UNIT-I CAUSES OF OVERVOLTAGES AND OVER CURRENTS
2 MARK QUESTION AND ANSWERS

1. Why protection of transmission line important?

It is essential for electrical power engineers to reduce the number of outages and preserve the continuity of service and electric supply.

2. What are the causes of over voltages in electric system?

(i) Lightning over voltages
(ii) Switching overvoltages

3. How does switching over voltage originate?

Switching over voltages originate in the system itself by connection and disconnection of circuit breaker contact or due to initiation or interruption of faults.

4.What is Isokeraunic level?

Isokeraunic level is defined as the number of days in a year when thunder is heard or recorded in particular location.

5. What are the factors that influence the lightning induced voltage on transmission lines?

(i) The ground conductivity
(ii) The leader stroke current
(iii) Corona

6. How is transmission lines classified?

Lines with no loss or ideal lines
(i)Line without distortion or distortion less lines
(ii)Line with small losses
(iii)Lines with infinite and finite length defined by all the four parameters

7. Define attenuation and distortion.

The decrease in the magnitude of the wave as it propagates along the line is called attenuation. The elongation or change of wave shape that occurs is called distortion.

8.How is attenuation and distortion caused?

Attenuation is caused due to the energy loss in the line an distortion is caused due to to the inductance and capacitance of the line.

9. What are the causes for the change of induction on transmission line?

The changes in the inductance are due to the skin effect, the proximity effect and non-uniform distribution effect of the currents and the nearness to steel structures.

10. What are the causes for the change of capacitance on transmission line?

The variation in capacitance is due to capacitance change in the insulation nearest to the ground structures, etc.

11.What is the effect of corona on transmission lines?

The effect of corona is to reduce the crest of the voltage wave under propagation, limiting the peak value to the critical corona voltage. Hence, the excess voltage above the critical voltage will cause power loss by ionizing the surrounding air.

12.What are the principles observed in the lattice diagram?

(i) All waves travel down hill, i.e, into the positive time.

(ii) The position of the wave at any instant is given by means of the time scale at the left of the lattice diagram

(iii) The total potential at any instant of time is the super position of all the waves which arrive at that point until that instant of time, displaced in position from each other by time intervals equal to the time difference of their arrival

13.Define corona.

The traveling wave is divided into a number of sections corresponding to different voltage levels, each voltage level corresponding to a different velocity of propagation since each lamination ionizes a different capacitance. Hence, a distortion is caused in the wave shape.

14. What are the components of switching surges?

Switching surges may include high natural frequencies of the system, damped normal frequency voltage component or the restriking and recovery voltage of the system with successive reflected waves from terminations.

15. How does switching surges cause damage to circuit breaker?

In circuit breaking operation, switching surges with a high rate of rise of voltage may cause repeated restriking of the arc between the contact of a circuit breaker, thereby causing destruction of the circuit breaker contacts.

16. What are the factors of origin of switching surges?

(i) De-energizing of transmission lines, cables, shunt capacitor banks

(ii) Disconnection of unloaded transformer, reactors

(iii) Energization or reclosing of lines and reactive load

(iv) Sudden switching off of loads

(v) Short circuit and fault clearance

(vi) Resonance phenomenon

14.Give the factor for over voltages generation in EHV system.

Over voltages are generated in EHV system when there is sudden release of internal energy

stored either in the electrostatic form in the electromagnetic form.

15.Give the situation that give rise to switching over voltages of short duration and lower magnitude.

(i) Single pole closing of circuit breaker
(ii) Interruption of fault current when the L-G or L-L fault is cleared
(iii) Resistance switching used in circuit breakers
(iv) Switching lines terminated by transformer
(v) Series capacitor compensated lines
(vi) Sparking of the surge diverter located at the receiving end of the line to limit the lightning over voltages.

16.What are the different method by which switching over voltages of short duration and long magnitude be calculated?

(i) Mathematical modeling of a system using digital computer
(ii) Scale modeling using transient network analyzers
(iii) By conducting field tests to determine the expected maximum amplitude of the over voltages and their duration at different points on the line.

17.What are the different measures to control or reduce over voltages?

