Chettinad College of Engineering & Technology Approved by AICTE-New Delhi and Affiliated to Anna University-Chennai		
Academic Year 2024-2025		
Question Bank		
Year/Semester: III/V **Date:13/08/2024**	**Department : EEE** **Subject Code/Title : EE3037&Power System Transients** **Faculty Name : Mrs.S.Malarkodi, AP/EEE**	**Unit: I, II, III, IV,V** **Section : Part A/B/C**

UNIT – 1

INTRODUCTION AND SURVEY

PART-A (2-MARKS)

1. **Define power system transients**(Nov/Dec 2011)
   The power system transient is the outward manifestation of a sudden change in circuit conditions as when a switch opens or closes or a fault occurs on a system. The transient period is very short.
2. **State the principle of superposition**
   According to the superposition principle, in any linear system if a stimulus S1 produces a response R1 and a stimulus S2 produces a response R2 then S1 and S2 applied simultaneously will evoke a response R1+ R2.
   The principle is not restricted to two stimuli but is true for any finite number.
3. **Mention the application of superposition principle in the determination of transient.**
   a) Due to the opening of switch in a circuit, the current is interrupted. The net current flowing in the circuit is zero due to this opening. (i.e) an injected current I2 flows in opposite direction to the existing current I1.
   b) According to superposition if the emf and the injected current I2 are applied simultaneously, the total response will be the sum of individual responses. The combined response will give the circuit's response to the interruption and will include all transient effects.
4. **Mention the limitations of superposition principle**.
   The superposition principle can be applied only in linear circuits. For the nonlinear devices such as saturable devices like iron cored reactor and unloaded transformer, this is not applicable. Since here the current is not directly proportional to voltage. For nonlinear resistors such as protective devices, the principle of superposition should not be applied.
5. **Mention the sources of power system transients**(Nov/Dec 201, 2013)(May/June 2012)
   The sources of transients are classified as,
   a) Internal sources
   b) External sources

The internal sources are classified as

a) Switching surges i.e., due to the opening and closing of a switch in power system
b) Insulation failures
c) Arcing ground
d) Ferro resonance

6. What is current chopping?

Current chopping is the production of high voltage transient across the contacts of air blast circuit breaker. When breaking low currents i.e., unloaded transformer or reactor magnetizing current, the powerful deionizing effect of air blast causes the current zero well before the natural current zero is reached. This phenomenon is called chopping and produces high voltage transients across the breaker circuits.

7. What is meant by ferroresonance?

Resonance causes high transient voltage in the power system. In usual transmission lines the capacitance is very small so that resonance rarely occurred in power system at normal frequency. However if generator emf wave is distorted, the trouble of resonance may occur dueto 5^{th} or higher harmonics. This phenomenon is called as ferroresonance, since the inductance involved is usually iron cored.

8. What are the causes of switching surges?

The making and breaking of electric circuits with switch gear may result in abnormal transient over voltages in a power system having large inductance and capacitances. The differentsituation under which this happens are summarized as

a) Interruption of low inductive currents by high speed circuit breaker
b) Interruption of small capacitance currents (switching operation of unloaded lines).
c) Ferroresonance
d) Energisation of loaded line.

9. What is meant by arcing ground?

The phenomenon of intermittent arc taking place in line to ground fault of a three phase system with consequent production of transients is known as arcing ground. Arcing ground can be prevented by earthing the neutral.

If the neutral of three phase wires was not earthed in long high voltage transmission lines a serious problem called arcing ground is produced. The arcing ground produces severe oscillations of three to four times the normal voltage.

10. What is meant by lightning?

An electric discharge between cloud and earth, between clouds or between the charge centers of the same cloud is known as lightning. Lightning is a huge spark and takes place when cloudsare charged to such a high potential with respect to earth or neighboring cloud.

