrt[3]{(24.739)^2 \times 26.833}}{\sqrt[3]{24 \times 24 \times 24}}\right]} \text{ F/km} = 9.01$$

$\times 10^{-9}$ F/km

25. A transmission line of 180 km length of a double circuit, 3-φ line 50 Hz with transposition is shown in figure below:



The distance between each conductor is d = 5 m and radius of each conductor is 1.5 cm. Calculate the reactance of the line.

A. 36.42 Ω

B. 40.56 Ω

C. 38.74 Ω

D. 28.72 Ω

Ans. A

Sol.: Self $(GMD)_a = \left[0.7788 \times r \times d_{aa}\right]^{-1}\frac{1}{2}$

Self $(GMD)_a = \left[0.7788 \times 1.5 \times 10^{-2} \times 15\right]^{-\frac{1}{2}}$ = 0.418m

Self $(GMD)_b = \left[0.7788 \times r \times d_{bb'}\right]^{-\frac{1}{2}} = \left[0.7788 \times 1.5 \times 10^{-2} \times 15\right]^{-\frac{1}{2}}$ = 0.418m

Self $(GMD)_c = \left[0.7788 \times r \times d_{cc'}\right]^{-1}\frac{1}{2} = \left[0.7788 \times 1.5 \times 10^{-2} \times 15\right]$ = 0.418m

Self GMD = [Self $(GMD)_a$ × Self $(GMD)_b$ × Self $(GMD)_c]^3$

Self GMD = $[0.418 \times 0.418 \times 0.418]^{\frac{1}{3}}$

Self GMD = 0.418 m

Mutual (GMD) = $\left[D_{ab} \times D_{bc} \times D_{ac}\right]^{\frac{1}{3}}$

$(D_{ab}) = \left[d_{ab} \times d_{ab'} \times d_{a'b} \times d_{a'b'}\right]^{\frac{1}{4}} = [5 \times 20 \times 10 \times 5]^{-\frac{1}{4}}$ = 8.408m

$(D_{bc}) = 3\left[d_{bc} \times d_{bc} \times d_{b_c} \times d_{b'c}\right]^{-\frac{1}{4}} = [5 \times 20 \times 10 \times 5]^{-\frac{1}{4}}$ = 8.408 m

$(D_{ca}) = 3\left[d_{ca} \times d_{ca'} \times d_{c'a} \times d_{c'a'}\right]^{-\frac{1}{4}} = [10 \times 5 \times 25 \times 10]^{-\frac{1}{4}}$ = 10.57 m

Mutual GMD = $[8.408 \times 8.40 \times 10.57]^{-\frac{1}{3}}$ = 9.07m

$L = 0.2 \ln\frac{(GMD)}{(GMR)}$ mH/km $= 0.2 \ln\left[\frac{9.07}{0.418}\right]$ = 0.646 mH/km.

Total inductance $L = \frac{180 \times 0.646}{1000}$ = 0.116 H

Reactance of line $X_L = 2\pi fL$

$X_L = 2 \times 3.14 \times 50 \times 0.116 = 36.42\ \Omega$

26. Which type of turbine is preferred for high water head?

A. Francis B. Kaplan

C. Pelton D. propeller

Ans. C

Sol.: Francis is preferred for very high head

Kaplan is preferred for low head

Pelton is preferred for high head

Propeller is preferred for medium head

27. Which of these following transmission lines the Ferranti effect will not occur?

A. Long transmission line B. Medium transmission line

C. Short transmission line D. None of the above

Ans. C

Sol.: When a long transmission line is operatedunder no load or light load condition, the receiving end voltage is greater than sending end voltage. This effect is called Ferranti effect. In short transmission lines, the capacitance effect is not considered. Hence, we can say that Ferranti effect will not occur in short transmission lines.

28. A polyphase synchronous machine excited with DC exciter is known as –

A. Alternator B. Three phase induction machine

C. Single phase induction motor D. DC Machine

Ans. A

Sol.: An alternator is a polyphase synchronous machine and it is excited with DC exciter. Also called as doubly excited machine.

29. The concept of an electrically short, medium and long line is primarily based on the

A. nominal voltage of the line

B. physical length of the line

C. wavelength of the line

D. power transmitted over the line

Ans. B

Sol.: Option B. is correct.

With the help of physical length of line, we can recognize line as short, medium and long line.

30. In guass-sidel method for load flow Analysis, what is the use of acceleration factor?

A. To improve the accuracy of convergence B. To speed up to convergence

C. To change the order of convergence D. All the above

Ans. B

Sol.: Acceleration factor is used in guass-sidel method to speed up the convergence.

31. An alternator having an induced e.m.f. of 1.6 p.u. is connected to an infinite bus of 1.0 p,u. if the bus bar has reactance of 0.6 p.u. and alternator has reactance of 0.2 p.u., what is the maximum power that can be transferred?

A. 2 p.u
B. 2.67 p.u
C. 5 p.u
D. 6 p.u

Ans. A

Sol.: $P_{max} = \frac{E_f V_t}{X} = \frac{1.6 \times 1}{(0.6 + 0.2)} = 2\text{p.u.}$

32. An overhead line having the surge impedance of 400 Ω is connected to a short length of cable of surge impedance of 50 Ω. A travelling wave of constant magnitude of 80 kV and infinite duration originates in the overhead line and travels towards the junction with cable. Find the energy transmitted for a duration of 3 μ*sec* into the cable after the wave has arrived at junctions.

A. 13.32 Joules
B. 15.94 Joules
C. 18.92 Joules
D. 24.86 Joules

Ans. C

Sol.: The transmitted voltage is given by

$$V_t = \left(\frac{2Z_{cable}}{Z_c + Z_{cable}}\right) \times V$$

$$V_t = \frac{2 \times 50}{400 + 50} \times 80KV = 17.77kV$$

Current transmitted into the cable is $J_t = \frac{V_t}{Z_{cable}} = \frac{17.77 \times 10^3}{50} = 0.355KA$

The energy transmitted for a duration of 3 μ*sec*

E = P × t

E = P = VI

$E = 17.77\times10^3\times0.355\times10^3\times3\times10^{-6}$

E=18.92 J

33. Stability of power system can be improved by

1) Using series compensators
2) Using parallel transmission lines
3) Reducing voltage of transmission

Which of the above statements are correct?

A. 1 only
B. 2 only
C. 2 and 3 only
D. 1 and 2

Ans. D

Sol.: Stability of a power system can be improved by

1) higher system voltage

2) use of parallel lines to reduce the series reactance.

3) Use of high speed circuit breakers and auto-reclosing breakers.

4) Reducing the series reactance there by increasing Pm and therefore increases the transient stability limit of a system.

34. Consider the following statements:

1. The positive and negative sequence components of voltage in a balanced 3-phase system are zero and only zero sequence component is present.

2. The zero sequence current flows only where neutral return path is available.

3. For a line to line fault, the sequence networks are connected in series.

Which of the following statements is/are correct?

