# Consolidated Electrical Quiz

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Electrical Quiz Part A

1.What will happen if neutral connection cut?

If neutral was cut with 3 phases energized, then line voltage will appear in single phase supply points, that is 400 V in 230 V equipment and will fail if started.

2. Why radial distribution is supposed to have transformer. delta - wye to the downstream level?

This is to break the Zero sequence path at each transformer secondary voltage level and enable individual system grounding on each transformer secondary.

3. What is the main difference between Dyn11 & Dyn1?

The phase shift of secondary voltage with respect to primary is +30 deg (Lead) & -30 deg(Lag) respectively.

4. Why CT/PT secondary are earthed at one point?

To prevent Capacitance Coupling between primary & Secondary,which could result in the secondary winding floating at up to the primary voltage to ground. Double earthling causes circulating current resulting mal operation of the concerned relay.

5. Why low PF starting in domestic air conditioning?

Mostly, Split phase IMs are used in residential ACs which don't use starting capacitors & hence lower pf of 0.2 to 0.3 range.

6. What's the normal operating temperature of batteries?

25 deg.C.9 deg C raise in temperature will halve its life.

7. How to find current of 415 V transformers/motors?

Multiply KVA/HP by 1.39 to get its load current in Amps.

8. What is Ferro resonance?

 A phenomenon of over voltage and very irregular wave shape associated with the excitation of saturable reactors in series capacitors in power systems mainly during single phase cut conditions in a 3 phase system.

9. Which reactance shall be used for short circuit calculation of generators?

Xd"v:Direct Axis Subtransient Reactance(Saturated at rated voltage) is used for short circuit calculations which flows during first few cycles of the fault. The fault current in two phase fault conditions shall be used for Relay settings and coordination.
Eg:Xd" for 6 MW GEN:0.2.

10. Which value shall be used for transformer inrush current, s/c calculation?

The base value of ONAN rating of the transformer shall be used.

11. What are the types of earthing system?

IT,TT,TN(TN-C,TN-S,TN-C-S).
TN-C-S is mostly used in our systems, the neutral is separated from the earth only at the service entrance panel & down stream of the distribution.

12. How much power for rotor of a generator is required?

Generally ,0.25% of generator rated power.
Eg:0.5 MW for a 200 MW GENERATOR.

13. Where 400 Hz used?

Air crafts,Submarines,Military Applications due to light weight and high speed.

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14. What are the effects of short circuit currents?

Thermal effects,
Dynamic forces,
System Stability.

15. How a lightning surge current is indicated?

Primary lightning surge:10/350 us.
Secondary lightning surge:8/20 us.
First number :Time taken to reach peak vale.
Second number :Time taken to drop to 50% peak current.

16. Which is the opt site test for transformer commissioning apart from LV tests?

HV Tan delta(Dissipation factor) test at 10 KV.

Also, excitation current test with tan delta test kit.

17. What is the min. clearance for a 110 KV OH Lines over a terrace?

15 feet over a terrace.

6.7 to 7.6 metres from ground.

18. How to calculate S/C current of a generator?

S/C current is full load current of the gen.divided by subtransient reactance of gen(Xd").

Typical value:0.15 unlinked with the size of gen.

19. Which value is being set for instantaneous over current protection?

For assymetrical fault current which will be about 1.8 times the symmetrical fault current.

20.Which is enemy for a flow of electron ?

HEAT.

21. Which parameter of an electrical equipment determines its Short Circuit Capacity(SCC) ?

Its impedance.

22. What do you mean by synchronization?

Matching to the sine waves of two different sources.

23. What is the operating temperature for OH lines?

75 deg. C with  25deg. C ambient,well below the annealing temperature(93 deg C) of aluminium.

24. What are the main conditions for paralleling transformers.?

Same polarity, phase shift  & impedance.

Delta primary will introduce 30 deg phase shift.
The difference of % Z shall be less than 10 %.Eg:(10-9)/9 =11.1%,
not ok.

25.What is amortissure winding?

A winding on the rotor shorted at both ends to dampen the waveform distortion during load changes.

26. How to measure soil resistivity?

Wenner's 4 point method.
By injecting ac current in between two probes and measuring the voltage in between two probes in perpendicular samples.

27. What is K rated transformers?

Derating factor of transformer due to harmonics.

28.What is Clophen?

It is a PCB used in transformers for insulation and cooling.

29. What is droop control of gen?

Decrease or increase in governor setting of the generator as the frequency decrease or increase.
Normally it's about 4 to 5 %.
All gens in parallel must be set in the same setting.
1 % of speed change varies 25 % of its output.

30. What is the convention of current flow direction?

Franklin convention of direction.
That is, current flow is from +ve to --ve whereas the flow of electrons is from --ve to +ve.

31.What are holes ?

Holes are positively charged atoms. Hole current is not the same as electron current & its mobility is less than 50% of normal current & it is only through semiconductor.

32.Transformer- charging without load or with min.load.
Which is better?

As L/R time constant only decides DC decaying duration, it is better to charge the transformer with minimum load.

33. Why capacitor block DC but conducts AC?

As DC is unidirectional, the cap. gets charged in the initial time of giving of supply and no more change & hence blocked.
Whereas, as AC is of alternating its polarity for 50 times per second, the capacitor also gets charged and discharged accordingly, thus conducting AC through it.

34. What is power factor?

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The ratio of real power to apparent power is power factor of the system.
If the peaks and troughs of voltage & current waves occur at the same time it is UPF.

35. What are 8 basic laws of Electrical Engineering.
(i)Ohm's Law.
(ii)Law of Resistance.
(iii)Joule's Law of Heating.
(iv)Fleming's right-hand rule.
(v)Fleming's Left Hand Rule.
(vi)Faraday's Law.
(vii)Lenz's Law.
(viii)Kirchhoff's current & Voltage law.

37.What is KW?

KW is kilo Joules/sec
& MW is mega Joules/sec.

38. Define DYn11 transformer vector group.
Indicates transformer primary & secondary winding connections.
LV Voltage & Current always lead HV side Voltage & Current by 30 degs.  Phase  markings clockwise  &  phase  rotation in anti clockwise.

39.What are the type of batteries?

Lead  -Acid.
Lithium --Ion.
Nickel-Cadmium.
These batteries are rechargable.