(i) One step or multi step energisation of lines by preinsertion or resistors
(ii) Phase controlled closing or circuit breakers with proper sensors
(iii) Drainage or trapped charges on long lines before the reclosing of the lines
(iv) Limiting the over voltages by using surge diverter.

18.What are the causes for power frequency and its harmonic over voltages?

(i) Sudden loss of loads
(ii) Disconnection of inductive loads or connection of capacitive loads
(iii) Ferranti effect, unsymmetrical faults
(iv) Saturation in transformers

19.How are the over voltage of power frequency harmonics and voltage with frequency measure the operating frequency caused?

These are caused during tap changing operations, by magnetic or Ferro resonance phenomena in large power transformers and by resonating over voltages due to series capacitors with shunt reactors or transformers.

20.What are the methods to control over voltages due to switching?

(i) Energization of transmission lines in one or more steps by inserting resistance and withdrawing then afterwards
(ii) Phase controlled closing of circuit breakers
(iii) Drainage of trapped charges before reclosing

(iv) Use of shunt reactors

(v)Limiting switching surges by suitable surge diverters.

21.Give the factor by which over voltages due to lightning strokes can be minimized or avoided in practice.

(i) Shielding the over head lines by using ground wires above the phase wires

(ii)Using the ground rods and counter poise wires

(iii) Including protective devices like expulsion gaps, protector tubes on the line and surge diverters at the line terminations and substations.

22.Where is surge arrester placed in substation?

Surge arresters are devices used at substations and at line terminations to discharge the lightning over voltages and short duration switching surges. These are usually mounted at the line end at the nearest point to he substation. They have a flash over voltage lower than that of any other insulation or apparatus at the substation.

13 MARK QUESTIONS

1. Explain the different theories of charge formation in clouds.
2. What are the mechanisms by which lightning strokes develop and induce over voltages onover head power lines?
3. Give the mathematical models for lightning discharges and explain them.
4. What are the causes for switching and power frequency over voltages? How are they controlled in power system?
5. Explain the different methods employed for lightning protection of over head lines.
6. Explain with suitable figures the principles and functioning of (a) Expulsion gaps (b) Protector tubes.
7. What is a surge arrester? Explain its function as a shunt protective device?
8. What is meant by insulation co-ordination? How are the protective devices chosen for optimal insulation level in a power system?
9. Write short notes on: (a) Rod gaps used as protective devices (b) Ground wires for protection of over head lines.
10. Derive the expression for the voltage and current waves on the long transmission lines and obtain the surge impedance of the line.
11. Explain the different aspects of insulation design and insulation co-ordination adopted for EHV systems.
12. A three phase single circuit transmission line is 400 km long . If the line is rated for 220 kV and has the parameter, R=0.1 ohms/km, L= 1.26 mH/km, C=0.009μF/km and G=0 . Find (a) Surge impedance and (b) the velocity of propagation neglecting the resistance of the line. If the surge of 150 kV and infinitely long tail strikes at one end of the line, what is the time taken for the surge to travel to the other end of the line?
13. An infinite rectangular wave on a line having a surge impedance of 500Ω strikes a transmission line terminated with a capacitance of 0.004μF, Calculate the extent to which the wave front is retarded?
14. An under ground cable of inductance 0.189 mH/km and of capacitance 0.3μF/km is connected to an over head line having an inductance of 1.26mH/km and capacitance of 0.009μF/km. Calculate the transmitted and reflected voltage and current waves at the junction, if the surge of 200kV travels to the junction (i) along the cable (ii) along the over head line.
15. A transmission line has the following line constants R=0.1 Ω/km, L= 1.26 mH/km and C= .009μF/km and G=0. If the line is a 3 phase line and is charged from one end at a line voltage of 230kV, find the rise in voltage at the other end , if the line length is 400km.

Unit II-BREAKDOWN IS GASES, LIQUIDS AND GASES

2 MARK QUESTION AND ANSWERS

1.What are the different gases that are used as insulating medium?

Air, Nitrogen, carbon dioxide, Freon and sulphur hexa fluoride.

2.What are the various phenomena that occur inn gaseous dielectric?

When the applied voltage is low, small currents flow between the electrodes and the insulation retains its electrical properties. On the other hand, if the applied voltages are large, the current flowing through the insulation increases very sharply and an electrical breakdown occurs.