A. 1 and 3 only

B. 2 and 3 only

C. 1 and 2 only

D. 2 only

Ans. D

Sol.: In a balanced three phase system, only positive sequence components exist, hence statement 1 is false. For a line to line fault, the sequence network is connected in series opposition, hence statement 3 is also false.

35. In 11 kV, 50 Hz system, the value of reactance and capacitance up to the location of circuit breaker is 6 Ω and 0.05 μF respectively. The value of resistance which will give damped frequency of oscillation, which is half of the natural frequency of oscillation will be ___________?

A. 3.4 kΩ

B. 10.5 kΩ

C. 6.8 kΩ

D. 2.8 kΩ

Ans. D

Sol.: $X_L = 2\pi fL$

$$L = \frac{6}{314} = 0.0191H$$

$$f_n = \frac{1}{2\pi\sqrt{LC}}$$

$$f_n = \frac{1}{2\pi\sqrt{0.0191 \times 0.05 \times 10^{-6}}}$$

F_n = 5.15 kHz

Required damped frequency of oscillation,

$$\frac{f_n}{2} = 2.575kHz$$

Damped frequency of oscillation,

$$f = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{1}{4R^2C^2}}$$

$$2.575 \times 10^3 = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{1}{4R^2C^2}}$$

$$R^2 = 7.85 \times 10^6$$

R = 2.8 kΩ

36. If the inertia constant H= 8 MJ/MVA for a 50 MVA generator, the stored energy is

A. 50 MJ B. 8 MJ

C. 400 MJ D. 6.25 MJ

Ans. C

Sol.: Stored energy = GH = 50 × 8 = 400 MJ.

37. A 500 MW, 21 k V, 50 Hz , 3 – phase 2 pole synchronous generator having unity power factor has a moment of inertia of 20× 10^3 kg – m^2. calculate inertia constant in MJ/MVA –

A. 1 B. 5.44

C. 1.97 D. 4.88

Ans. C

Sol.: J = moment of inertia = 1000 kg – m^2

$N_s = \frac{120 \times f}{P} = \frac{120 \times 50}{2}$ = 3000 rpm

$\omega_s = \frac{2\pi Ns}{60} = \frac{2 \times 3.14 \times 3000}{60}$ = 314

Kinetic energy of rotor = ½ Jω_s^2 = ½ ×20× 1000× $(314)^2$ = 10000× 98596 = 985.96MJ

S: rating of machine

S = 500 MVA

Inertia constant (H) = $\frac{\text{Kinetic energy}}{s} = \frac{985.96}{500}$ = 1.97 MJ/MVA

38. For 275 kV transmission line, voltage profile at sending as well as receiving end voltage profile is maintained at 275 kV. The value of power at unity power factor that can be received for such voltage profile is _________MW. Take: A = 0.85∠5° and B = 200∠75° Ω.

A. 112.6 B. 115.6

C. 117.6 D. None of the above

Ans. C

Sol.: Given $|V_s| = |V_R|$ = 275 kV

α = 5°

β = 75°

Since the power is received of unity pf, therefore, $Q_R = 0$,

$$Q_R = \frac{|V_S||V_R|}{|B|}\sin(\beta-\delta) - \frac{|A||V_R|^2}{|B|}\sin(\beta-\alpha)$$

$$0 = \frac{275\times275}{200}\sin\left(75^\circ-\delta\right) - \frac{0.85}{200}\times(275)^2\sin\left(75^\circ-5^\circ\right)$$

387sin(75° – δ) = 302

δ = 22°

$$P_R = \frac{|V_s||V_R|}{|B|}\cos(\beta-\delta) - \frac{|A||V_R|^2}{|B|}\cos(\beta-\alpha)$$

$$= \frac{275\times275}{200}\cos\left(75^\circ-22^\circ\right) - \frac{0.85\times275^2}{200}\cos 70^\circ = 117.63 \text{ MW}$$

39. For a good voltage profile under no load condition, a long transmission line required?

A. Shunt capacitors at receiving end
B. Shunt reactors at receiving end
C. Series capacitor in line
D. None of the above

Ans. B

Sol.: Under no load condition for a long line, receiving end voltage becomes higher sending side voltage. This effect is called as Ferranti effect.

To reduce this effect, shunt reactors is connected across the load.

40. An 80-bus power system has 10 generator buses. For the load flow analysis, using N-R method the size of Jacobian is

A. 150 × 150
B. 151 × 151
C. 149 × 149
D. 169 × 169

Ans. C

Sol.: Total buses, n = 80

Total generator bus, m = 10 (out of which one is slack bus)

Size of Jacobian = (2n – m – 1) x (2n – m – 1) = (2 × 80) – 10 – 1 = 149 x 149

41. Power plant having maximum demand more than the installed rated capacity will have utilization factor

A. Equal to unity
B. Less than unity
C. More than unity
D. None

Ans. C

Sol.: Utilization factor = (Maximum load) / (Rated Plant capacity)

According to question, Maximum load > Rated plant capacity

Therefore, Utilization factor will be more than unity.

42. An unloaded generator with a pre-fault voltage of 1 p.u. has following sequence impedances: Z_0 = j0.08 p.u., Z_1 = Z_2 = j0.30 p.u. The neutral is grounded with a reactance of 0.04 p.u. If a line to ground fault occurs at the terminal of the generator, then the fault current is

A. 1.25 p.u.

B. 4.4 p.u.

C. 1.38 p.u.

D. 3.75 p.u.

Ans. D

Sol.: $I_f = I_a = \dfrac{3E_a}{Z_1 + Z_2 + Z_0 + 3Z_n} = \dfrac{3 \times 1}{0.30 + 0.30 + 0.08 + (3 \times 0.04)} = 3.75\text{p.u}$

43. The capacitance measured between any two cores of a three-phase belted cable is 0.2 μF/km. The charging kVAr taken by a 10 km length of this cable when connected to a 11 kV, 50 Hz supply system is

A. 263.01 kVAr

B. 151.849 kVAr

C. 345.13 kVAr

D. 198.06 kVAr

Ans. B

Sol.: Let C_3 be the measured capacitance between any two cores. We know that $C_3 = \dfrac{C_n}{2}$

Where C_n = capacitance of each conductor to neutral

$C_n = 2C_3 = 2 \times 0.2 \times 10 = 4$ μF (for 10 km)

Total charging KVA\ph = $\sqrt{3}\, V_L\, I_{Cph} \times 10^{-3}$

$I_{CPh} = V_{pw}C_n = \dfrac{11 \times 10^3}{\sqrt{3}} \times 2\pi \times 50 \times 4 \times 10^{-6} = 7.97A$

Total charging KVA\ph = $\sqrt{3}$ x 11000 x 7.97 × 10^{-3} = 151.849 kVar

44. A power is transmitted through HVDC line of resistance of 10 Ω. If sending end voltage is 240V and receiving end voltage is 200 V. Then the power transmission will be:

A. 800 W

B. 960 W

C. 160 W

D. 0 W

Ans. B

Sol.: Transmitted power = $V_s I_{dc}$

$I_{ds} = \dfrac{V_s - V_R}{R} = \dfrac{240 - 200}{10} = 4A$

Power transmitted = 240 × 4 = 960 W

45. A 3-φ, 50 Hz, synchronous generator has rating 150 MVA . The kinetic energy of the machine at synchronous speed is 600 MJ. The machine is running steadily at synchronous speed and delivering 40 MW power at power angle of 15 electrical degrees. If load is suddenly removed, assuming the acceleration is constant for 8 cycles, the value of power angle after 5 cycle is _______ electrical degrees.