Aluminium-Air batteries
are non rechargable batteries.

40.Who used the term Electric first in the world ?
Willium Gilbert

41.What is  Bio Electricity?

Control of our body actions, signaling, brain function ,heart function are done by tiny electricity produced by our body. This is bio electricity.

42.What are the inter state  transmission charges?

The inter state transmission charges consists of injection point charges(UP and withdrawal point charges  based on PoC tariff and the transmission loss for both injecting and with drawing entity.

43.Enumerate about  DGA.

High CO,CO2:Thermal over heating.

High Acetylene(C2H2): Arcing.

H2:Less than 500 PPM  is normal.
ROGERS Ratio of CH4/H2:0.1 TO 1.0.

The more important factor of DGA gases is not only the ppm, mainly,
the trending whether  upward or downward.
Total gas content shall be about within 15%. C2H16:Ethane.
Gas Ratios:Roger,IEC,DOREMBERG,DUVEL.
CO2/CO:25-OK.
Other Tests:
Dielectric oil test,
Moisture content,
Karl Fisscher,
Oxidation Inhibitor,
Power factor.

H2 high content alone will not indicate any fault but only combined with other gases.

44. What is Corona?

When there is high enough potential(more than 14 kv/cm) to ionise the air around a live conductor,Corona discharge  occurs, ozone & nitrates are formed which damage the insulation.

45. Which is the best relay for gen.protection?

High Impedance differential relay than biased differently ,as the settings keep on increasing with fault current.

46. Why transformers fire and burst?

Mainly due to tank rupture which enables air entry into the tank for fire initiation ,fire occur in transformers when it's oil lose it's dielectric strength.
Also,
(i)Low oil level.
(ii)Voltage surges.
(iii)Presence of appreciable quantum of combustible gases viz,
Hydrogen,
Methane,
Ethane,
Methelyne,
Acetylene,
Ageing,
Insulation failures.

47 Is the earthing of Surge Arrester(SA) to be combined with system earthing?

Yes, To have equal relative potential at all points of the facility. It also depends on the relative distance of SA & system grounding.

48. What is wave of AC Voltage and current waves?

Mono chromatic Transverse Sinusoidal Electro Magnetic (MTSEM) Wave.

49. State typical X/R ratio for 110 kV & 230 kV equipment?

3.4 & 7.36 respectively.

50. What are the factors that decide voltage regulation?

Load & PF, Resistance & Reactance.

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Electrical Quiz Part  B


1.What causes an arc flash?

An arc flash happens when an electric current flows through air gap
between a line to earth or between line to line.
Even a 300 mA of arcing current can produce fire.

2. What is the temperature of the arcing?
20,000 deg C and sounds at about 140 dB.

3. What is a typical acceptable unbalance in Voltage?
About 1% .Because,even 1% unbalance  Voltage itself could cause 6 %
unbalance in Current.

4. Where symmetrical components are used?
To study power system analysis in unbalanced conditions.

5. When unbalanced conditions will occur in power system?
Phase to ground and Phase to Phase faults,
Open conductor and unbalance in impedances.

6. In which equipment, positive and negative sequence components are
equal?
In transformers and lines.

7.Shall Generators produce negative sequence currents?

No,but negative sequence currents can flow in their windings due to system
faults.

8. What is the Zero sequence reactance(Xo) of transformers &
transmission lines?
Xo of Transformers:$0.85*X1$

Xo of Lines:3*X1

9.What can we see when CT secondary got open circuit ?

A Big orange Basket Ball with a big bang!

10.Who discovered about God Particles?

Prof.Higgis.

11.What are the main advantages of nuclear fusion  over nuclear fission?

No radioactive radiation,
No nuclear waste,
No nuclear weapons
in the case of nuclear fusion,
whereas all these evils are in nuclear fission.

So, most of our reactors are of fission type.

12. What is the creepage distance?

The shortest path between two conductive paths or live to grounded portion.

Eg:Transformer bushing live and it's bottom body.
Rod gap arrester is used for protection of transformer bushings against lightning and surges.

13. What is tracking in power system ?

A process that produces a partially conductive path due to improper creepage distance is called tracking which affects discs,Post Type insulators and transformer,CT bushings and lead to flash overs.

14.What are the reasons for tracking?

(i)Humidity.
(ii)Contaminations.
(iii)Corrosive chemicals.

(iv)Location altitude.

15. Why star connections are more common in U/G system?

Since these connections are not more susceptible to ferro resonance.

16. What is skin effect of AC current?

The effect of flowing current in the outer skin of the conductor due to its own alternating magnetic field.That's why no skin effect in DC current.


17. What is VAR?

The reactive power required to create the magnetic coupling needed to produce the actual work.

18. To which the active power(kW) is related?

Directly proportional to the torque applied to the rotor shaft either by turbo turbine,hydro turbine,gas turbine and wind turbine .

19.To which the reactive power(kVAR) is related?

Generator's excitation,Capacitor,EHV Transmission line compensation.

20.How VAR is increased?

If the excitation current of the Generator is increased(over excited),the magnetic coupling of the rotor with the stator magnetic field gets  increased and MVAR is raised.

21.Which fault level will be better for time grading for O/C relays and why?

The phase to phase fault level(86.6 % of three phase
fault level) will be opt for time grading the O/C relays since three phase faults are rare. No time grading for E/L relays.


22.Does the load current of a line have any effect on the fault current?

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No, only the fault impedance from the source to the fault, influence the fault current and will be inversely proportional to the fault impedance.

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23. Why phase to ground fault current is higher than the three phase fault current ?

The Delta/Star is only the source of Zero sequence current.
As,the  fault impedance  of 3 phase fault includes  the impedance of   transmission line and sub transmission lines, whereas
Zero sequence impedance does not and hence the positive sequence fault  impedance is higher than the zero sequence impedance and hence zero sequence current(line to ground ) is higher than the 3 phase fault current.
Of course, it also depends upon how far the ground fault occurs.

24.One kWhr is equal to how much kCal and vice versa?

One kWhr = 859.85 kCal(3412 btu).
Say, 860 kCal.

One kcal = 4.184 kilo joules(4.184 kWatt.Sec)=4.184/3600= 0.0012 kWhr.

25. What is magneto hydro dynamics?

Magneto hydro dynamics employs a magnetic field to drive an ionised field.