11. What are types of lightning?

a) Direct strike

b) Indirect stroke

12. What are the types of power system transients?(Nov/Dec 2011)

a) Ultra-fast transients
b) Medium fats transients
c) Slow transients

13. What are the effects of lightning? (Nov/Dec 2011)

Lightning produces a steep fronted voltage wave on the line. The voltage of this wave may rise from zero to peak value in about 1μs and decay to half the peak value in about 5μs.

14. What is meant insulation failure?

The insulation failure between line and earth which high voltage in the system. Suppose a line at potential V is earthed at point C, the earthing of line causes two equal voltages – v travel along the main wire and return wire. Due to insulation failure, the current to earth is twice the ratio of voltage to impedance.

15. What is meant by subsidence transients?

When a disturbance such as a fault occurs on the primary of transformer, then subsidence transient is produced. Due to this sudden reduction of voltage produces on the primary.

16. Show the power system transients with respect to time duration.

S.No	Nature of the transient phenomena	Time duration
1.	Lightning	0.1μs – 1.0ms
2.	Switching	10μs to less than a second
3.	Sub synchronous resonance	0.1ms – 5 seconds
4.	Transient stability	1ms – 10 seconds
5.	Long term dynamics	05. – 1000 seconds
6.	Tie-line dynamics	0.5 – 1000 seconds
7.	Daily load managements, operating action	Upto 24hrs

PART-B&C

1. **Examine the sources of transients? Also explain how transients affect the power Systems**
2. **Derive and explain RL circuit transient with sine wave excitation.**
3. **Explain the double frequency transients with necessary diagrams.**
4. **Derive an expression for the transient current in RLC.**

UNIT-2 SWITCHING TRANSIENTS

PART-A (2-MARKS)

1. Define load switching.

The frequent functions performed by switching devices are to switch on and switch off load(ie)load switching which is represented by a parallel RL circuit.Low power factor loads are inductive and high power factor loads are resistive.When a high pf load is switched off, the effective capacitance of load becomesimportant in determining the form of transient produced.

2. What is meant by current chopping?

When breaking low currents(ie)unloaded transformer or reactor magnetizing current, the powerful deionizing effect of air blast circuit breaker(CB) causes the current abrupbtly to zero well before the natural current zero is reached.

3. Define capacitance switching.

The shunt capacitors are employed to correct a lagging power factor, or in some cases, to provide voltage support for the system. In some applicationsthey are switched in and out quite frequently as the system load varies and the system fluctuates. The switching operations are nontrival and should be carefully considered when designing capacitor banks and their associated switching equipment.

4. What is meant by ferroresonance?

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5. What is meant by abnormal switching transients?

Due to some other circumstances like transients the voltage and current magnitude may rise high. The transients occur due to the trapping of energy and its subsequent release somewhere in the circuit. Such transients are referred as abnormal current and voltage transients.

6. Define arcing ground.

If the neutral of three phase wires was not earthed in long enough voltage transmission lines a serious problems called arching ground is produced. The arching ground produces severe oscillations of three to four times the normal voltage. The phenomenon of intermittent arc takes place in line to ground fault of a three phase system with consequent production of transients is known as arching ground.

7. What is meant by resistance switching?

A deliberate connection of a resistance in parallel with the contact space (arc) is made to overcome the effect of transient recovery voltage. This is known as resistance switching.

8. Define switching transients.

The switching transient is initiated whenever there is sudden change of circuit conditions. This transient is most frequently developed due to switching operations such as the closing of a switch (or) circuit breaker to energies a load. The opening of a circuit breaker to clear a fault.

9. Give the relation between time constant of parallel and series circuit.

Time constant of parallel circuit Tp=RC Time constant of series circuit Ts=L/R

10. State the principle of superposition.

According to the superposition principle, in any linear system if a stimulus produces S1 produce a response R1 and a stimulus S2 produces a response R2 then S1 and S2 applied simultaneously will evoke a response R1+R2. The principle is not restricted to two stimuli but is true for any finite number.

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13. What are the causes of switching surges?