A. 16.32°

B. 18°

C. 15.62°

D. 17.34°

Ans. B

Sol.: P_e = 40 MW

K.E. = 600 MJ

$$H = \frac{\text{stored K.E.}}{\text{VA ratings of alternator}}$$

$$H = \frac{600}{150} = 4$$

$$M = \frac{GH}{\pi f} = \frac{150 \times 4}{180 \times 50} = 0.066$$

δ_o = 15°

Time period for 5 cycle is

$$t = \frac{5}{50} = 0.1\text{sec}$$

According of the swing equation,

$$\frac{d^2\delta}{dt^2} = \frac{P_a}{M}$$

Where, P_a = accelerating power, P_a = 40 MW

Now, Integrating twice,

$$\delta = \left(\frac{P_a}{M}\right)\left(\frac{t^2}{2}\right) + \delta_0$$

$$\delta = \frac{40}{0.066}\left(\frac{(0.1)}{2}\right)^2 + 15^\circ$$

δ = 18°

46. Let Jodhpur generating station is delivering 200MW at 50Hz to Jaipur & Udaipur drawing 50MW & 150MW respectively ,rating of the generator is 200MVA & H=8MJ/MVA .If Jaipur line is tripped due to heavy rain , find the steady state frequency(in Hz) of the generator if the governing system has a time delay of 0.5 sec?

A. 50.78

B. 49.78

C. 51.78

D. 52.78

Ans. A

Sol.: $\Delta P_d = 50MW$

$T_d = 0.5s$

$H \times S = 200 \times 8 = 1600$ MJ

$$\frac{f_n}{f_i} = \sqrt{\frac{(H \times S + \Delta P_d \times T_d)}{H \times S}}$$

where f_n is new frequency in Hz and f_i is initial frequency in Hz.

$$\frac{f_n}{50} = \sqrt{\frac{(200 \times 8 + 50 \times 0.5)}{200 \times 8}}$$

$f_n = 50.78$ Hz

47. The Y-Bus matrix of a 4-bus system in per unit is given below,

$$Y_{Bus} = j\begin{bmatrix} -5 & 2.5 & 2.5 & 0 \\ 2.5 & -11 & 2.5 & 6 \\ 2.5 & 2.5 & -10 & 4 \\ 0 & 6 & 4 & -12 \end{bmatrix}$$, the buses having shunt element are

A. 1 & 2

B. 3 & 4

C. 1 & 3

D. 2 & 4

Ans. B

Sol.: The sum of elements of a row are non-zero for a bus having shunt element.

For bus 1, S_1 = -5 + 2.5 + 2.5 + 0 = 0 ; no shunt element

For bus 2, S_2 = 2.5 + -11 + 2.5 + 6 = 0 ; no shunt element

For bus 3, S_3 = 2.5 + 2.5 - 10 + 4 = -1 ; shunt element

For bus 4, S_4 = 0 + 6 + 4 - 12 = -2 ; shunt element

48. Which of the following power plant has high initial cost, low running cost and high maintenance cost?

A. Thermal power plant

B. Diesel power plant

C. Hydroelectric plant

D. Nuclear power plant

Ans. D

Sol.: The initial cost of a nuclear power plant is high as a huge investment is required to build a nuclear reactor. The running cost is low as a very small amount can produce a large amount of power. It has a very high maintenance cost as very skilled personnel are required to operate and maintain a nuclear power plant.

49. A turbo alternator of 120 MVA has an inertia constant of 4. The value of inertia constant for an alternator of 30 MVA is

A. 8

B. 1

C. 16

D. 2

Ans. C

Sol.: $\text{Inertia constant}, H = \dfrac{\text{k.E. stored in rotor}}{\text{Rating (in MVA)}}$

or $H \propto \dfrac{1}{\text{Rating of machine}}$

$\dfrac{H_2}{H_1} = \dfrac{120}{30}$

$H_2 = 16$

50. Consider the following advantages with respect of HVDC transmission:

1) Long distance transmission

2) Low cost of transmission

3) Higher efficiency

Which of the above advantages are correct?

A. 1 and 2 only

B. 1 and 3 only

C. 2 and 3 only

D. 1, 2 and 3

Ans. D

Sol.: **Advantages of HVDC systems:**

i. Economical for long distance bulk power transmission by overhead lines.

ii. Greater power per conductor and simpler line construction.

iii. No skin effect.

iv. No reactive compensation is required.

v. Higher operating voltage is possible.

vi. No stability problem.

Disadvantages of HVDC systems:

i. Installation of converters and switch gear makes it expensive.

ii. Harmonic are generated which require filters.

iii. Voltage transformation is not easy.

51. What is the effect of rain and storms on the corona loss?

A. Increases

B. Decreases

C. No effect

D. Couldn't be determined

Ans. A

Sol.: In bad weather conditions like rains and storms, the number of ions in air increases, which reduces the critical disruptive voltage and the corona appears at a low voltage. Hence, the corona loss increases.

52. In case of single line to ground fault

A. all sequence networks are connected in parallel.

B. all sequence networks are connected in series

C. positive and negative sequence networks are connected in parallel

D. zero and negative sequence networks are connected in series.

Ans. B

Sol.: In case of single line to ground foult

Fault current, $I_t = \dfrac{3E}{Z_1 + Z_2 + Z_0 + 3Z_f}$

∴ the positive and zero sequence networks are to be connected in series for the solution of currents under fault conditions.

53. The additional cost per hour to increase the output of plant 1 and plant 2 by 1MW are respectively.

A. 15 Rs/MWhr,15 Rs/MWhr

B. 9.65 Rs/MWhr,5.23 Rs/MWhr

C. 13.3 Rs/MWhr,4.2 Rs/MWhr

D. 10.32 Rs/MWhr,4.65 Rs/MWhr

Ans. D

Sol.: $P_L = B_{11}P_1^2 + 2B_{12}P_1P_2 + B_{22}P_2^2$

$\dfrac{dP_L}{dP_1} = 2P_1B_{11} + 2B_{12}P_2$ =2(150)(0.12 × 10^{-2}) + 2(– 0.01 × 10^{-2}) (240) = 0.312

$\dfrac{dP_L}{dP_2} = 2B_{12}P_1 + 2B_{22}P_2$ =2(-0.01×10^{-2})(150)+2(0.15×10^{-2}) (240) = 0.69