3. What is break down voltage?

The maximum voltage applied to the insulation at the moment of breakdown is called the breakdown voltage.

4. Give the types of electrical discharge in gases.

(i) Non sustaining discharges
(ii) Self sustaining discharges

5.Define spark breakdown and ionization.

The break down in a gas, called spark breakdown is the transition of a non-sustaining discharge into self sustaining discharge.

The build-up of high current s in a breakdown is due to the process known as ionization in which electrons and ions are created from neutral atoms or molecules and their migration to the anode and cathode respectively leads to high currents.

6. Give the theories that explain the mechanism for breakdown.

(i) Townsend theory
(ii) Streamer theory

7.What are the conditions in the gases that govern the ionization process?

(i) Pressure
(ii) Temperature
(iii) Electrode field configuration
(iv) Nature of electrode surfaces
(v) Availability of initial conducting particles

8.Define the elastic collision & inelastic collision.

Elastic collision are collisions which when occur, no change takes place in the internal energy of the particles but only their kinetic energy gets redistributed.

Inelastic collision are those in which internal changes in energy take place within an atom or a molecule at the expense of the kinetic energy of the colliding particles.

9. Define electron drift velocity.

The electron drift velocity which has been defined as the average velocity, with which the centre of mass of the electron swarm moves in the direction of the field.

10. What is Maxwellian distribution?

The Maxwellian distribution has been found to apply where there is thermal equilibrium between the electrons and molecules.

$$F(\varepsilon) = C_1 \varepsilon^{0.5} \exp(1.5 \varepsilon/ \varepsilon)$$

11.What is Druyesteynian distribution?

Druyesteynian distribution applies when the electron or ion energy is much greater then the thermal energy and is therefore expected to be more of application in transcend discharges.

$$F(\varepsilon) = C_2 \varepsilon^{0.5} \exp(-0.55 \varepsilon^2/ \varepsilon^{-2})$$

12. Define collision cross section.

Collision cross section is defined as the area of contact between two particles during collision. The total area of impact.

13. What is mean free path?

The mean free path is defined as the average distance between collisions. When the discharge occurs large number of collisions occurs between the electrons and the gas molecules.

14. What are the different processes by which radiation can be absorbed by atom?

i. Excitation of the atom to a higher energy state
ii. Continuous absorption by direct excitation of the atom or dissociation of diatomic molecule or direct ionization

15.Define the secondary ionization process.

The secondary ionization processes by which secondary electrons are produced are the one which sustain a discharge after it is established due to ionization by collision and photo ionization.

16.What is an electron attachment collision?

The types of collisions in which electrons may become attached to atoms or molecules to form negative ions are called attachment collisions. Electron attachment process depends on the energy of the electron and the nature of the gas.

17.Define time lag.

The time difference between the application of a voltage sufficient to cause breakdown and the occurrence of breakdown itself is called the time lag.

18.On what factors does time lag depend?

i. Statistical time lag- Pre ionization , size of the gap and quantity of radiation
ii. Formative time lag – Mechanism of the avalanche growth in the gap, transit time.

19.What is Paschen's Law?

V=f(pd);P-pressure, d-distance

20.What are the effects of corona?

(i) Loss of power
(ii) Deterioration of insulation
(iii) Rise to radio interference.

21.Define corona.

If the field is non-uniform an increase in voltage will first cause a discharge in the gas to appear at points with highest electric filed intensity namely at sharp points or where the electrodes are curved or on transmission lines. This form of discharge is called a corona discharge.

13 MARK QUESTIONS

1. Describe the current growth phenomenon in a gas subjected to uniform electric fields.
2. Define Townsend's first and second ionization coefficients. How is the condition for breakdown obtained in a Townsend discharge?
3. Derive the criterion for breakdown in electronegative gases.
4. What are the anode and the cathode streamers? Explain the mechanism of their formation and development leading to breakdown.
5. What is Paschen's law? How do you account for the minimum voltage for breakdown under a given 'p x d' condition?
6. Explain the various theories that explain breakdown in commercial liquid dielectrics.
7. What is stressed oil volume theory, how does it explain breakdown in large volumes of commercial liquid dielectrics?
8. What do you understand by "intrinsic strength" of a solid dielectric? How does breakdown occur due to electrons in a solid dielectric?
9. Explain the different mechanisms by which breakdown occurs in solid dielectrics in practice.
10. Describe the mechanism of short term breakdown of composite insulation.