The making and breaking of electric circuits with switch gear may result in abnormal transient over voltages in a power systems having large inductances and capacitances. The different situations under which happens are summarized as, 1. Interruption of low inductive currents by high speed circuit breaker. 2. Interruption of small capacitance currents. 3. Ferro resonance. 4. Energisation of loaded line.

14. What are the types of power system transients?

a) Ultra fast transients b) Medium fast transients c) Slow transients.

15. Why the air blast circuit breakers are more sensitive to restriking voltage transient?

In air blast circuit breaker it is observed that the rate at which dielectric strength of the gap increases is lower than the oil C.B. Since air has a much lower dielectric strength than the gases at the same temp and pressure in oil CB. The dielectric strength of a gas increases with pressure. Thus the air blast CB is more sensitive to the restriking voltage transient.

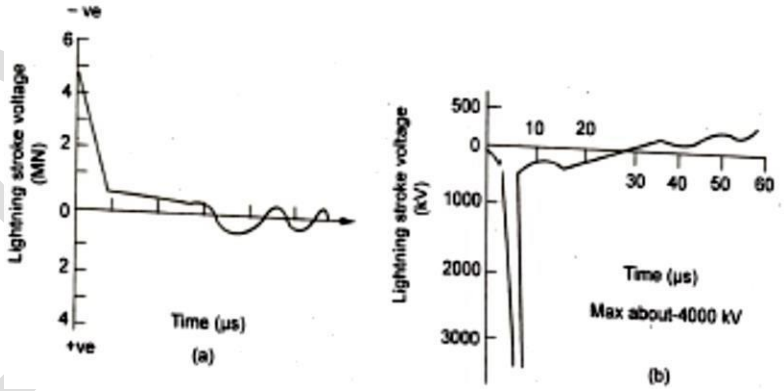
PART-B &C

1. Explain resistance switching with equivalent circuit.
2. Explain with appropriate waveform (a) current suppression (b) current chopping (c) ferro resonance condition.
3. Explain load switching with equivalent circuit.
4. What is capacitance switching? Explain in brief the effect of source regulation and capacitance switching with a restrike.
5. Write short notes on ferroresonance effect.
6. Explain the appropriate waveform, the capacitance switching with one and multiple restrikes.
7. Explain the switching in both normal and abnormal conditions with neat sketches.
8. Describe about the Current chopping phenomenon in ac system?
9. Explain how can switching surges affects the capacitive circuits.

UNIT-3 LIGHTNING TRANSIENTS

PART-A (2-MARKS)

1. Give the measurement details of induced voltage on overhead lines due to lighting.



2. What is the significance of tower footing resistance? *

The tower footing resistance is particularly important parameters in determination of lightning flashover rates. The lower the value of tower footing resistance helps in reduction of the peak voltage at the tower top is obtained. It is defined as, the resistance offered by tower footing to the dissipation of current. The value of tower footing resistance can influence the lightning performance of transmission line.

3. Define isokeraunic level or thunderstorm days?

The keraunic number is a system to describe lightning activity in an area based upon the audible detection of thunder. It is defined as the average number of days per year when thunder can be heard in a given

area, and the likelihood thereby of a thunderstorm. An isokeraunic map plots contours of equal keraunic number.

4. **What is ground wire? ***
   Transmission line towers are interconnected by ground wires, installed to reduce the voltages induced on the phase conductors by lightning strokes to nearby ground and to shield phase conductors from direct lightning strokes. Ground wires also named as shield wires hang above the phase conductors in the tower and are electrically connected with the tower frame.

5. **State the parameters and characteristics of the lightning stroke. ***
   The parameters and characteristics of lightning mainly includes the amplitude of the currents, the rate of rise, the probability distribution, magnitude and wave shapes of the lightning return stroke current or voltage, charge in the lightning flash and velocity of the return stroke. Basically lightning phenomenon is a random in nature. Occurrences of successive lightning discharges are not same. Hence the measurement of its characteristics is extremely difficult due to random nature of lightning.

6. **What is charging of thunder clouds**?
   When the rising ice crystals collide with graupel, the ice crystals become positively charged and the graupel becomes negatively charged. The updraft carries the positively charged ice crystals upward toward the top of the storm cloud.