Penalty factor of plant 1, $L_1 = \dfrac{1}{1 \dfrac{-dP_L}{dP_1}}$

$L_1 = \dfrac{1}{1 - 0.312} = 1.453$

$L_2 = \dfrac{1}{1 \dfrac{-dP_L}{dP_2}} = \dfrac{1}{1 - 0.69} = 3.225$

λ = 15 Rs/MWhr (given)

Now $I_{C1} \times L_1 = \lambda$

I_{C1} × 1.453 = 15

I_{C1}=10.32 Rs/MWhr

$I_{C2} \times L_2 = \lambda$

$I_{C2} \times 3.225 = 15$

I_{C2} = 4.651 Rs/MWhr

54. An ACSR conductor is made up of 30 aluminium strands and 19 steel strands. The conductor is denoted as:

A. 19/30 ACSR B. 30/19 ACSR

C. 19/11 ACSR D. 30/49 ACSR

Ans. B

Sol.: An ACSR (Aluminium Conductor Steel Reinforced) conductor is made up of aluminium strands concentrically surrounding steel strands. The ACSR conductor is denoted as x/y, where x is number of aluminium strands, and y is the number of steel strands. Hence, the ACSR conductor consisting of 30 aluminium strands and 19 steel strands is denoted as 30/19 ACSR.

55. For which value of damping parameter, the transient stability is assured by equal area criterion?

A. Independent of systems damping.

B. If only damping is exactly zero.

C. For allvalues of damping parameters.

D. If only damping is positive and finite.

Ans. B

Sol.: When we are analyzing transient stability by equal area criteria method we normally assume that damping is zero.

56. The drooping power-frequency characteristics of two generators G_1 and G_2 are

Generator G_1: Slope of power-frequency characteristic is 1 MW/Hz

No-load frequency is 52 Hz

Generator G_2: Slope of power-frequency characteristic is 2 MW/Hz

No-load frequency is 51 Hz

The generators G_1 and G_2 are connected in parallel and loaded with total load of 10 MW. The load shared by G_1 and G_2 are respectively.

A. 3 MW, 7 MW B. 7 MW, 3 MW

C. 5 MW, 5 MW D. 4 MW, 6 MW

Ans. B

Sol.: f_c = common frequency of operation of the generators when sharing the load

From G_1 characteristics

$$\frac{52 - f_c}{0 - P_1} = 1 \Rightarrow f_c = 52 - P_1 (1)$$

From G_2 characteristics

$$\frac{51 - f_c}{0 - P_2} = 2 \Rightarrow f_c = 51 - 2P_2 (2)$$

From (1) and (2)

$P_1 - 2P_2 = 1 (3)$

Also, $P_1 + P_2 = 10 (4)$

Solving (3) and (4)

$P_2 = 3MWP_1 = 7MW$

57. The thermal efficiency of a thermal power plant is increased by:

A. Superheating the steam produced

B. Increasing the speed of steam driving the turbines

C. Using brown coal as fuel

D. Using coal in powdered form

Ans. D

Sol.: When finely powdered coal is used in thermal power plant, greater surface area of coal is exposed to heat and oxygen for combustion. This ensures faster and complete combustion of coal. It also reduces the amount of unburned carbon particles left in ash. In this way, thermal efficiency of the thermal power plant is increased.

58. Which of the following statement is NOT correct about insulator?

A. High insulating resistance

B. High relative permittivity

C. It should be porous.

D. High ratio of puncture strength to flash-over voltage

Ans. C

Sol.: The material should not be porous and there should be no effect of change in temperature over insulator, so, Option C is not correct statement about insulator.

59. Which of the following method is used for reducing the interference and noise in the telephone lines?

A. Bundling of conductors

B. Transposition of conductors

C. Insulation of conductors

D. Grading of cables

Ans. B

Sol.: When the spacing between the conductors is unsymmetrical, the three phases will have unequal inductances, resulting in voltage drops of different magnitudes. This will introduce interference and noise in the telephone lines. This interference can be reduced by making the voltage drop same in all conductors. This can be achieved by exchanging the position of the power conductors at regular intervals along the line, so that each conductor occupies the position of the other conductor and at equal distance. This process of exchanging the position of conductors is known as the transposition of conductors.

60. There are 3 loads connected to one generating system

Load 1 → 200 kW load (light)

Load 2 → inductor motor [200 HP, 0.7 lagging and 80% efficiency]

Load 3 → synchronous motor [100 HP, 90% efficiency]

If the combined power factor is 1. What will be the power factor of synchronous motor is _____(leading).

A. 0.8

B. 0.6

C. 0.4

D. 0.2

Ans. C

Sol.: Active power consumed by IM

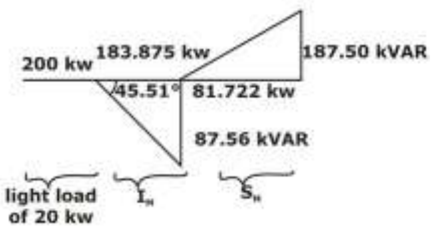
$= \frac{200 \times 735.5}{0.8}$ = 183.875 kW

PF = 0.7 lag = cos φ_{IM}

Φ_{IM} = 45.57°

Active Power consumed by synchronous motor (SM)

$= \frac{100 \times 735.5}{0.9} = 81.722\text{kW}$



Reactive power consumed by IM = 183.875 × tan (45.57) = 187.57 kVAR

So reactive power supplies by SM = 187.57 kVAR

$\phi = \tan^{-1}\left(\frac{187.57}{81.458^{\circ}}\right) = 66.458^{\circ}$

So PF of synchronous motor = cos (66.458°) = 0.4 (lead)

61. Which of the following buses are used to form bus admittance matrix for load flow analysis?

1) Load bus

2) Generator bus3) Slack bus

A. 1 and 2 only

B. 1 and 3 only

C. 2 and 3 only

D. 1, 2 and 3

Ans. D

Sol.: All buses load, gen, slack buses are used to form Y-bus matrix.

62. The insulation strength of an EHV transmission line is mainly governed by

A. load power factor

B. harmonics

C. switching over-voltages

D. corona

Ans. C

Sol.: Since, EHV, operates above 400 kV, and above 345 kV, switching surges are more dangerous than lightning overvoltage.