A magneto hydro dynamic  (MHD) generator works on this principle, which transforms thermal & kinetic energy into power directly  without moving parts.

26.Why transformer produce humming sound?

Due to magnetostriction property of the ferromagnetic materials.

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27.What is the frequency of humming sound of the transformer?

Twice the power system operating frequency of the transformer i.e., the 50 Hz transformer produces humming sound at
100 Hz.

28. What does the difference in transformer humming indicate?

Difference in humming sound indicates the presence of harmonics in the load apart from load variations.

In addition to the fundamental frequency humming, harmonics are also doubled creating humming different from 100 Hz.

29.What are the main emissions from fossil fuel plants?

The fossil fuel (coal,lignite,gas,oil) thermal plants emit green house gases apart from sulphurous oxides( which cause acid rain),
nitrogen oxides (NOx), Particulate Matter (PM), condensable PM, Mercury (Hg), trace metals and radioactive nucleoids.

30. What is the speed of lightning in OH lines?

1000 feet/micro sec.

31.What are the cleaning agents for electrical equipment?

(i) Carbon Tetra Chloride (CTC)
(ii)Iso Prophynol Alcohol.
(iii) Collonite for bushing cleaning.
Never use kerosene.

32. What shall be the rating of the CTs of a breaker?

It shall be the continuous rating of the breaker.
For eg ,if the continuous rating of the breaker is 1200 A,the CT Ratio shall be 1200-800-400/1--1 A.

33. What is the main reason for the conservator tank in a transformer?

(i)To provide space for expansion of transformer oil due to heating .
(ii)To minimise the quantity of oil in contact with air to avoid oxidation and hence sludging.
Conservator tank capacity may be 5 % of main tank capacity.

34.What precautions are must while erecting PTs?

The primary neutral of PTs should be properly earthed to avoid potential rise with respect to earth  under fault conditions and damage the windings. Also,its secondary voltage may contain third harmonics and there will be ratio error.

35. What is meant by positively/ negatively charged one?

When an element / terminal is capable of loosing an electron,it is said to be positively charged. Reversely, if an element / terminal gains an electron, it is said to be negatively charged.

36. What are thermistors?

Alloys of semi conductors whose resistance  vary with temperature rise . Used in Generators ,TVs,etc  for temperature  monitoring.

37.What are the units in MKS system for power and energy?

P:Joule/Sec.
E:Joules(Watts).

Eg:One unit(kWhr) :3600 kJ.

38. The tungsten filament of 60 W or 100 W bulb, which is thinner?

60 W bulb filament is thinner than that of 100 W bulb.

39. Where is the electric field in a current carrying conductor?

Inside the conductor and parallel to it.

40. Why heat is produced in a conductor when current passing through it?

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Due to collision of electron on atom.

41. When the power delivered in a cell is maximum?

When its load resistance equals to its internal resistance.

42. What is the direction of flow of current inside & outside the cell?

Inside the cell,from negative plate to positive plate and

outside the cell,from positive plate to negative plate.


43.What is the property of heater coil?

High resistance and high melting point(Nichrome wire).

44.What is the charge of an electron?

1.6*10 power minus 19 Coulombs.

45.What is the potential of earth?

      Zero.

46.What  is the electric field inside a charged  conductor?

      Zero.

47. What is the property of a  fuse wire?

High resistance with  low melting point(Alloy of lead & tin wire).

48. How the loads are connected in a house wiring?

Parallel to the Power point so that the voltage to all the loads is constant.

49. Which are the charge carriers constituting current in metals, liquids,gases and semi conductors?

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Metals:Free electrons.
Liquids:Positive & Negative ions.
Gases:Positive ions & free electrons.
Semi conductors:Holes & free electrons.

50.What is the dielectric strength?

The maximum value of potential gradient that can be safely applied against the ends of a dielectric.

51.What is the dielectric strength of air?

3 kV/mm.

52.What is lightning?

Discharge of electrostatic charges from clouds.

53.How sound occurs in lightning?

Lightning heats air - expands-lighter air  rise up- creates vacuum-neighbouring air rapidly fill up the vacuum causing heavy sound.
That's why thunder is heard after Lightning.

54.What is an electrolyte?

A liquid which allow current through them and also dissociate ions.
Eg:Salt solutions of acids & bases. Potassium hydroxide,
Sodium Chloride,Nitric Acid, Sulphuric Acid, Sodium Acetate, Chloric acid, etc.

55.Which is the only liquid metal conductor?

Mercury. Used in Bucholtz's relay float switches.

56. Name the liquids which won't allow passage of current?

Distilled water & vegetable oils.

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57.Which device accelerate electrons?

Betatron. The device with a circular vacuum tube placed in a magnetic field, into which electrons are injected used to accelerate electrons to high energy.

58.What is hysteresis loss?

The electrical loss occured while an AC current magnetise and demagnetise an iron core again & again.

59.Which electrical quantity remain unchanged in the transformers?

Frequency.

60. In electromagnetic induction,the induced emf is independent of which parameter?

Winding resistance.

61.What is the base temperature for meggering?
20 deg C.

For every 10 deg rise in temperatureerature,halve the IR value.

Disconnect the leads after one minute for capacitance discharging.

62.What is Faraday's law of induction?

Induced emf is directly proportional to rate of change of magnetic flux.

63. Difference in energy storing by inductor and capacitor?

Magnetic field Vs Electrostatic field.

64.Lenz's law gives what?

Direction of induced current.

65.Is there any medium EM waves that won't travel?

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No, Electromagnetic waves do not require a medium to travel and these waves can travel through solids, liquids, gases, and even space, which is a vacuum and has no matter.

66.What are all the electromagnetic waves?

They are  different types of waves on the electromagnetic spectrum:

(i)Gamma rays
(ii) X-rays
(iii)Ultraviolet waves. (iv)Even visible light.

67.How electromagnetic waves are constituted?

As the name ifself implies, electromagnetic waves are a typical combination of  both electric fields as well as magnetic fields.

Figuratively ,an EM wave is two waves that are traveling and oscillating at  right angle to each other.

68.What will be the resistance of a 230 V,100 W bulb?

R = V sqare/P=230 Sq/100
=529 Ohms.