7. **What is called charge formation?**
   Mason considered that the thunder cloud is a uniform mixture of both positive and negative charges which gets separated vertically by hailstones and air currents. According to the theory given by Wilson and others, the rate at which the charge getting accumulated in the cloud is relatively slow. The positive and negative charges in the cloud get separated vertically due to hailstones and air currents.

8. **What are the factors contributing to a good line design? ***
   Ground wires with sufficient mechanical strength must be located to shield the line conductors adequately from direct strokes. Adequate clearance from the line conductor to the tower or to ground must be maintained so that the full effectiveness of the insulating structure can be obtained.

9. **List out the important characteristics of lightning. ***
   The parameters and characteristics of lightning mainly includes the amplitude of the currents, the rate of rise, the probability distribution, magnitude and wave shapes of the lightning return stroke current or voltage, charge in the lightning flash and velocity of the return stroke. Basically lightning phenomenon is a random in nature. Occurrences of successive lightning discharges are not same. Hence the measurement of its characteristics is extremely difficult due to random nature of lightning.

10. **Mention different theories of charge formation.**
    *Mason considered that the thunder cloud is a uniform mixture of both positive and negative charges which gets separated vertically by hailstones and air currents.
    *According to the theory given by Wilson and others, the rate at which the charge getting accumulated in the cloud is relatively slow.

11. Write the equation for tower footing resistance. *

Tower footing resistance is the resistance offered by tower footing to the dissipation of current. The effective of a ground wire depends to a large extend on the lower footing resistance. The voltage and the current transmitted into the tower will depend upon the surge. impedance of the tower and ground impedance (i.e., the tower-footing resistance) of the tower. Taking all the factors into consideration such as wave shape, the magnitude of lightning current striking the tower, surge impedance, potential wave at the top of the tower, footing impedance, etc.

The tower-footing resistance is given by, R=V/I ohm

The value of tower-footing resistance should be always low. If the tower-footing resistance is low, the chances of occurrence of flashover are eliminated and the potential at the top of the tower is reduced. Always tower-footing resistance is connected in parallel with ground rods or counterpoise wires. If the tower-footing resistance is low, it helps in controlling the lightning over voltages on the lines effectively with the help of ground wires. The tower-footing resistance lies between 10-20 ohm. For medium-voltage transmission lines, it is less than 10 ohm. Thus in order to keep the tower-footing resistance low, some special arrangements are made.

12. What is the rate of charging of thunder clouds?

The equation gives rate of charging of thunder Q_sh clouds

$$Q_g = \frac{Q_s h}{v\lambda l[1 - e^{-\lambda t}]}$$

13. How would you modeling a lightning strike?

The modeling of lightning strike behavior and estimation of the subsequent electric discharge is of great practical importance. In this study, a complete two- dimensional physics-based analytic formulation is presented for elevated grounded systems that can be envisioned to be contained within two non-concentric circular domains.

14. Differentiate between direct and indirect lightning stroke.

Direct lightning stroke is the one which strikes either the phase conductors or the tower or shield (ground wire generates very high voltages in the power line Indirect lightning stroke is a very high voltage can be generated in the power line due to the stroke which hits the nearby ground. Such strokes are called indirect lightning stroke or induced lightning stroke.

15. What are the properties of good transmission line?

- Reduce the number of outages
- High ground impedance or tower footing resistance is to be avoided
- Incidence of strokes
- High surge impedance in ground wires, tower structures are to be avoided.