63. Size of the Jacobian matrix is (k × k), that consists of 61 buses out of 61 buses, 20 are PV buses and rest are PQ and a slack bus. The value if 'k' is

A. 60 B. 80

C. 100 D. None

Ans. C

Sol.: Total Bus = 61

PV = 20

Slack = 1

Size of Jacobian matrix = (2 × 61 – 20 – 2) (2 × 61 – 20 – 2) = (122 – 22) (122 – 22)

= 100 × 100

So, a = 100

64. A synchronous machine rated 50 MW, 50 Hz has a rated load of 40 MW. Load varies by 1% for 1% change in frequency. The load frequency constant parameter in pu MW/Hz is

A. 0.024 B. 0.016

C. 0.031 D. 0.078

Ans. B

Sol.: Rated load 40 MW varies by 1%

$\Rightarrow \frac{1}{100} \times 40 = 0.4$ Mw

1% of charge in frequency

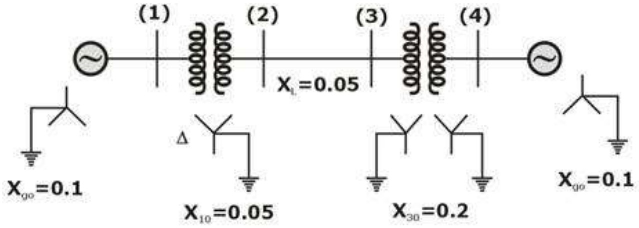
$\Rightarrow \frac{1}{100} \times 50 = 0.5$ Hz

Load frequency constant parameter D = $\frac{0.4}{0.5}$ = 0.8 Mw/Hz

Base Value = 50 MW

D in p.u. Mw/Hz = $\frac{0.8}{50}$ = 0.016

65. For the network shown in figure the zero-sequence reactance in p.u. are indicated. The zero-sequence driving point reactance of the node 4 is

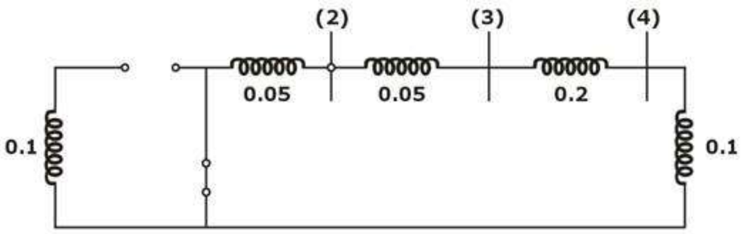


A. 0.05 B. 0.06

C. 0.075 D. 0.08

Ans. C

Sol.:



X_{eq} = (.05+0.05+0.2) || (0.1) =0.075 p.u.

66. The Y-bus matrix of 100 bus interconnected system having 80% sparse. Calculate the number of transmission lines in the system.

A. 300　　B. 950

C. 1000　　D. 2000

Ans. B

Sol.: $t = \frac{n^2(1-k)-n}{2}$

$t = \frac{100^2(1-0.8)-100}{2}$

t = 950

67. The maximum temperature permitted for class A insulation is

A. 180 degree centigrade　　B. 105 degree centigrade

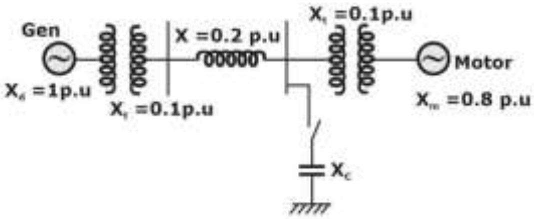
C. 120 degree centigrade　　D. None of the above

Ans. B

Sol.:

Insulator class	Maximum temperature allows
A	105°C
B	120°C
E	130°C
F	155°C

68. In the system shown in the figure, a 3-φ static capacitive reactor of reactance 1.2 p.u. per phase is connected through a switch at the motor bus bar. Assume the internal voltage of generator to be 1.5 p.u. and that of the motor to be 1.0 p.u. Find the ratio of steady state power limit, when switch is opened to when switch is closed.

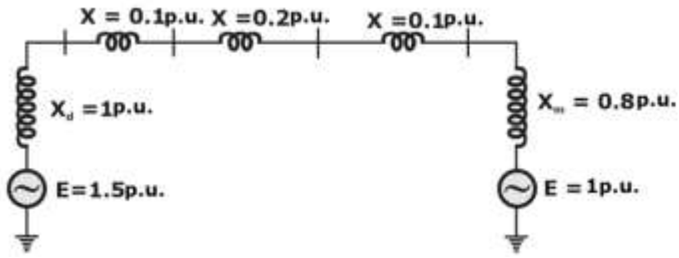


A. 0.55　　B. 1.2

C. 0.86　　D. 1.5

Ans. A

Sol.: When switch is open, the single line diagram is



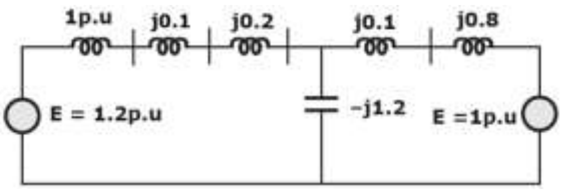
X_{eq} = 1 + 0.1 + 0.2 + 0.1 + 0.8 = j2.2 p.u.

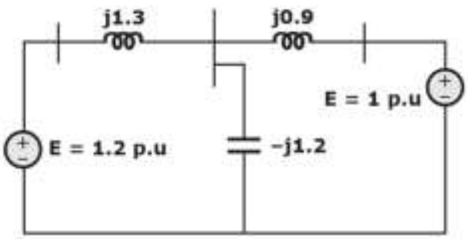
In this case, steady state power limit is

$$P_{max} = \frac{EV}{X}$$

$$P_{max} = \frac{1.5 \times 1}{2.2} = 0.681 p.u$$

When switch is closed, the reactance diagram is





The equivalent reactance between alternator and motor will be

$$X_{eq} = j1.3 + j0.9 + \frac{(j1.3 \times j0.9)}{-j1.2}$$

$$X_{eq} = j1.225 p.u.$$

New steady state power limit will be

$$P_{max} = \frac{1.5 \times 1}{1.225} = 1.224 p.u$$

The required ratio is = $\frac{0.681}{1.224} = 0.55$

69. A 50 Hz, 2 pole turbo generator rated 100 MVA, 33 kV has an inertia constant of 4 MJ/MVA. If the mechanical input is suddenly raised to 70 MW for an electrical load of 40 MW, then the rotor acceleration is

A. 337.5 elec-deg/s^2
B. 220.6 elec-deg/s^2
C. 675 elec-deg/s^2
D. 830 elec-deg/s^2

Ans. C

Sol.: Stored energy = GH = 100 × 4 = 400Rj

Accelerating power = P_a = 70 – 40 = 30 Mw

$$P_a = \frac{Md^2\delta}{dt^2}$$

$$M = \frac{GH}{180f} = \frac{400}{180 \times 50} = \frac{2}{45} \text{ MJ.s/ele.day}$$

$$\frac{2}{45}\frac{d^2\delta}{dt^2} = 30$$

Rotor acceleration, $\alpha = \frac{d^2\delta}{dt^2} = \frac{30 \times 45}{2}$ = 675 elec deg/s^2

70. In Gauss-Seidel load flow method the number of iterations may be reduced if the correction in voltage at each bus is multiplied by

A. Gauss constant
B. Acceleration factor
C. Blocking factor
D. Lagrange multiplier

Ans. B

Sol.: In gauss-seidal method, by using acceleration factor, the number of iterations may be reduced. However it may be noted that a wrong selection of α may result in slower convergence and sometimes even result in divergence from the solution.

71. What is the type of falut?

If, $I_{positive}$ = j1.653 p.u.

$I_{negative}$ = -j0.5° p.u.

I_{zero} = –j1.153 p.u.

