CMR
INSTITUTE OF
TECHNOLOGY

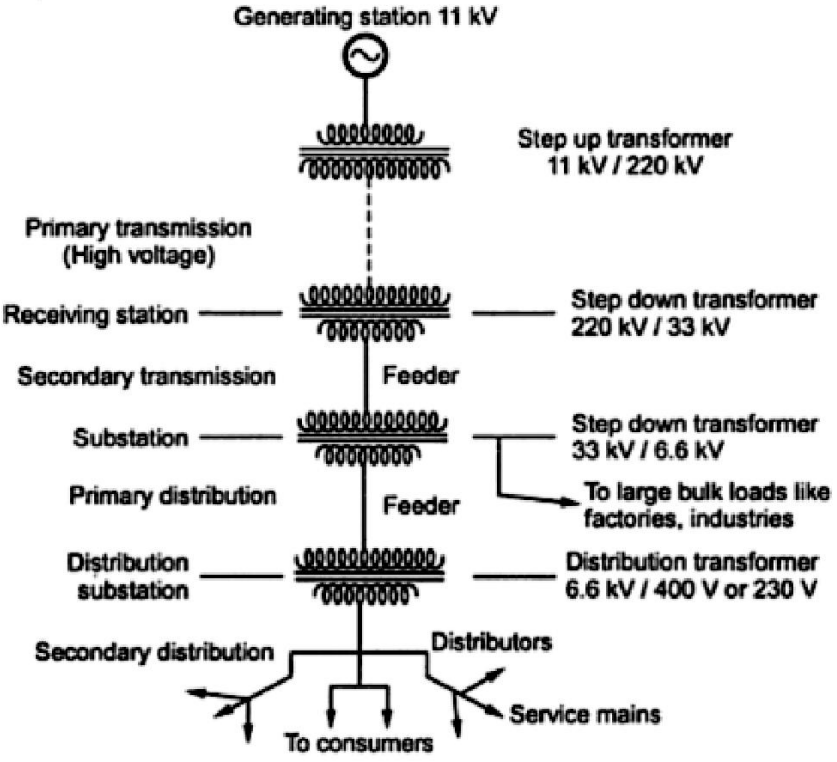
USN | | | | | | | | | | |

Internal Assesment Test - I

| Sub: | **Transmission & Distribution** | | | | | | | Code: | 21EE51 |
|---|---|---|---|---|---|---|---|---|---|
| Date: | 2/1/2024 | Duration: | 90 mins | Max Marks: | 50 | Sem: | V$^{th}$ | Branch: | EEE |

Answer **Any FIVE FULL** Questions

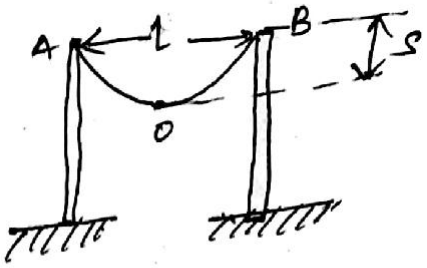
| | | Marks | OBE | |
|---|---|---|---|---|
| | | | CO | RBT |
| 1 | Draw the single line diagram of a 11KV transmission & distribution system indicating the standard voltage and explain in brief.<br>Diagram-5<br>Explanation-5 | 10 | CO 2 | L2 |
| 2 | With usual notations derive an expression for the sag of a transmission line when the supports are at equal & unequal levels.<br>DERIVATION OF SAG AT EQUAL VOLTAGES-5<br>DERIVATION OF SAG AT UNEQUAL VOLTAGES-5 | 10 | CO 2 | L2 |
| 3 | Derive an expression for string efficiency of a 3 disc string insulator.<br>EFFICIENCY DERIVATION-5 | 10 | CO 2 | L2 |
| 4 | What are the advantages of high voltage transmission and explain<br>ADAVATAGES & EXPLAINATION OF HIGH VOLTAGE TRANSMISSION-EACH- 3 MARKS | 10 | CO 2 | L2 |
| 5 | A transmission line has a span of 275m between level supports. The conductor has an effective diameter of 1.96 cm & weighs 0.265 kg/m. its ultimate strength is 2060Kg. if the conductor has ice coating of radial thickness 1.27 cm & is subjected to a wind pressure of 3.9 gm/cm2 of projected area, calculate sag for a safety factor of 3. Weight of 1cc of ice is 0.91 gm.<br>WT OF CONDUCTOR- 5 MARKS<br>SAG CALCULATION-5 MARKS | 10 | CO 2 | L3 |
| 6 | The towers of height 30m and 90m respectively support a transmission line conductor at water crossing .The horizontal distance between the towers is 500m.If the tension in the conductor is 1600kg, find the minimum clearance of the conductor and water and clearance mid way between the supports .Weight of conductor is 1.5kg/m. Base of the towers can be considered to be at water level.<br>WT 0F A CONDUCTOR-3 MARKS<br>SAG- 3 MARKS<br>CLEARANCE-4 MARKS | 10 | CO 2 | L3 |
| 7 | a.A single phase transmission line is supported by 3 disc insulator. The potential across top and middle unit are 7Kv and 13KV respectively. Calculate i) the ratio of capacitance between pin &earth to the self capacitance of each unit ii) line voltage iii) string efficiency k=0.57, V=55Kv, Eff= 87%<br><br>Write a short note about<br>i) Types of insulators-5 MARKS | 10 | CO 6 | L2 |