PART-B&C

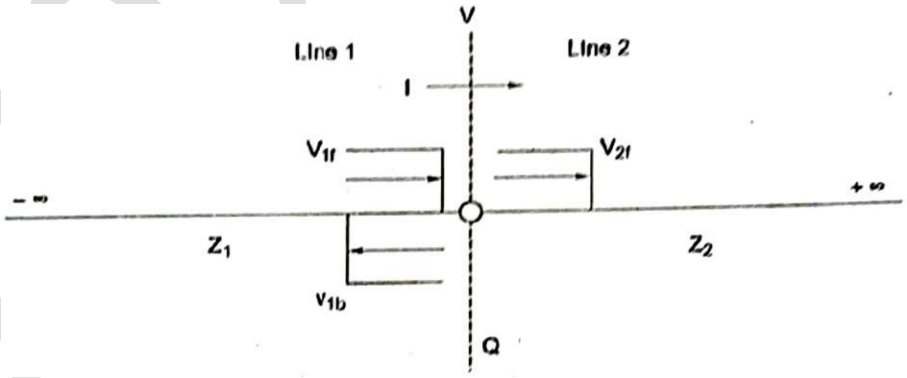
1. What are the two theories of charge formation in the clouds. Explain them in detail. (or) Explain the formation of thunder clouds with the aid of various theories. (8)
2. Explain the interaction between lightning and power system. (8) (or) Demonstrate how lightning interact with power system.
3. With a neat diagram, explain the protection offered by ground wires. (8) (or) How the ground wires protect the transmission line from lighting transients? Explain.
4. Discuss the mechanism of lightning discharge. (8) (or) Explain in detail with necessary diagram, the mechanism of lightning discharges and also the characteristics of the lightning strokes.
5. Explain the lightning protection schemes for transmission lines. (16)
6. Discuss in detail, the factors that contribute to good line design. How the ground wires are protected from lighting transients?
7. Sketch the characteristics of lightning strokes and also discuss parameters of lightning flash.
8. Derive an expression for the mathematical model for lightning.
9. Differentiate between direct and indirect lightning strokes.
10. Explain the mechanism of lightning discharge and concept of tower footing Resistance.
11. Sketch the characteristics of lighting strokes and also discuss the parameters of lightning flash.

UNIT-4

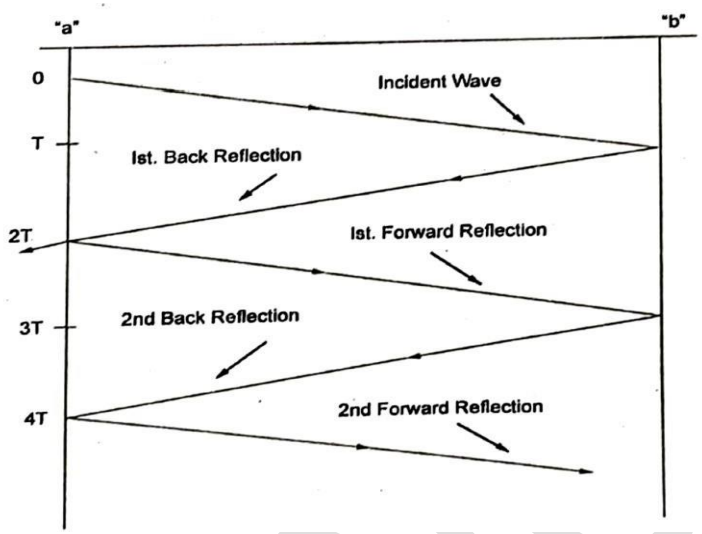
PART-A

TRAVELLINING WAVES ON TRANSMISSION LINE AND COMPUTATION OF TRANSIENTS.

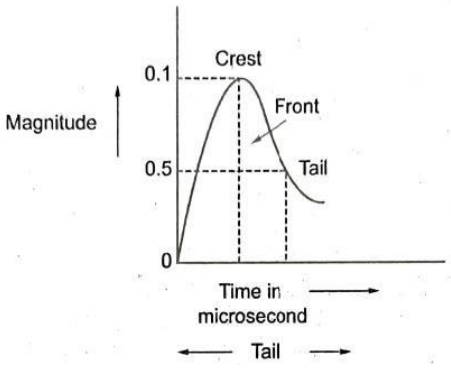
1. Draw the diagrams of meeting of two positive current waves in opposite directions.