69. What are the constituents of Edison alkali cell?

Perforated steel ribbon and nickel plates with  potasium hydroxide as electrolyte and an output of 1.75 V..

70.What is electrolysis?

The dissociation of a liquid into ions on passing a current is electrolysis.

71.What are ideal voltmeters?

Potentiometer and vacuum tube voltmeter.

72.What are primary cells?

Cells that can  not be recharged.
Eg:Voltaic cell(I hope first cell,Volt named after him)
Daniel cell,
Lechlanchee cell,
Buncen cell,
Fuel cell.

73.What are secondary cells?

Rechargeable.
Eg:Lead- Acid,
Nickel-Cadmium,
Lithium- Ion.

74.What is Foucault's current?

 Foucault's Current ( eddy current) are circulating current induced within
the  conductors in plane perpendicular to the changing magnetic field
in the conductor  itself due to Faraday's law of induction.

75. Working principle wise difference between auto transformer and power
transformer?

Self induction Vs Mutual induction.

76. What is the polarity of the secondary winding current in a step up
transformer?

Opposite polarity.

77.What for a transformer is employed?

To obtain a suitable voltage.(Step up or Step down)

78.On which factor the magnitude of the potential difference across the
secondary of a  transformer is independent?

Resistance of both  primary and secondary winding.

79.To which law,Faraday's law of induction is related?

Law of conservation of Energy.

80.What is an AC current?

The one which periodically changes its magnitude and direction with respect to time.

81.How much is the period
(T) of our AC ?

   T = 20 millisecond.

82.Define power frequency
(F)?

The number of cycles gone through by AC per second .
  F=1/T=1/20ms=50Hz.

Or, the number of positive peaks achieved by the voltage/current waves in one second is frequency.

83.What is the mean value of the current over a complete cycle?

       Zero.

84.What is RMS value?

Root mean square value

85.Which value the AC meters indicate?
        RMS Value.

86.What happens when a DC voltage applied to a capacitor?
         Blocked.

87.What is wattless power.

Since reactive power transfers no net energy to the load, it is called wattless power.

88. Why the average power consumed in a pure inductor is zero?

The power absorbed to magnetise the inductor in the first quarter cycle is returned back to the source in the next quarter cycle making the average power as Zero.

89. Which is the best component to limit the current in an AC circuit?

A choke coil and a resistor can limit the current. But,the choke coil is better as there is no large power loss except hysteresis and eddy current losses.

90. What is the inductive reactance of an inductor in a DC circuit?

Zero.
Xl =2Phi f L =0 since f (frequency) is zero.

91. What is the peak voltage of AC 230 V and peak to peak voltage?

V peak =1.414 x230 =325V

V peak to peak=650 V.

92. What is the average voltage of 220 V AC during positive half cycle?

198 V.

The average or mean value of a a sine wave
(symmetrical alternating quantity) is the average value measured over only one half of a cycle, since, the average value over one complete cycle is zero regardless of the peak amplitude.

93. How much power a choke coil consume?
Almost zero.

94. What is a capacitor for a DC current?

A perfect insulator.

**95. Magnetism of a substance depends on which factor?**

Spinning of electrons.

**96. What is the formula for the voltage induced in a generator?**

Emf=(2)(K)(F)(Flux)( N)(10 power minus 8) Volts.
where K =1.05.
=(105)(10 power minus 8) (N)(Flux).
=(N)(Flux)(10 power minus 6) Volts.

**97. What is THURY system?**

DC system.

**98. What are the advantages of DC system?**

(i)Unity PF.
(ii)No skin effect.
(iii)Higher effective pressure for the same insulation.That is,for 200 V
AC insulation,about 400 V DC could be applied.
(iv)No dielectric loss.
(v)No inductive or capacitive troubles such as surge and ubnormal voltage
rise.
(vi)No charging current.

**99.What are the advantages of AC system?**

(i)Higher copper efficiency.
(ii)Easy transformation and transmission of required voltage.
(iii)Natural Generation is only AC.
(iv)Greater flexibility and advantageous of synchronous and induction
machines.

**100. What is fringe effect in transformers?**

Flux leakage in mutual induction of transformer winding is the fringe
effect  pertinent to magnetic cores with an air gap.

Fringing effect lowers the reluctance of the magnetic path and thus increases inductance of the winding made on such a gapped magnetic core.


Electrical Quiz Part C

1.In what way star winding advantages than delta winding?

(i)In delta,it must withstand the total line voltage whereas in star winding,a single winding has to withstand only 58 %(100/1.732) of line voltage.

(ii)In delta winding,third harmonic current will be circulating and heat up the winding whereas it will not appear in star winding.

2.What is the main reason for transients in AC system?

By switching of inductive or capacitive loads under normal & fault conditions and also lightning surges.

3. What is the maximum possible voltage rise as switch opens?

E max=Ib(root over L/C)
where Ib:Breaking current.
L & C are network inductance & capacitance.

4. What is carona?

A bluish tufts or streamer appearing around the current carrying conductor with hissing sound due to ionisation of air
when the potential gradient of a conductor rises and exceeds the dielectric strength of air.

5. What is an oscillation in a transmission line?

A recurring disturbance due to unbalance of electrostatic and electromagnetic energy fields.

6. What is a surge?

An oscillation of low frequency and rapidly damped.
Eg:Switching and lightning surge.

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7. What is the important condition in designing a better transmission line?

Shall be non - oscillatory so that the transient quickly dies out for which the transmission line resistance must be equal or greater than it's surge impedance(Root over L/C).
If its resistance is less than its surge impedance, then, the line will be electrically oscillatory.

8 What is the average value of a sine wave?

The average voltage (or current) of a sine wave, is
the quotient of the area under the waveform with respect to time.

In other words, the averaging of all the instantaneous values along time axis with time being one full period, (T) against the root mean square value as in RMS value.

But,since it is zero over one complete cycle, the average or mean value of a sine wave is the average value measured for half of a cycle.

9.What is the surge impedance of a transmission line?

*$Zc=\sqrt{(L/C)}$*

10.What is the transient frequency (natural frequency) of a transmission line?

The natural frequency is the rate at which a wave vibrates when it is not disturbed by an outside force and expressed as $\omega n$, equal to the speed of vibration divided by it's wavelength (lambda).