At the generating station, an electrical power is generated with the help of three phase alternators running in parallel. As shown in fig, the vlg level is 11kV but the vlg level may be 6.6kV, 22kV or 33kV depending upon the capacity of the generating station. After the generating station, the actual transmission & distribution scheme may be divided into four section namely.

## Sag :-

Sag is defined as the difference in level b/w the point of support & the lowest point on the conductor. is called



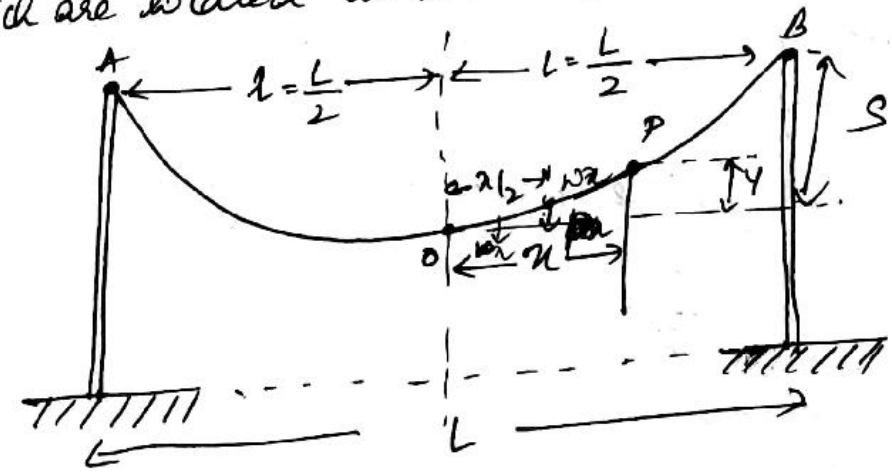

Consider an overhead transmission line suspended between the two supports A & B. where L represented the difference distance b/w the two pts. S denotes the Sag. O is the lower point on the conductor.

Sag calculation can be carried out on two conditions.

1. Supports supporting the conductors are at same level
2. Supports supporting the conductor at unequal level.

1. Supports at Equal level.

Consider a conductor supported by the 2 supports A & B which are located at same level as shown in fig




The point O is the lowest point on the trajectory. O' is the midspan as shown in fig.