2. **Draw the neat sketch of Bewley's lattice diagram.**

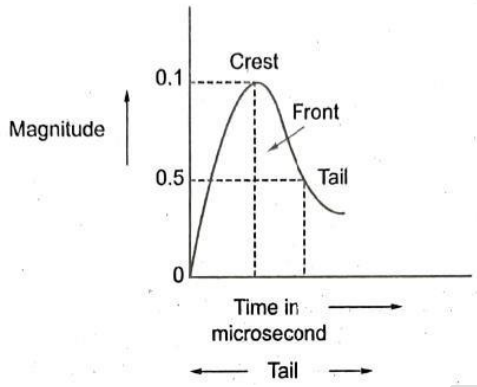


3. **Define crest and front of a travelling wave?**



Crest - it is the maximum aptitude of the wave, and it is expressed in kV or kA.
Front - It is the portion of the wave before the crest and is expressed in time from the beginning of the wave to the crest value in milliseconds or us.

4. **What are the specifications of a travelling wave?**
The travelling wave can be represented mathematically in a number of ways. It is most commonly representing in the form of infinite rectangular or step wave. A travelling wave is characterized by four specifications as illustrated in the figure below.



Crest - it is the maximum aptitude of the wave, and it is expressed in kV or kA.
Front - It is the portion of the wave before the crest and is expressed in time from the beginning of the wave to the crest value in milliseconds or us.
Tail - The tail of the wave is the portion beyond the crest. It is expressed in time from the beginning of the wave to the point where the wave has reduced to 50% of its value at its crest.
Polarity - Polarity of the crest voltage and value. A positive wave of 500 kV crest 1 us front and 25 us tail will be presented as +500/1.0/25.0.

5. **Write down the expressions for reflection coefficient and refraction coefficient.**
a= $[Z_B - Z_A / Z_A+Z_B]$ and is called the reflection coefficient $1 \leq a \leq +1$
b= $[2Z_B / Z_B + Z_A]$ and is called the refraction coefficient.

6. **Define lumped parameters**.
A lumped system is one in which the dependent variables of interest are a function of time alone. In general, this will mean solving a set of ordinary differential equations (ODEs) A distributed system is one in which all dependent variables are functions of time and one or more spatial variables.

7. **What are the principles observed in lattice diagram**?
   - All waves travel downward, because time always increases.
   - The position of any wave at any time can be deduced directly from the diagram.
   - The total potential at any point at any instant of time is the superposition of all the waves which have arrived at that point up until the instant of time, displaced in position from each other by intervals equal to the difference in their time of arrival.
   - The history and origin of the wave is easily traced. It is possible to find where it comes from and just what other waves went into its composition.
   - Attenuation is included, so that the wave arriving at the far end of a line corresponds to the value entering to the value entering multiplied by the attenuation factor of the line.

8. **What are standing waves? Define standing wave ratio.**
Standing wave, also called **stationary wave**, combination of two waves moving in opposite directions, each having the same amplitude and frequency. The phenomenon is the result of interference that is, when waves are superimposed, their energies are either added together or cancelled out.
The ratio of Vmax to Vmin is defined as the **standing wave ratio** (SWR, or S for short) and is given in

$$SWR = \frac{V_{max}}{V_{min}} = \frac{I_{max}}{I_{min}} = \frac{1+|K_F|}{1-|K_F|}$$

terms of the reflection coefficient at the termination by
The standing wave ratio is a measure for the amount of mismatch at the termination. The standing wave ratio for a matched termination is SWR = 1.

9. **What is attenuation? How they are caused**?
   Attenuation is a general term that refers to any reduction in the strength of a signal. Attenuation is caused by passive media components, such as cables, cable splices, and connectors.

10. **Define reflection and refraction coefficients**.
    A "reflection coefficient" is the operator determined on transition points, which permits the calculation of a reflected wave in terms of the incident wave. Likewise, the "refraction coefficient" gives the transmitted wave.