The natural frequency, allows the transient oscillatory phenomena very often.$Zn = Zc/2$.

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11.What are the sources of oscillations in the system itself?

   EHV Transformers.

They have appreciable electrostatic capacitance between turns and also to  ground which may create high frequency oscillations
in the transformerr itself and also produce voltage rise and may puncture the
insulation.

12. How to minimise lightning disturbances ?

(i)By use of one or two ground wires grounded at frequent intervals in EHV lines especially at one  tower before the entry to SS.

(ii) By installing Surge Arresters across the bus bars at generating station and sub station entries.

(iii) By operating the EHV lines just below the critical corona voltage so that any disturbance causes corona
discharge thus dissipating the extra disturbance energy.

13.What are the types of Surge Arresters(SA)?

a.Rod Gap Arrester.
b.Sphere Gap Arrester.
c.Horn Gap Arrester.
d.Multiple-Gap Arrester.
e.Impulse Protective Gap.
f.Electrolytic Arrester.
g.Expulsion Type Lightning Arrester.
h.Valve Type Lightning Arresters.
i.Thyrite Lightning Arrester.
j.Auto valve Arrester.
k.Oxide Film Arrester.
l.Metal Oxide Surge Arresters  (Widely used).

14. What are the parameters that determine the size of the conductor?

a.Current carrying capacity.
b.Required voltage regulation.
c.Corona.
d.Permissible energy loss.
e.Mechanical strength.
Last but not the least,
f.Cost.

15. Why two separate conductors,viz,twin moose or quadra moose are used?

To reduce the inductive drop.

If two separate lines of half of it's cross section against  a single line
for a given cross section of conductor ,
with interlink  at regular intervals are used,the inductive drop will be lesser.

16.Which materials are used for making insulator?
a.Porcelain.
b.Polimer.
c.Glass.
d.Patenated compounds.

17. What are the reasons for failure of  the insulators?
a.Absorbtion of moisture due to porosity.
b.Brittleness due to over firing.
c.Combined electrical and mechanical stress.
d.Cracks due to sudden change in temperatureeratureerature.
e.Mechanical stresses due
to unequal temperatureerature coefficients of the Rim cap.
f.The cement hydrates for a long time,increase in volume which stresses
the porcelain.

18. What for arcing rings are used in EHV lines?
To protect  both the lines and insulators from the power of arc.

19.What are the advantages in neutral grounded system?

a.Except under unusual transient conditions,the line to neutral voltage
never exceeds the line to line voltage .

b.A grounding on one line trips the breaker and warns the operator of trouble.

c.The dynamic arcing to ground has but little tendency to high frequency oscillations.

d.Protection of power system will be more reliable.

e.Communication interference due to electrostatic imbalance will be minimised.

20. What are the disadvantages in neutral grounded system?

a.The line will be inoperative for a single line ground fault.

b.The ground fault current may produce heavy mechanical forces on generator and transformer windings.

c.The dynamic arcing to ground may shatter the insulators and even burn off the conductors.

Neutral grounded system is more preferable except in IT industry where sophisticated equipment are used and uninterrupted supply is the must.

21. What are the electrical stresses which a transformer is subjected to?

Transient surges due to

a.Switching.

b.Breaking down of line insulators.

c.Arcing grounds.

d.Short circuits.

e.Lightning.

22.What are steady state surges?

Due to ground fault of one  transmission line.

23. What are the types of construction of transformers?

When windings surround the core, the transformer is core form whereas ,when the windings are surrounded by the core, the transformer is shell form.

a.Core type:Widely used ,
the primary and secondary windings are wound  on the side
limbs  surrounding outside the core ring  and has two magnetic circuits.

Exposed windings and hence better cooling.

b.Shell type:
The primary and secondary windings pass inside the steel magnetic circuit (core) which forms a shell (மேலோடு)around the windings in the central limb with only one magnetic circuit.

Widely used in low voltage applications like transformers used in electronic circuits and power electronic converters etc.

24.Which type of winding is used in both core and shell-type transformer?

In core type ,concentric and inter leaved type of windings are used.

In concentric,as both windings are placed on same side,
the flow of currents in windings should be in opposite direction as per Lenz Law.

The low voltage windings are placed near the core,to reduce the insulation withstand voltage near the core.

In inter leaved type, half of each winding is placed on a limb.

In shell type sand-witched type windings are used to decrease the leakage flux.
Grading of insulation is done as descending order of priority.

25. How is the Back to Back test on transformers conducted?

Back to Back test or *Sumpner test* is a factory test done on two transformers on full load to find out the full load loss and their heat run ability without actually loading.

The LV side of the two transformers are connected in parallel with each other and connected to variable supply voltage.

The HV side of the two transformers are connected in series so that the voltage across them is equal and opposite simulating a zero voltage condition and a variable voltage source is connected .

Now,rated voltage is applied in the LV side with the variac supplying to HV side is set on zero at this condition both the transformers are working at Open Circuit condition and wattmeter reading reads the sum of core losses of both Transformers.

Now, gradually the variac setting of the HV side is increased till the rated HV current and the wattmeter reads the sum of copper loss of both Transformers.

Also, both Transformers are checked for heat run test simultaneously without actually loading them.

The transformers are kept in this condition for 48 hours and temperature is noted on hourly basis till it maintains constant temperature and should be within the limit.

26.Why is a circular core not preferred in a transformer?

Although circular cross section of core would be compatible with circular windings, it is highly inconvenient because laminations of different sizes are to be stacked.
In a rectangular cross section core, laminations are of the same size could be easily arranged.

Moreover mechanical strength of the core falls, when riveting the circular laminations, which is why rectangular core is universally adopted.

27. What is the cause of saturation in transformers?

Saturation of transformer is mainly based on type of material used in core. Every material has the limit above which increase in magnetic field strength (H in Ampere Turn/m) will not increase the flux density (B in Tesla) in the magnetic material which can be known from the B-H curve of the particular material.
Saturation of magnetic core is exceeding their capability and no longer respond linearly with magnetic flux to increases in primary current.

The secondary therefore no longer follows the primary, basically it holds.

Generally, core saturation depends upon the Voltage to frequency ratio which should be always maintained constant.

On the other hand ,if voltage is higher than the equipment rated voltage, it will draw more magnetising current that simply means higher value of H and will cause saturation.