A. L-G fault
B. LL-G fault
C. 3-phase fault
D. None of the above

Ans. B

Sol.: In LLG fault:

$I_{positive} + I_{negative} + I_{zero} = 0$

Here, j1.653 – j0.5 – j1.153 = 0

72. The per unit value of a 4Ω resistor at 100 MVA base and 10 kV base voltage is

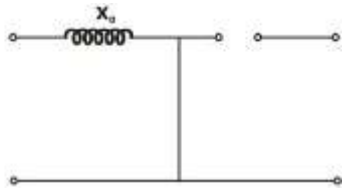
A. 2 p.u.
B. 4 p.u.
C. 0.4 p.u.
D. 40 p.u.

Ans. B

Sol.: $Z_{base} = \frac{(kV)^2}{MVA} = \frac{(10)^2}{100} = 1\Omega$

$$Z_{p.u.} = \frac{Z_{actual}}{Z_{bcce}} = \frac{4}{1} = 4p.u$$

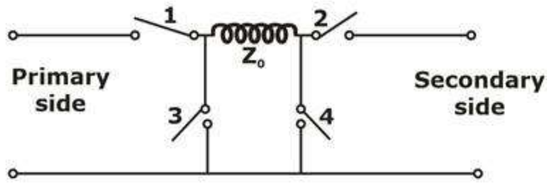
73. The zero-sequence impedance of a 3φ transformer is shown below. The connection of its winding are:



A. Delta-star with grounded – delta
B. Star- star delta
C. Star with neutral grounded – delta
D. Delta -star with neutral grounded.

Ans. C

Sol.: The switch diagram for representing transformer in zero sequence network is given below:



→ Switch 1 and 2 are series switch. It is closed when the winding is star connected and neutral is grounded.

→ Switch 3 and 4 are shunt switches.

It is closed when winding 1 and 4 are closed. Therefore option 'C' is correct.

74. Making and breaking currents of 3 phase Ac circuit breakers in power system are represent____

A. RMS and RMS value
B. Instantaneous and RMS value
C. RMS value and Instantaneous
D. Any of the above

Ans. B

Sol.: Making current = 2.55 × Breaking current

The instantaneous or peak value of the current flowing through the circuit breaker at the instant of breaker closing is called making current.

The RMS value of current passing through the circuit breaker at the time of opening of breaker is called breaking current.

75. The capacitance of 3-core cable between any conductors with sheath earthed equals to 9μF. The capacitance per phase will be

A. 3μF
B. 6μF
C. 9μF
D. 27μF

Ans. A

Sol.: $\text{Capacitance per phase} = \frac{\text{Capacitance between conductor}}{3}$

$\text{Capacitance per phase} = \frac{9\mu F}{3} = 3\mu F$

76. There are 10 generator buses in a 150-bus power system. In a particular iteration N-R flow (in polar coordinates) technique, the reactive power limit of 2 buses is violated, then

A. The number of unknown voltage angles remains unchanged and the number of unknown voltage magnitude decreases by two.

B. The number of unknown voltage angle increase by two and the number of unknown voltage magnitude decrease by two.

C. The number of unknown voltage angle increases by two and the number of unknown voltage magnitude increases by two.

D. The number of unknown voltage angle remains unchanged and the number of unknown voltage magnitude increases by two.

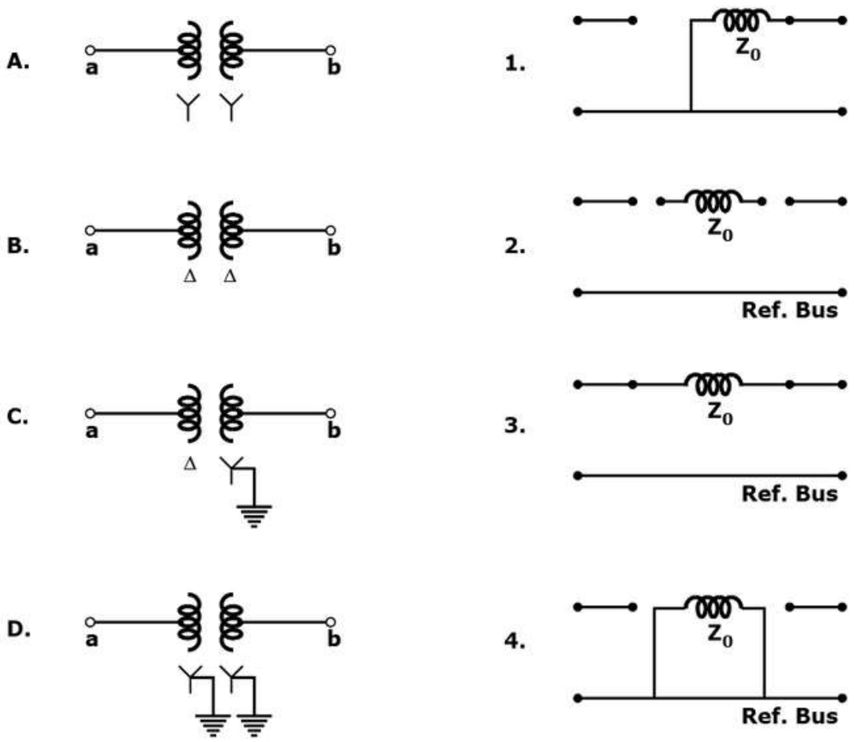
Ans. D

Sol.: When the reactive power limit of two buses is violated, then they are converted from PV to PQ bus.

So, number of unknown voltage magnitude increase by two. There will not be any effect on number of unknown voltage angle.

77. List-I (symbol of 3-phase transformer connection) with List-II (zero sequence equivalent circuit) and select the correct answer using the codes given below the lists:

List-I **List-II**



The correct sequence of the list (A B C D) is

A. 2 4 1 3
B. 3 4 2 1
C. 1 2 3 4
D. 2 1 3 4

Ans. A

Sol.: When the transformer is having delta connection, then it is not further connected to the line. And if the transformer is star connected with neutral grounded, then it will be connected to the reference bus also.

78. Consider a 3-φ, 3-core cable operating at 50 Hz, 22 KV. The inter phase capacitance between each pair of conductors is 0.3 μF and capacitance between each line conductor and the sheath is 0.5 μF. Find the line charging current (in Amperes) __________.

A. 2.32
B. 7.20
C. 5.35
D. 9.62

Ans. C

Sol.: $C_{\text{line to line}} = 0.3\mu F$

$C_{\text{line to sheath}} = 0.5\ \mu F$

$C_{\text{phase}} = C_{\text{line to sheath}} + 3\ C_{\text{line to line}}$

$C_{\text{phase}} = 0.5 + 3 \times 0.3 = 1.4\ \mu F$

The line charging current is given by

$$I_c = \omega C_{ph} V_{ph} = 22 \times 50 \times 1.4 \times 10^{-6} \times \frac{22}{\sqrt{3}} \times 10^3 = 5.35A$$

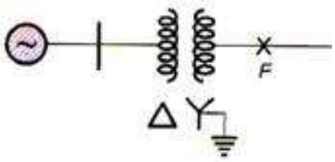
79. Critical clearing angle is related to

A. Stability study of power system
B. Power flow study of power system
C. Regulation of transmission line
D. Power factor improvement of the system

Ans. A

Sol.: The maximum allowable value of the clearing time and angle for the system to remain stable are known respectively as critical clearing time and angle.