UNIT III-GENEATION OF HIGH VOLTAGES AND HIGH CURRENTS

2 MARK QUESTION AND ANSWERS

1.Give the different forms of high voltages.

(i) High dc voltages
(ii) High ac voltages of power frequency
(iii) High ac voltages of high frequency
(iv) High transient or impulse voltages of very short duration
(v) Transient voltages of longer duration.

2.Give the circuits that produce high dc voltages.

(i) Half wave and full wave rectifier circuit
(ii) Voltage doubler circuit
(iii) Voltage multiplier circuit
(iv) Van de Graaff generators

3.On what factors does ripple δV depend?

(i) The supply voltage frequency ,f
(ii) The time constant CR_L
(iii) The reactance of the supply transformer, X_L

4.Give the circuits that produce high dc voltages.

(i) Cascade transformers
(ii) Resonant transformers

5.How is ripple voltage kept low?

The ripple voltage is kept as low as possible with the proper choice of the filter capacitor and the transformer reactance for a given load R_L.

6.What is the use of regulator circuit?

The Dc voltage regulator consists of detecting elements actuated by the detector in such a manner as to correct the changes.

7.What are the types of regulator?

(i) Series type
(ii) Shunt or parallel type

8.What are the chief advantages of resonant transformers?

(i) It gives an output of pure sine wave.
(ii) Power requirement are less

(iii) No high power arcing and heavy current surges occur if the test object fails, as resonance ceases at the failure of the test object
(iv) Cascading is also possible for very high voltages.
(v) Simple and compact test arrangement
(vi) No repeated flashovers occur in case of partial failures of the test object and insulation recovery.

9.Give the advantages of high frequency transformers.

(i) The absence of iron core in cost and size
(ii) Pure sine wave output
(iii) Slow build-up of voltage over a few cycles and hence no damage due to switching surges.
(iv) Uniform distribution of voltage across the winding coils due to subdivision of coil stack into a number of units.

10.What are the components of multistage impulse generator?

(i) DC charging set
(ii) Charging resistors
(iii) Generator capacitors and spark gaps
(iv) Wave shaping resistors and capacitors
(v) Triggering system.
(vi) Voltage dividers
(vii) Gas insulated impulse generator.

11.What are the different circuits that are used for producing switching impulse voltage?

(i) Impulse generator circuit modified to give longer duration wave shapes
(ii) Power transformers or testing transformers excited by dc voltages giving oscillatory waves and these include tesla coil.

12.Define standard switching impulse voltage.

Standard switching impulse voltage is defined both by the Indian standards and the IEC, as 250/2500 μs wave, with the same tolerance for time to front and time to tail as those for the lightning impulse voltage wave and time to half value of (2500±500) μs

13. Define duration of wave.

The duration of the wave is defined as the total time of the wave during which the current is at least 10% of its peak value.

14. What are the essential parts of impulse current generator?

(i) DC charging unit giving a variable voltage to the capacitor bank.
(ii) Capacitors of high value each with very low self inductance, capable of giving

high short circuit currents.

(iii) An additional air cored inductor of high current value

(iv) Proper shunts and oscillograph for measurement purposes

(v) A triggering unit and spark gap for the initiation of the current generator.

15.Define peak to peak ripple.

Peak to peak ripple is defined as the difference between maximum and minimum dc voltages.

16.Define time to front if a impulse voltage waveform.

Time to front of an impulse voltage waveform is defined as 1.25 times the interval between 0.1 to 0.9 of peak value.

17.What is the use of tesla coil?

Tesla coil is used for generation of high frequency ac voltages.

18. What is trigatron gap?

A trigatron gap consists of a high voltage spherical electrode of suitable size, an earthed main electrode of spherical shape and a trigger electrode through the main electrode.

19.What are the methods available for measuring ac voltages of power frequency?