28. What happens when a transformer is saturated?

Worst the flux control is lost, current increases, heats up and if allowed to continue, rapidly builds up temperature making the windings very hot and causing the enamel insulation to fail, shorting out the transformer and causing major hazards leading to transformer failure.

29. What are active and passive electrical components?

Active Components:
Those components which require no external source to their operation is called active Components.
For Example: Diodes Transistors, SCR etc.

The Diode will not conduct the current until the supply voltage reach to 0.3(In case of Germanium) or 0.7V(In case of Silicon) and
SCR require triggering voltage to conduct.

Passive Components:
Those components which require any external source for their operation are called Passive Components.
For Eg: Resistor, Capacitor, Inductor, & transformers.

30. Why one of the secondary terminal of the Instrument transformers are grounded?

a.The unlike polarity terminal of the CT and neutral of the PT is grounded to avoid voltages due to capacitive coupling between the CT secondary and the line being monitored (CT Primary) and also for PT.

b.Instrument transformer's secondary ref terminal
grounded as protection against electrostatic voltages or insulation failure.

31. What is the formula for the emf induced in a transformer?

EMF induced in primary winding
$E_1(rms) = 4.44fN_1 \Phi_m$.

Similarly,
EMF induced in secondary winding
$E_2(rms) = 4.44fN_2 \Phi_m$.
where,
$\Phi_m$ = Maximum flux in the core in Wb= ($B_m$ x A),
f:frequency.
$N_2$:Number of windings in the secondary.

32. What are the fundamental principles adopted in transformers?

Primary Power( $V_1I_1$) =Secondary Power($V_2I_2$)
$V_1I_1=V_2I_2$.(Neglecting the losses).

$V_1/V_2 = I_2/I_1$

Primary Magneto Motive Force(MMF) $N_1I_1$=Secondary MMF
($N_2I_2$).

$N_1I_1=N_2I_2$.

$N_1/N_2 =I_2/I_1$.

There fore,
$V_1/V_2=N_1/N_2=I_2/I_1=K$.

If $N_2 > N_1$, i.e. K > 1,
then the transformer is step-up transformer.

If $N_2 < N_1$, i.e. K < 1,
then the transformer is step-down transformer.

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33. What are Instrument Transformers?

Instrument Transformers are used in AC system for
measurement of electrical quantities,
i.e. voltage, current, power, energy, power factor, frequency through the
measuring instruments  designed for 5 A ,1 A and 110 V.

Also used with protective relays for protection of power system.

Basic function of Instrument transformers is to step down the AC power
system high voltage and current as it is impossible to design the meters
and relays for measuring  such high level voltage and current.

Current Transformer (C.T.):
Used to step down the current of the power system to a lower level to make
it feasible in the measurable and monitoring range of 1 A or 5 A for various
meters & protective relays ,viz,directional,
distance relays,transformer protection relays,etc.

Potential Transformer (P.T.): Used to step down the voltage of power
system ,viz,11,22,33,110,230 kV to a lower level of 110 V to make it
feasible to be measured by small rating of  voltmeter ,energy meter,etc and
protective relays as required.

34. What is the main difference between CT and PT?

C.T. is having very few turns or bar primary. Primary is connected in series
with the power circuit and hence  called as series transformer.

The metering & protection secondary , having large no. of turns
and   connected directly to an ammeter,energy meter,etc and protective
relays respectively.

As the ammeter is having very small resistance and could not balance with
the ampere turns of the primary as the primary load current is independent
and secondary current is only the replica of the load current, the CT
secondary must be either in circuit or shorted.

One terminal of CT secondary is grounded to avoid heavy  voltage on

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secondary with respect to earth in view of safety of devices and personnel.

  P.T. Primary  have large no. of turns and  connected across the line and ground , parallel with the supply.
  P.T. Secondary, having few turns and connected directly
to  voltmeter,energy meter and relays as required.

As the voltmeter is having high resistance , the  P.T.secondary operates almost in open circuited condition.
The neutral terminal of the   P.T. secondary is grounded to maintain the secondary voltage with respect to earth for  the safety of operators.


35. What is the general and prior requirement of transformers?
a.Longer life and higher operating efficiency.
b.Very rugged and shall be capable of withstanding a great deal of abuse.



38. What is the Break Down Voltage (BDV) of Transformer oil?

The oil must withstand not less than 40 kV with a gap of 2.5 mm between 5/8th inch  brass sphere.

39. What is the best method for dehydrating the transformer oil?

By pumping and passing the oil through the filter press( several thickness of blotting paper) in a vacuum chamber ,that is oil filtering machine.

40. In which quantity,the short circuit of turns or layers in an electrical equipment reflect?
In decrease of  winding resistance.

41. What is the general principle of operation of Voltage Regulators?

By changing the mutual inductance between the primary and secondary winding of the transformer either through mechanical means or
by changing their
turns ratio slightly through cutting in or out of certain turns ,mostly in HV winding.

42. What will be the primary and secondary current of a transformer?

a.Seconday current of a transformer is only the actual load current.

b.The primary current will be the sum of the magnetising currents of both windings and the current which counter balances the demagnetising effect of the secondary load current.

43. What are the ACSR conductors used for 11 & 22 kV and LT conductors?

ACSR,7/4.09 mm for HT.

ACSR,7/3.35 mm for HT.


ACSR,7/2.29 mm for LT lines.

44.What is the maximum length allowable for HT distribution and LT lines?

10 kM for HT lines subject to regulation limit of +/-6%

3 kM for LT lines subject to regulation limit of +/- 6%

45. What is a three phase circuit?

A combination of three circuits energised by alternating electro motive forces which differ in phase by one third of a cycle ,i.e,120 degree for transfer of optimum power.

46. Why is three phase preferred and not other numbers?

Basically any number of phases are possible but in case of "even" number phases like 2, 4, 6....,  will have have equal angle in them (180,90,60 deg ....)and as such a pair of phases in such system will always be in opposite direction to each other resulting  higher neutral current.

Whereas, in a 3 phase power system, none of the phases are in  phase opposition resulting very  small neutral current.

Also, 5,7,9... odd ones are possible , but uneconomical due to number of conductors(6,8,10 nos.) and hence the material involved will be higher. Hence,the optimum required phases is only three.