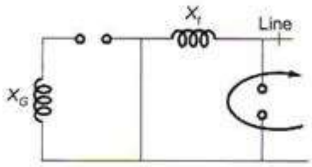
80. For the system shown in the diagram given below, what is a line-to-ground fault on the line side of the transformer equivalent to?



A. A line-to-ground fault on the generator side of the transformer
B. A line-to-line fault on the generator side of the transformer
C. A double line-to-ground fault on the generator side of the transformer
D. A 3-phase fault on the generator side of the transformer

Ans. B

Sol.:



Because of Δ-connection of transformer, zero sequence current not flow from Gen. side i.e, for LG fault on lines side of transformer, generator is supplying only positive and negative sequence current i.e. LG fault on lines side is same as LL fault on Gen. side.

81. A synchronous phase modifier supplies

A. Inductive reactive power only

B. Active power only

C. Both active and reactive power

D. Both lagging and leading reactive power

Ans. D

Sol.: SPM is a synchronous motor operating under no load conditions under variety of excitation. Depending on load, it may be overexcited (supplies lagging VAR) or under-excited (supplies leading VAR)

82. The incremental cost characteristics of two plant system are:

$(IC_1) = P_1 + 90$ Rs/MWhr

$(IC_2) = 1.3P_2 + 70$ Rs/MWhr

Where, P_1 and P_2 are in MW. The loss coefficient matrix in MW^{-1} is $\begin{bmatrix} 0.011 & -0.001 \\ -0.001 & 0.04 \end{bmatrix}$. The optimum scheduling for l = 140 Rs/MWhr. Find the total transmission losses.

A. 1.2 MW

B. 2.99 MW

C. 5.88 MW

D. 12.65 MW

Ans. B

Sol.: Total transmission loss is given by,

$$P_L = B_{11}P_1^2 + 2B_{12}P_1P_2 + B_{12}P_2^2$$

$$\frac{dP_L}{\delta P_1} = 2B_{11}P_1 + 2B_{12}P_2$$

$$\frac{dP_L}{\delta P_2} = 2B_{22}P_2 + 2B_{12}P_1$$

$$\frac{dP_L}{\delta P_1} = 2 \times 0.011P_1 - 2 \times 0.001P_2$$

$$\frac{dP_L}{\delta P_1} = 0.022P_1 - 0.002P_2$$

$$\frac{dP_L}{\delta P_2} = 2 \times 0.04P_2 - 2 \times 0.001P_1$$

$$\frac{dP_L}{\delta P_2} = 0.08P_2 - 0.002P_1$$

Penalty factor for plant 1,

$$L_1 = \frac{1}{1-\frac{dP_L}{dP_1}} = \frac{1}{1-\left(0.22P_1 - 0.002P_2\right)}$$

Similarly Penalty factor for plant 2,

$$L_2 = \frac{1}{1-\frac{dP_L}{dP_2}} = \frac{1}{1-\left(0.08P_2 - 0.002P_1\right)}$$

We know that

$I = (IC_1)L_1 = (IC_2)L_2$

$$\frac{P_1 + 90}{\left[1-\left(0.022P_1 - 0.002P_2\right)\right]} = 140$$

$P_1 + 90 = 140 - 3.08\ P_1 + 0.28\ P_2$

$4.08\ P_1 - 0.28\ P_2 = 50$ ……………… (i)

$$\frac{1.3P_2 + 70}{\left[1-\left(0.08P_2 - 0.002P_1\right)\right]} = 140$$

$1.3\ P_2 + 70 = 140 - 11.2\ P_2 + 0.28\ P_1$

$12.5\ P_2 - 0.28\ P_1 = 70$ …………… (ii)

By solving equation (i) and (ii), we get

$P_1 = 12.65$ MW & $P_2 = 5.88$ MW

So, the total transmission losses are

$$P_L = B_{11}P_1^2 + 2B_{12}P_1P_2 + B_{22}P_2^2$$

$P_L = 0.011 \times (12.65)^2 - 2 \times 0.001 \times 12.65 \times 5.88 + 0.04 \times (5.88)^2$

$P_L = 2.99$ MW

83. Corona loss in a dc line is

A. Same as in ac linear equal rms voltage

B. More than that in AC line at same rms voltage

C. Less than that in AC line at same RMS voltage

D. Almost zero watt.

Ans. C

Sol.: As we known,

Corona loss α (f + 25)

Where f is operating frequency of system

For HVDC, f = 0 Hz

While for AC transmission, f = 50 Hz

Hence, coronal loss is less for HVDC.

84. If the torque angle 'delta' increases indefinitely, the system indicates

A. Steady state stability
B. Permanent stability
C. Instability
D. None of the above

Ans. C

Sol.: Swing curves are used to determine stability of the system. If the rotor angle δ reaches to a maximum and then decreases then it shows that system has transient stability. And if the δ increases indefinitely then it shows system is unstable.

85. A transmission line with reactance of 0.2 pu is supplied at constant voltage of 1.2 pu, it is supplying reactive power 0.3 pu and is operating at half of the steady state stability limit. The receiving end voltage of feeder is

A. 0.06
B. 1.1
C. 1
D. 0.98

Ans. D

Sol.: Given, $X = 0.2$, $V_s = 1.2$ p.u.

$Q = 0.3$ pu , $P = P_{em} /2$

$P = V_s V_r \sin\delta /X$

$P = P_{em}\sin\delta$

$P_{em} /2 = P_{em} \sin\delta$

$\delta = 30^o$

$Q = V_sV_r \cos \delta/X - V_r^2/X$

$0.3 = (1.2 V_R \cos 30 - V_R^2) / 0.3$

$5V_r^2 - 5.196 V_r + 0.3 = 0$

$V_r = 0.98$ p.u.

86. The corona loss on a particular ac system of frequency 60 Hz is 2 kW/phase per km. The corona loss on the same system in case of DC transmission will be.

A. Zero
B. 0.588 kW/phase/Km
C. 0.92 kW/phase/Km
D. 6.8 kW/phase/Km

Ans. B

Sol.: Since, corona loss P_c:

P_c ɑ $(f + 25)$

For ac, f = 60 Hz

P_{ac} ɑ $(60 + 25)$

For dc, f = 0 H

P_{dc} ɑ 25

$$P_{dc} = \frac{25}{85} \times 2$$

$P_{dc} = 0.588$ kW/phase/Km

87. How many insulator discs of 11 kV are required in order to design a transmission line of 132 kV rating?

A. 11

B. 12

C. 10

D. Insufficient data

Ans. B

Sol.: Rating of one insulator disc is 110 kV

$$\text{No. of insulator discs} = \frac{\text{Line Rating}}{\text{Rating of each disc}}$$

$$n = \frac{132\text{kV}}{11\text{kV}} = 12 \text{ discs}$$

n = 12 discs

88. The formula for Surge impedance for loss less line when r=0 and g=0 is

A. $Z_c = \sqrt{\frac{L}{C}}$

B. $Z_c = \sqrt{\frac{C}{L}}$

C. $Z_c = \sqrt{C}$

D. $Z_c = \sqrt{\frac{1}{C}}$

Ans. A

Sol.: The surge impedance for a lossless line is when r=o and g=0 is

$$Z_c = \sqrt{\frac{L}{C}}$$

89. Equal-Area Criterion is employed to determine

A. The steady state stability

B. The transient stability

C. The reactive power limit

D. The rating of a circuit breaker

Ans. B

Sol.: Equal-area criterion is employed to analyse the transient stability.