(i) Series impedance ammeters

(ii) Potential dividers

(iii) Potential transformers

(iv) Electrostatic voltmeters

(v) Sphere gaps

20.What are the methods available for measuring dc current?

(i) Resistive shunts with milli ammeter

(ii) Hall effect generators

(iii) Magnetic links

13 MARK QUESTIONS

1. Explain with diagram, different types of rectifier circuits for producing high d.c voltages.
2. Why is Cockcroft Walton circuit preferred for voltage multiplier circuits? Explain its working with a schematic diagram.
3. Give the expression for ripple and regulation in voltage multiplier circuits. How are the ripple and regulation minimized?
4. Describe with a neat sketch the working of a Van de Graaff generator. What are the factors that limit the maximum voltage obtained?
5. Explain the different schemes for cascade connection of transformers for producing very high a.c. voltages.
6. What is the principle of operation of a resonant transformer? How is it advantageous over the cascade connected transformer?
7. What is Tesla coil? How is damped high frequency oscillations obtained from a Tesla coil?
8. Give the Marx circuit arrangement for multistage impulse generators. How is the basin arrangement modified to accommodate the wave time control resistance?
9. Describe the circuit arrangement for producing lightning current waveforms in lab.
10. What is trigatron gap? Explain its functions and operations

UNIT IV-MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENT

2 MARK QUESTION AND ANSWERS

1. Why is measurement of high voltages and high current necessary?

In industrial testing and research laboratories, it is essential to measure the voltages and currents accurately, ensuring perfect safety to the personnel and equipment.

2.What are the methods available for measuring dc voltages?

(i) Series resistance micro ammeter
(ii) Resistance potential divider
(iii) Generating voltmeter
(iv) Sphere and other spark gaps

3.What are the methods available for measuring ac voltages of high frequency?

(i) Potential dividers with a cathode ray oscillograph
(ii) Peak voltmeters
(iii) Sphere gaps

4.What are the methods available for measuring ac voltages of power frequency?

(vi) Series impedance ammeters
(vii)Potential dividers
(viii) Potential transformers
(ix) Electrostatic voltmeters
(x) Sphere gaps

5.What are the methods available for measuring dc current?

(iv) Resistive shunts with milli ammeter
(v) Hall effect generators
(vi) Magnetic links

6.What are the methods available for measuring ac current of high frequency?

(i) Resistive shunts
(ii) Magnetic potentiometers
(iii) Magnetic links
(iv) Hall effect generators

7.What are the methods available for measuring ac current of power frequency?

(i) Resistive shunts
(ii) Electromagnetic current transformers

8.What are limitations in the series resistance design?

(i) Power dissipation and source loading
(ii) Temperature effects and long time stability
(iii) Voltage dependence or resistive elements
(iv) Sensitivity to mechanical stresses.

9.What is generating voltmeter?

A generating voltmeter is a variable capacitor electrostatic voltage generator which generates current proportional to the applied external voltage. The device is driven by an external synchronous or constant speed motor and does not absorb power or energy from the voltage measuring source.

10.What are the advantages and limitations of generating voltmeter?

Advantages:

(i) No source loading by the meter
(ii) No direct connection to high voltage electrode
(iii) Scale is linear and extension of range is easy
(iv) A very convenient instrument for electrostatic devices.

Limitations:

(i) They require calibration
(ii) Careful construction is needed and is cumbersome instrument requiring an auxiliary drive
(iii) Disturbance in position and mounting of the electrodes make the calibration invalid.

11.Give the different methods of measuring dc electric field strength.

(i) Variable capacitor field meter
(ii) Vibrating plate field meter
(iii) A.C field strength meter: capacitor probe

12.How series capacitance is formed in voltmeter for measurement?

The series capacitance is formed as a parallel plate capacitor between the high voltage terminal of the transformer and a ground plate suspended above it.

13.What are the advantages of capacitance voltage transformers (CVT)?

(i) Simple design and easy installation
(ii) Can be used both as a voltage measuring device for meter and relaying purposes and also as a coupling condenser for power line carrier communication and relaying.

14.What are the different ways by which sphere gap can be arranged?