Also,the 120 degree offset of the three waveforms that provides a smoother continuous transfer of power without any time difference and hence only with a little bit voltage ripple.

Also, 3 phases provide power throughout the cycle (i.e. there is no point of time when there would not be voltage difference between phases to provide power.

47. What are the values of Form factor,Crest factor of sine waves?

Form factor:
It is the ratio of the root mean square (RMS) value to the average value of an alternating quantity (current or voltage) and is equal to 1.11.

Crest or Peak Factor:
It is the ratio of maximum value to the R.M.S value of an alternating quantity and is equal to 1.414(root 2).

48. Define Load Factor,
Diversity Factor and
Plant Load Factor.

a.Load Factor/
Demand factor/ Max.Utilization factor

The ratio of the maximum coincident demand or load of a system, or part of a system, to the total connected load of the system is load or demand factor and usually less than one.
Depends upon the nature of load,viz,domestic,
commercial,industry,
hospitals,educational institutions,etc..

Lower the load factor, less
the system capacity required to serve the connected load.

b.Diversity Factor

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DF  is defined as the ratio of the sum of the maximum demands of the various part of a system to the coincident maximum demand of the whole system. The maximum demands of the individual consumers of a group do not occur simultaneously.

i.e),DF:Max demand of the subdivision system/
Max demand of the whole system.
Shall be more than 1.00.

c.Plant Load Factor
It is a measure of the output of a power plant
compared to
the actual output to that of  it can maximum generate.

PLF:Actual energy generated /Maximum possible energy that can be generated.


49. What is the electrical tension?

Electro Motive Force or
Potential Difference is referred as electrical tension.

!
50.What do you mean by phase difference?

The time difference of any two electrical quantities of the same frequency at any instant is the phase difference between the two .
First quantity to reach the maximum value is said to be in lead with its lagging quantity.

51. What is the conventional direction of any vector diagram?

Counter clockwise.


52. How many vector groups in transformer windings connection and based on which  parameter?

Three groups based on angular displacement between the primary and secondary windings with Zero or
30 or180 degree.

53. Define Peak Value, Average Value and RMS Value of a sine wave?

Peak/Crest/ Max Value:

The maximum value attained by an alternating quantity during one cycle is called its Peak value
at 90 degrees.
Em ,Im:1.414 Erms,
1.414 Irms.

Average Value:The  average or mean value of a a sine wave (symmetrical alternating quantity)  is the average value measured over only one half of a cycle, since, the average value over one complete cycle is zero regardless of the peak amplitude.
The average value of a sine wave of voltage or current is 0.637 times the peak value, (Vm or Im).
i.e,(2/3.14)Vm.

The average voltage value of 230 V (rms) is 207 volts.


RMS Value:It is square root of the average of instantaneous voltage or current values of the AC.
Irms =0.707(Imax).

54. What is the rating of Surge Arrester?
Voltage (of course,phase to neutral) of the circuit on which it is to be used.

55.What is the continuous current rating of the fuse wires?
110 % of their rated current

and they will blow of at about 166 % of their rated current.

56.What is meant by incandescent?
It means temperature radiation.

57. What may be the cold resitance of a 60 W incandescent bulb?
       16 .5 ohms.

58. What is the formula for heavy water and where it is used?
D3O.
Heavy water is used as moderator in nuclear reactor.

59. What is the speed of hydro turbines?
Generally,about 330 rpm,
Vertical Kaplan.

60. What is the speed of thermal turbines?
3000 rpm,
Francis turbines.

61. Why the positive terminals of station battery is more corroded than it's negative terminal?

To have corrosion, there has to be a current flow in one direction that remove electrons from material (which corrodes away) and deposits the electrons on a different material.That is why, the positive terminals are more corroded and hence negative is permanently connected to one end of the trip coils and positive is always extended as + Return through any actuating relay.

62. What are the options for Earth Fault connections?

a.Holmogren connection(Residual current),widely used.

b. Toroid CT connection(combining of all 3 phases).More sensitive,even 1 % of E/F setting could be achieved.

63. Define Restricted Earth Fault Prorection.
a.Zone type ,differential protection.
b.Used on generators and transformers.
c.Very fast for internal earth faults.

d.Sometimes used as voltage operated if used as High Impedance differential protection.

64. What is the back emf?

The voltage induced in an inductive machine due to the flow of current through it is called as back emf because of it's polarity opposite to the applied voltage.

65. What will happen to an induction motor with it's rotor blocked condition?

Its coil will burn.

If the motor freely rotates ,the back emf will counter acts the applied voltage preventing higher current in the stator's coil which burn the same.

66. When Zero sequence current flow?

Only during ground fault. As they are all in phase with each other and have no sequence at all , occurs only during ground fault and the magnitude is $3Ir0$.

67. Why a delta tertiary winding is employed in a star/star auto transformer?

a. Act as a Zero sequence filter so that ground fault current will not pass on to the source.

b.Reduces the unbalancing in the primary windings during any unbalance in load.

c.Redistributes the flow of fault current and limits
L - G fault current.

d.The circulating current in the delta winding balances the zero sequence component of unbalance load preventing zero sequence flux and also in the transformer core and also reduces the zero sequence impedance of transformer.

68. What will be the capacity of the tertiary winding?

The Delta tertiary is customarily sized at 1/3 of the main winding rating
(33.3 MVA in a 100 MVA Auto transformer)
to handle a completely unbalanced secondary zero-sequence current and
to allow the odd harmonics to circulate.

69. Upto which voltage level Vacuum breakers are used?Why?
Upto distribution class,i.e.33 kV level Vacuum breakers are used as it is
very difficult to create vacuum and maintain beyond certain capacity.

For transmission class,SF6 breakers are used.

70. How to test the vacuum interrupter bottles?

By applying an ac voltage of 2 times V rated + 1 kV in between the top and
bottom of the interrupter bottles.
Anabond can be applied in the flange joints of the interrupter housing to
prevent moisture inside the housing.The concerned  colour enamel paint
may also be applied on the flange joints.

71. What is thumb rule for transformer inrush current?

About 10 to 12 times the rated current of the transformers.

72. What type of CTs are used for E/F relays?
Any protection class CTs except PX Class( used for differential relays) are
used.
Also,Core balance/Zero sequence/Ring type CTs could be used.