11. **Why step waves are considered to be dangerous to the apparatus**?
    Due to cause of maximum gradients and sustained tail producing oscillations, step waves are considered to be dangerous to the apparatus.

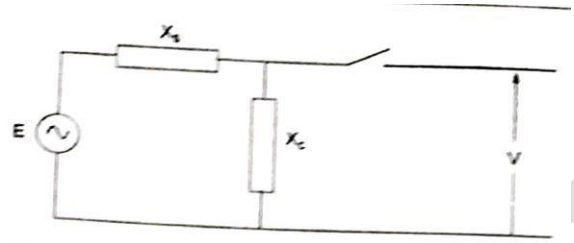
PART-B&C

1. Explore the steps involved in Bewely's lattice diagram construction with an example
2. Evaluate the value of current in a transmission line considering its series and shunt lumped parameters
3. Discuss and drive transient response of systems with series and shunt lumped parameters and Distributed lines
4. Draw the step response of a travelling wave. Explain it by using Bewely's lattice diagram
5. Derive the reflection and refraction co efficient of a travelling wave with diagrams
6. Describe briefly about standing waves and Standing Wave Ratio (SWR) and natural frequency
7. A long transmission line is energized by a unit step voltage 1.0 v at the sending end and is open circuited at the receiving end. Construct the Bewley lattice diagram and obtain the value of the voltage at the voltage receiving end after a long time. Take the attenuation factor $\alpha = 0.8$

UNIT-5 TRANSIENTS IN INTEGRATED POWER SYSTEM

PART-A

1. Write an expression for amplitude of the over voltage with circuit diagram during the load rejection.



Simplified equivalent ***circuit during load rejection***

$$V = E\left(\frac{X_C}{X_C - X_S}\right)$$

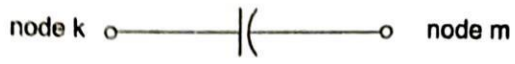
2. **Write a short note on EMTP.**
   - The EMTP became popular for the calculation of power-system transients especially a switching overvoltage from the viewpoint of and insulation design coordination of a transmission line and a substation in 1966.
   - The EMTP development was a part of system analysis computerization including a power/load flow analysis program and a stability analysis program. Before the EMTP, a transient network analyzer (INA) was used.
   - The EMTP was based on method of traveling wave analysis in a hydraulic system, well known as a water hammer.

3. **What is meant by kilometric fault? (or) Define short line or kilometric fault.**
   One interesting phenomenon is the short-line or kilometric faults on transmission lines. They are faults that occur at considerably short distances from the line sending end (usually a few kilometers). The natural frequencies of these shorter line sections will be very high (can eventually reach 100 kHz). Moreover, the shape of the recovery transient will deviate from the usually expected high frequency sinusoidal waveforms, and will exhibit instead several superimposed high-frequency ramp functions of both positive and negative slopes.

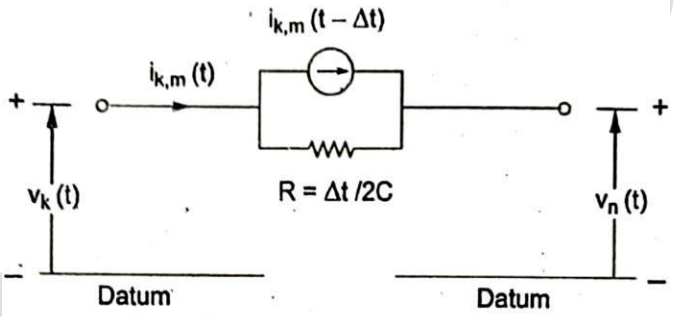
4. **Write the network calculation to model a transmission network of EMTP**.
   To compute the unknown voltages of the nodes, a set of equations is formulated by applying the nodal analysis (NA) method.

$$\begin{bmatrix} \frac{1}{R}+\frac{1}{R_L} & -\frac{1}{R_L} \\ -\frac{1}{R_L} & \frac{1}{R_L}+\frac{1}{R_C} \end{bmatrix} \begin{bmatrix} u_1(t_i) \\ u_2(t_i) \end{bmatrix} = \begin{bmatrix} \frac{v(t_i)}{R} \\ 0 \end{bmatrix} - \begin{bmatrix} I_L(t_i-\Delta t) \\ I_C(t_i-\Delta t)-I_L(t_i-\Delta t) \end{bmatrix}$$

5. **Draw the Norton's equivalent circuit to model a capacitor in a network for EMTP calculation**.