Sphere gaps can be arranged either (i) Vertically with lower sphere grounded or (ii) horizontally with both sphere connected to the source voltage or one sphere grounded. In horizontally configurations, it is generally arranged such that both spheres are symmetrically at high voltage above the ground. The two shapes used are identical in size and shape.

15.Why is series resistance connected between the source and sphere gap?

A series resistance is usually connected between the source and the sphere gap to (i) limit the breakdown current and (ii) to suppress unwanted oscillations in the source voltage when breakdown occurs.

16.Give the factors that affect the spark over voltage of sphere gap.

(i) Nearby earthed objects
(ii) Atmospheric conditions and humidity
(iii) Irradiation
(iv) Polarity and rise time of voltage waveform.

17. What are the elements that cause different error in the potential divider for impulse voltage measurement?

(i) Residual inductance in the elements.
(ii) Stray capacitance occurring

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(i) Simple design and easy installation

(ii) Can be used both as a voltage measuring device for meter and relaying purposes and also as a coupling condenser for power line carrier communication and relaying.

(iii) Frequency independent voltage distribution along elements as against conventional magnetic potential transformers which require additional insulation design against surges.

(iv) Provides isolation between the high voltage terminal and low voltage metering.

22.What are the sources that contribute to the error?

(i) The effective value of the capacitance being different from the measured value of C.

(ii) Imperfect rectifiers which allows small reverse currents

(iii) Non-sinusoidal voltage waveforms with more than one peak or maxima per half cycle.

(iv) Deviation of the frequency from that of the value used for calibration.

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(i) Nearby earthed objects

(ii) Atmospheric conditions and humidity

(iii) Irradiation

(iv) Polarity and rise time of voltage waveform.

26.What are the different techniques for impulse current measurement?

(i) Rogowski coil

(ii) Magnetic links

(iii) Hall generators

(iv) Faraday generator

(v) Current transformer

27.What is hall voltage and hall coefficient?

If electric current flows through a metal plate located in a magnetic field perpendi9cular to it, Lorenz forces will deflect the electrons in the metal structure in a direction normal to the direction of both the current and the magnetic field. The charge displacement generates an emf in the normal direction, called the "Hall voltage". The Hall voltage is proportional to the current I a, the magnetic flux density B and the reciprocal; of the plate thickness, the proportionality constant R is called the "Hall coefficient"

$$V_H = R\ (Bi / d)$$

13 MARK QUESTIONS

1. Discuss the different methods of measuring high dc voltages. What are the limitations in each method?
2. Describe the generating voltmeter used for measuring high dc voltages.
3. What is capacitance voltage transformer? Explain with phasor diagram how a tuned capacitance voltage transformer can be used for voltage measurements in power systems.
4. Explain the principle and construction of an electrostatic voltmeter for high voltages. What are its merits and demerits for high voltage a.c measurement?
5. Give the basic circuit for measuring the peak voltage of (i) a.c voltage and (ii) impulse voltage. What is the difference in measurement technique in the above two cases?
6. Explain how a sphere gap can be used to measure the peak value of voltages. What are the parameters and factors that influence such voltage measurement?
7. Give the schematic arrangement of an impulse potential divider with an oscilloscope connected for measuring impulse voltages. Explain the arrangement used to minimize errors.
8. Explain the different method of high current measurement with their relative merits and demerits.
9. What are the different types of resistive shunts used for impulse current measurement? Discuss their characteristics and limitations.
10. What are the requirements of an oscillograph for impulse and high frequency measurement in high voltage test circuits?
11. Explain the necessity of earthing and shielding arrangements in impulse measurements and in high voltage laboratories. Give a sketch of the multiple shielding arrangements used for impulse voltage and current measurement.
12. What is mixed potential divider? How is it used for impulse voltage measurements?
13. The H.V arm of an RC divider has 15 numbers of 120 ohms resistors with a 20pF capacitor to ground from each of the junction points. The L.V arm resistance is 5 ohms. Determine the capacitance needed in the L.V arm for correct compensation.
14. A coaxial shunt is to be designed to measure an impulse current of 50 kA. If the bandwidth of the shunt is to be at least 10MHz and if the voltage drop across the shunt should not exceed 50 V, find the ohmic value of the shunt and its dimensions.
15. A Rogowski coil is to be designed to measure impulse current of 10kA having a rate of change of current of 10^{11}A/s. the current is read by a TVM as potential drop across the integrating circuit connected to the secondary. Estimate the values of mutual inductance, resistance and capacitance to be connected, if the meter reading is to be 10V for full scale deflection.