90. Which of the following conductors below are homogenous conductors?

A. All Aluminium Conductor (AAC)& All Aluminium Alloy Conductor (AAAC)

B. Aluminium Conductor Alloy Reinforced (ACAR) & Aluminium Conductor Steel Reinforced(ACSR)

C. Both A & B

D. None of these

Ans. A

Sol.: If only one material is used as major part of conductor such type of conductors are called homogenous conductors AAC & AAAC are homogenous conductors.

91. For a string insulator unit, bottom most unit voltage is 1/4th of total voltage. If total insulator units are 5. Then string efficiency is _____%.

A. 25
B. 50
C. 75
D. 80

Ans. D

Sol.: $\eta = \frac{V}{nV_n} \times 100\%$

$\eta = \frac{V}{nV_n} \times 100\%$

n = 5

$V_5 = 0.25$ V

$\eta = \frac{V}{5 \times 0.25V} \times 100\% = 80\%$

92. Find the total number of strands in a ACSR conductor if the given number of layers is 5

A. 61
B. 12
C. 36
D. 13

Ans. A

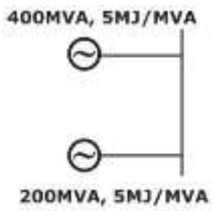
Sol.: The formula for total number of strands in a ACSR conductor is

$N = 3x^2 - 3x + 1$ where x = number of layers

N = 3(25) – 15 +1

N=61

93. The equivalent inertia constant (in MJ/MVA) on a common base 100 MVA for shown figure is __________.



A. 10
B. 20
C. 30
D. 40

Ans. C

Sol.: We know $M = \frac{GH}{\pi f} \Rightarrow H \propto \frac{1}{G}$

$\frac{H_{old}}{H_{new}} = \frac{5_{new}}{5_{old}}$

Machine I:

$\frac{5}{H_{new}} = \frac{100}{400}$

H_{1New} = 20 MJ/MVA

Machine 2:

$$\frac{5}{H_{new}} = \frac{100}{200}$$

H_{2New} = 10 MJ/MVA

H_{eq} = 20 + 10 = 30 MJ/MVA

94. What should be the phase angle displacement between the alternator excitation voltage and the infinite bus voltage for maximum power transfer between them?

A. 0^0

B. 90^0

C. 180^0

D. 270^0

Ans. B

Sol.: As we know, power transfer between alternator and infinite bus is given by

$$P_e = \left(\frac{EV}{X}\right)\sin\delta$$

So, for displacement angle(δ) = 90^0 the value of sinδ =1 i.e. maximum.

95. The inductance of a transmission line is minimum when

A. GMD is high

B. GMR is high

C. both GMD and GMR are high

D. GMD is low and GMR is high

Ans. D

Sol.: The inductance of the transmission line is low when GMD is low and GMR is high

96. In a two bus AC system, the sending end voltage, V_s and receiving end voltage, V_r for the line is 1 p.u. The line reactance is j0.06 p.u. and the resistance is neglected. If the real power flow through the line is 8 p.u., find the reactive power absorbed by the line is __________.

A. 4.08 p.u.

B. 2.04 p.u.

C. 1.20 p.u.

D. 5.3 p.u.

Ans. A

Sol.: Real power flow is

P = 8 p.u.

$$P = \frac{V_S V_R}{X}\sin\delta$$

$$8 = \frac{1\times 1}{0.06}\sin\delta$$

δ = 28.68°

The reactive power at the receiving end of the line is given by

$$Q_R = \frac{V_S V_R}{X}\cos\delta - \frac{|V_R|^2}{X}$$

$$Q_R = \frac{1\times1}{0.06}\cos\left(28.68^{\circ}\right) - \frac{(1)^2}{0.06}$$

$$Q_R = -j2.04\text{p.u.}$$

The reactive power at the sending end of the line is

$$Q_s = \frac{|V_R|^2}{X} - \frac{V_s V_R}{X}\cos\delta$$

$$Q_s = \frac{(1)^2}{0.06} - \frac{1\times1}{0.06}\cos\left(28.68^{\circ}\right)$$

$$Q_s = j2.04\text{p.u}$$

So, the reactive power absorbed by the line is

Q_{Line} = j2.04 + j2.04 = j4.08 p.u.

Q_{Line} = j4.08 p.u.

97. Which of the following materials can not be used as a moderator?

A. Deuterium
B. Graphite
C. Heavy water
D. Beryllium

Ans. A

Sol.: Deuterium is not a moderator

The purpose of moderator material in the reactor core is to moderate or reduce the neutron speed to a value that increases the probability of fission occurance.

Example- Heavy water (D_2O), graphite, Boron, Beryllium, Helium, Lithium.

98. For what purpose is graphite used in a nuclear power plant?

A. To ensure easier fuel combustion
B. To slow down the moving neutrons
C. To absorb the excess neutrons
D. To carry the heat produced during fission

Ans. B

Sol.: In a nuclear power plant, a moderator is used in a nuclear reactor to slow down the motion of the neutrons. The moderator is made up of graphite material. The moderators enclose the fuel rods. When the neutrons are fired, it acts as a barrier between the neutrons and the fuel rods, and prevents the neutrons to directly strike the fuel rods. This reduces the speed of the moving neutrons and in turn reduces the nuclear chain reaction.

99. In high voltage transmission line, ___________conductor is top most conductor.

A. R phase
B. Y phase
C. B phase
D. Earth

Ans. D

Sol.: The top most conductor of overhead transmission is earth conductor. Earth conductors provide a low impedance path for current. In overhead lines, the earth wire is often hung at the top of poles to help provide lightning protection for the phase wires.

100. The transmission line having a diameter of 4 cm and μ_r= 6 produces an internal inductance 0.12 μH/m. If it is replaced by an ASCR conductor which has a same diameter size but μ_r = 10, what will be the new internal inductance (μH/m)?

A. 0.1
B. 0.2
C. 0.4
D. None of the above

Ans. B

Sol.: We know L_{int} α μ_r

L_{int_1} = 0.12 μH/m

μ_{r_1} = 6

L_{int_2} / L_{int_1} = μ_{r_2} / μ_{r_1}

L_{int_2} / 0.12 = 10 / 6

L_{int_2} = 0.2 μH/m

***