(a) Capacitance



(b) Equivalent impedance network

6. **What are the applications of EMTP?**
   - The EMTP is a comprehensive computer program designed to solve electrical transient problem in lumpy circuits, distributed circuits.
   - This program is capable of solving steady state circuit problems.
   - Transient analysis can be carried out in circuits with any arbitrary configuration of lumped parameters. (R,L & C)

7. **What are the effects of load rejection in power systems?**
   Load rejection: Power flow across impedance causes a voltage difference between the sending and receiving ends when the load has an inductive component. If the load is suddenly disconnected (load rejection), a power frequency voltage increase may result at the point of load.
   The amplitude of the overvoltage can be evaluated approximately as

$$V = E\left(\frac{X_C}{X_C - X_S}\right)$$

8. How will you calculate the probability of strikes for an overhead line?

   Lightning Strike Frequency: Although the frequency of lightning strikes might vary year to year, long term (usually many years to decades) maintained records give a statistical approximate number of expected strikes each year. This is usually referred as Isokeraunic Level.

   Overhead Hit Frequency: Strike radius is the scope of the ground elevated Structures or ground itself that will be exposed to lightning. This, usually calculated in meters, is very much dependent of lightning strike peak current Magnitude.

9. **Mention any four causes of switching surge**.
   - Interruption of low inductive currents by high speed circuit breaker
   - Interruption of small capacitance current
   - Ferro resonance
   - Energization of loaded line

10. What is the effect of switching surges in integrated power system?

The disturbance produced by the switching operation is modified by the interconnected system spreads through the system, setting up waves that travel along the lines and reflect to and from the open ends.

11. Distinguish between line dropping and load rejection

Voltage drop or line drop in general, on transmission lines the voltage s]simply decreases as one moves from the substation out forward the end of distribution feeder. This change in voltage is known as line dropping.

In real world, load rejection is when there is a fault on the transmission line which is sensed by the` protection system and trip the circuit breaker concern during that's tine the load connected with the feeder and lines are suddenly dropped (i.e) load throw off or load rejection occurs

12. **Mention the features of EMTP.(N/D-2014**)
    - Sophisticated computer program for the simulation electromagnetic Electromechanical and control system transients in multiphase power systems.
    - Advanced model of electrical machines
    - Detailed and precise models of lines and cables
    - Complete model of transformers etc.

13. Mention the effects of transients when switch is closed?(N/D-2013)

When a switch is suddenly closed immediately prior to the circuit being completed, certain voltage across the switch contacts. At the moment the contacts made by pre striking discharge, this voltage appears.

14. What are the potential advantages of EMTP?
    - EMTP is a comprehensive computer program defined to solve:
    - Electrical transient problems in lumpy circuits and distributed circuits
    - Steady- state circuit problems
    - Arbitrary configuration of lumped parameters
    - Distributed parameters, transposed (or) untransposed)

15. Which software do you suggested to solve electrical transient Problems? (M/J2014)
    - EMTP- Electro Magnetic Transient Analysis Program

PART-B &C

1. Examine the switching surges in a power system and also outline the concept of line dropping and load rejection in a power system.
2. Explain the voltage transients on closing and reclosing of lines and switching surges on integrated power system.
3. Interpret the need for simulation studies. Also describe the key points of EMTP software and the steps involved to do a simulation study of a sample power system.
4. Describe in detail about the causes of over voltages induced by various faults occurring in a power System.
5. Evaluate the reflection and transmission coefficient in an integrated power system.
6. Analyze the computation of Transients in power system using EMTP