UNIT-V –TESTING AND INSULATION COORDINATION

2 MARK QUESTION AND ANSWERS

1.What is the necessity of high voltage testing?

It is essential to ensure that the electrical equipment is capable of withstanding the over voltages that are met with in service. The over voltages may be either due to natural causes like lightning or system originated ones such as switching or power frequency transient voltages. Hence, testing for over voltages is necessary.

2.What are the classifications of over voltage test?

(i) Power frequency voltage test
(ii) Impulse voltage test.

3.Define disruptive discharge voltage.

Disruptive discharge voltage is defined as the voltage which produces the loss of dielectric strength of insulation. It is that voltage at which the electrical stress in the insulation causes a failure which includes the collapse of voltage and passage of current.

4.Define withstand voltage

The voltage which has to applied to a test object under specified conditions in a withstand test is called the withstand voltage.

5.Define fifty percent flashover voltage.

This is the voltage which has a probability of 50% flashover, when applied to test object.

6.What is hundred percent flashover voltages.

The voltage that causes a flashover at each of its applications under specified conditions, when applied to test objects as specified , is hundred per cent flash over voltage.

7.Define creepage distance.

It is the shortest distance on the contour of the external surface of the insulator unit or between two metal fittings on the insulator.

8.Give the absolute parameters for testing.

(i) Temperature : 27 degrees
(ii) Pressure : 1013millibars
(iii) Absolute humidity : 17 gm / m^3

9. What is type test and routine test?

Type test are intended to prove or check the design features and the quality. The routine tests

are intended to check the quality of the individual test piece.

10. Give the different power frequency test.

(i) dry& wet flashover test
(ii) wet & dry flashover test

11.What is dry& wet flashover test?

If the test is conducted under normal conditions without any rain or precipitation it is called dry flash over test. If the test is done under conditions of rain it is called wet flash over test.

12.What is wet & dry flashover test?

In these test, the voltage specified in the relevant specification is applied under dry or wet conditions for a period of one minute with an insulator mounted as in service conditions.

13.Give the different impulse test.

(i) Impulse withstand voltage test.
(ii) Impulse withstand flash over test.
(iii) Pollution test.

14.Define the impulse withstand voltage test.

This is the test done by applying standard impulse voltage of specified value under dry conditions with both positive and negative polarities of the wave. If five consecutive waves do not cause a flash over or puncture, the insulator is deemed to have passed the test.

15.What is the various type of pollution?

(i) Dust, micro organisms, bird secretions flies
(ii) Industrial pollution
(iii) Coastal pollution
(iv) Desert pollution
(v) Ice and fog deposits.

16.What are the different types of power frequency test for bushing?

(i) Power factor voltage test
(ii) Internal or partial discharge test
(iii) Momentary withstand test at power frequency.
(iv) One minute wet with stand test at power frequency
(v) Visible discharge test at power frequency.

17.What are the different types of impulse voltage test for bushing?

(i) Full wave withstand test
(ii) Chopped wave with stand and switching surge test.
(iii) Temperature rise and thermal stability tests.

18. Define an isolator.

An isolator or a disconnector is a mechanical switching device, which provides in the open position, an isolating distance in accordance with special requirements.

19. What does testing of circuit breaker intended to evaluate?

(i) The constructional and operational characteristics

(ii) The electrical characteristics of the circuit which the switch or breaker has to interrupt or make.

20.What are the various methods of conducting short circuit test?

(i) Direct test

(ii) Synthetic test

21.Give the advantage and disadvantages on field test.

Advantages:

(i) The circuit breaker is tested under actual conditions

(ii) Special occasions

(iii) To assess the thermal and dynamic effects of short circuit currents, to study applications of safety devices and to revise the performance test procedures.

Disadvantages:

(i) The circuit breaker can be tested at only a given rated voltage and network capacity.

(ii) The necessity to interrupt the normal service and to test only at light load conditions.