We normally use 5P20 CTs which are used for O/C relays.

73. What is Knee Point voltage of CT?

The  Knee Point Voltage of a Current Transformer is defined as
the voltage at which 10 % increase in voltage of CT secondary results in 50
% increase in secondary current (Saturation voltage).

For a CT of 5P20,30 VA Burden,1A CT,the Knee Point Voltage(Vk)
will be 30 x 20 =600 V.

Therefore Knee Point voltage of Protection Class CT must be more than the voltage drop across the burden to maintain CT core in its linear zone.

For PX Class CTs,the Vk will be still higher.

74. What is the Accuracy Limit Factor(ALF) of a CT?

ALF is the maximum value of primary current, beyond which protection core of of a CT starts saturated. The value of rated accuracy limit primary current is always many times more than the value of instrument limit primary current.

75. why ALF must be specified for a CT?

Actually CT transforms the fault current of the electrical power system for operation of the protection relays connected to the secondary of that CT. But,if the core of the CT becomes saturated at lower value of primary current (as in the case of metering CT) the system fault current will not reflect properly to the secondary
resulting , inoperative of the relays.
Hence,the rated ALF should not be so less, so that the relays will not operate and also must not be so high that it can damage the relays.

So, ALF should not have lower value (< 5) and at the same time not as high as 50.
The standard values of ALF as per IS-2705 are 5, 10, 15, 20 and 30.
Our CTs are mostly 5P20.

76. What is Synchro Check Relay?

The synchronism check relay element commonly provides a three-fold check,viz,Phase angle difference,Voltage difference, Frequency difference of incoming machine and grid and give necessary pulse to close the generator breaker.

The scheme with phase angle setting of 20°to 30°.with a locking period of typically 5 secs.

The voltage check give positive pulse only if the differential voltage is nil.

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The logic also incorporates a frequency difference(max 0.1%) check, either by direct measurement or by using a timer in conjunction with the phase angle check with 2 second timer and the the logic gives an output only if the phase difference does not exceed the phase angle setting over a period of 2 seconds which also limits the frequency difference.

While all the above three conditions are satisfied,the relay gives the closing pulse to the generator breaker.

77. What is the phase to phase clearance inside a 11 kV distribution transformer?

      12 inches.

78. What will be the magnitude of magnetising current of a transformer?

About 1 % of it's rated current,which is almost purely inductive.

79.Why grounding is the must for an electrical power system?

a. To provide an electrical return path to the source for ground fault current for proper protection.

b. To reduce step and touch potential during faults for safety purposes.

80.What is meant by soil resistivity?

The resistivity is the reciprocal of conductivity.

Soil resistivity measured in
ohm-centimeter ($\Omega$-cm) is the resistance in ohms ($\Omega$) of a one inch cube of soil, measured from
opposite sides of the cube.

It vary according to type of soil from 340 ohm- cm for Clay
to 4.5 lakhs ohm-cm in rock.

81.How to improve the earthing system where the soil resistivity is on higher side?

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By providing four nos.of grounding bore well for a diameter of 9 inch for a depth of 50 feet at the sub station corner area and provided with 6 inch dia GI pipe and side area filled with Ground Enhancing Material (GEM) upto 10 feet depth from the top surface.All these pipes shall be connected to SS ground grid.The no. of bore pipes may be restricted according to the SS requirement.

Ground wells are a common solution for GIS substations installed in urban areas with desert type sandy soil.

82.What is Ground Potential Rise (GPR)?

GPR is the maximum voltage rise the earth grid sees relative to remote earth during a fault.

GPR= Ig x Rg
Where,
Ig : Ground grid current.

Rg : Ground resistance.

GPR occurs when large amounts of electricity enter the earth which is typically caused when substations or high-voltage towers fault,(fault current) or when lightning strikes occur .

We cannot have more than 5000V as  GPR.

83. What about providing concrete floor in the switch yard?

  Since the concrete resistivity could be  as high as 3000 ohm-cm, which  have significant impact reducing the step and touch  potentials.

As the reinforced concrete floor will be essentially an equipotential surface with no significant step and touch potentials.
But,care should be taken to have only gravel spread area around the transformer to prevent oil fire.

84. What is DC Offset in a
Power system?

The asymmetrical response to the fault in an AC Power system is  called DC Offset and it is a naturally occurring phenomenon of an electrical system.

A sine waveform has a DC offset if the average value of the waveform over an half positive period is not zero.

85. How a DC component can occur in an AC Power system?

A short circuit can occur at any time (from 0 to 360 deg) during the sine-wave cycle.
If a  fault occurs after zero degree and cleared within the positive  half cycle(i.e.180 deg),the average value of which  will be positive DC current and that is how the DC component enters the AC power system while clearing the assymetrical  faults in the system.

86. Why DC offset occurs in a Power system ?

DC offset occurs in a Power system since
Current cannot change instantaneously in an inductive network and always  lag or lead the applied voltage by it's natural power factor.

87. Which determines the decay of DC offset in a power system?

The decay of the DC component is a function of the system X/R ratio looking into the fault.

It is also a function of the voltage phase angle at the time of the fault, so it will be different in each phase.

The X/R Ratio (power factor) of the system determine how rapidly  the DC current decay and also
on the L/R ,time constant of the system.

Higher the X/R ratio ,faster the decay.

88. What are the evil effects of the DC component in the power system?

This DC component, which will decay dependent on  L/R ,time constant, can easily  saturate  the CTs, as well as the fault

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sensing of the protective relays.
In addition, when the fault current is interrupted, the resulting DC tail can maintain the current above the relay's pickup setting for a time dependent on the CT's secondary circuit L/R time constant affecting the protection.

89. When DC offset will not occur in the power system?

Faults that occurs and cleared in the first current zero crossing itself,won't produce DC offset while those occur at current maximum and voltage max produce DC offset.
DC current appear in the AC system only when the fault occurs other than zero current crossing.

90. What is the effect of DC Offset on transformers?

If the DC offset during asymmetrical current faults could drive a substantial DC current through the primary winding , saturate the core (usually 1.8 Tesla) get DC saturated so that the inductance is reduced and primary current increases.

Apparently, the DC-offset fault is cleared in most cases within five cycles which may be about 1.6 to 1.7 times the symmetrical fault current as a worst case.