(iii) Extra inconvenience and expenses in installation of controlling and measuring equipment in the field.

22.What are the different test conducted on circuit breaker and isolator?

(i) The dielectric test

(ii) The temperature rise test

(iii) The mechanical test

(iv) The short circuit test.

23.What are the different tests available for testing cables?

(i) Mechanical test

(ii) Thermal duty tests

(iii) Dielectric power factor test

(iv) Power frequency withstand voltage test

(v) Impulse withstand voltage test

(vi) Partial discharge test

(vii) Life expectancy test.

24.Give the methods of testing transformers.

(i) Induced over voltage test

(ii) Partial discharge test.

25.What is the purpose of impulse testing of transformers?

The purpose of the impulse test is to determine the ability of the insulation of the transformers to withstand the transient voltages due to lightning, etc.

26.What is the sequence of impulse testing?

(i) Applying impulse voltage of magnitude 57% of the Basic impulse Level(BIS) of the transformer under test.

(ii) One full wave voltage of 100% BIL.

(iii) Two chopped waves of 100% BIL

(iv) One full wave of 100% BIL

(v) One full wave of 75% BIL

27.What are the different methods by which fault in transformer insulation is located in impulse test?

(i) General observations

(ii) Voltage oscillogram method

(iii) Neutral current method.

(iv) Transferred surge current method.

28.Give the various test methods on surge arresters.

(i) Power frequency spark over test

(ii) Hundred percent standard impulse spark over test

(iii) Front of wave spark over test

(iv) Residual voltage test

29.What are the conditions for surge arrester to pass the test?

(i) The power frequency spark over voltage before and after the test does not differ by more than 10%.

(ii)The voltage and current waveforms of the diverter do no differ significantly in the two applications

(iii) The non-linear resistance elements in the diverter do not show any sign of puncture or external flashover.

30.Give the conditions for diverter to pass the test.

(i) The power frequency spark over voltage before and after the application of the current wave does not differ by 10%.

(ii) The voltage across the arrester at the first and the last application does not differ by more than 8%

31.What are the conditions for arrester to pass the test?

(i) The average power frequency spark over voltage before and after the test does not differ by more than 10%

(ii) The residual voltage at the rated current does not vary by more than 10%

(iii) The follow-on power frequency current is interrupted each time

(iv) No significant change signs of flashover or puncture occur to the prorated unit.

32.Give the other tests that are conducted on surge arrester.

(i) Mechanical test like porosity test , temperature cycle test, etc

(ii) Pressure relief test

(iii) The voltage withstand test on the insulator housing of the diverter

(iv) The switching surge flashover test

(v) The pollution test.

33.What are the requirements of a protective device connected in parallel?

(i) It should not usually flashover for power frequency over voltages

(ii) It should be capable of discharging high energies contained in surges and recover insulation strength quickly.

(iii) It should not allow power frequency follow-on current to flow.

34.What are the different types of surge arrester used?

(i) Silicon carbide arresters with spark gaps

(ii) Silicon carbide arresters with current limiting gaps

(iii)The gapless metal oxide arrester.

35What are the insulation level and protective safety margin?

(i) Selecting the risk of failure

(ii) The statistical safety factor

(iii)Then fixing the withstand voltage and designing the insulation level of any equipment or equipment or apparatus corresponding to 90% or 95% of the withstand voltage thus fixed.

13 MARK QUESTIONS

1. What are the different power frequency tests done on insulators? Mention the procedure for testing.
2. What is the significance of impulse tests? Briefly explain the impulse testing of insulators.
3. What are the significance of power factor tests and partial discharge tests on bushing? How are they conducted in the laboratory?
4. Mention the different electrical tests done on isolators and circuit breakers.
5. Why is synthetic testing advantageous over the other testing methods for short circuit tests? Give the layout for synthetic testing.
6. Explain the partial discharge tests on high voltage cables. How is a fault in the insulation located in this test?
7. Explain the method of impulse testing of high voltage transformers. What is the procedure adopted for locating the failure?
8. What is an operating duty cycle test on a surge arrester? Why is it more significant than other tests?
9. Explain the importance of RIV measurement for EHV power apparatus.
10. Explain with a schematic diagram one method of measuring RIV of transmission line hardware.