Let $L$ = Length of span in meters

$w$ = weight per unit length of conductor in kg/m

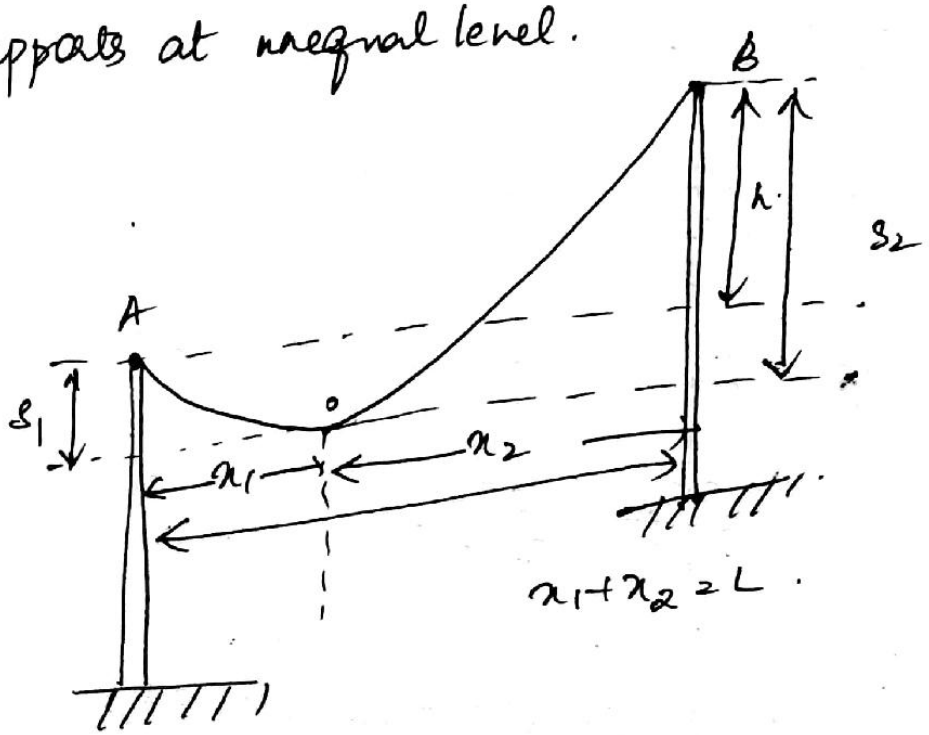
$T$ = Tension in the conductor in kg

The sag at any pt on the conductor is

$$= S - y$$

$$= \frac{wL^2}{8T} - \frac{wx^2}{2T} \qquad = \frac{w}{8T}\left[L^2 - 4x^2\right]$$

Supports at unequal level.



$$x_1 + x_2 = L$$

$$x_1 = L - \left[\frac{Th}{\omega L} + \frac{L}{2}\right]$$

$$\boxed{x_1 = \frac{L}{2} - \frac{Th}{\omega L}}$$

Once the $x_1$ & $x_2$ values are known, $S_1$ & $S_2$ can be determined.

3.

## Advantages of High Vlg transmission

1. It reduces the size (area of x-section of the core carrying the current) of the conductor material. This further reduces the cost of the supporting structure materials.
2. Cost of the conductor is reduced.
3. Wt of the conductor is reduced.
4. Reduction in line losses or copper losses ($I^2R$) due to reduced current.
5. Transmission efficiency is increased due to low line losses.
6. With increase in transmission Vlg, the current is reduced & Vlg drop in the lines is low. This leads to better Vlg regulation.

## Effect of High Vlg on volume of Copper

Let a 3ϕ ac s/m is used for the transmission.

P → power transmitted in KW
V → line Vlg in V
$\cos\phi$ → power factor of load
L ⇒ length in meters
ρ → Resistivity of conductor material.

③. Effect of High vlg on line drop

line drop = $I \times R$

line drop = $I \times \frac{\rho L}{A} = I \times \frac{\rho L}{(I/J)}$

$$\text{line drop} = J\rho L$$

$$\% \text{ line drop} = J\rho L \times 100$$

Higher the transmission vlg level, lesser is the % line drop.

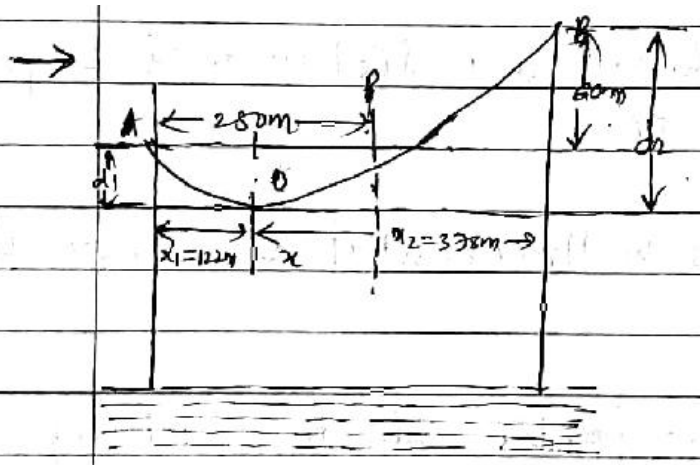
7

Properties:

1. High mechanical strength.
2. High electrical resistance.
3. High relative permeability.
4. Insulator material should be non-porus, free from impurities and crack.
5. High ratio of puncture strength to flash over-safety factor.

1. Pin type Insulators.
2. Suspension Type Insulators.
3. Strain Insulators.
4. Shackle insulators.

5.




$$x_1 = \frac{l - hT}{2wl}$$

Here $l = \frac{500}{2} = 250$ m,

$h = 90 - 30 = 60$ m

$T = 1600$ kg-wt

$w = 1.5$ kg-wt/m

$$\therefore x = \frac{250 - 60 \times 1600}{2 \times 1.5 \times 250}$$

$$= 250 - 128 = 122 \text{ m}$$

$$x_1 = 250 + 128 = 378 \text{ m}$$

$$d_1 = \frac{w x_1^2}{2T} = \frac{1.5 \times 122^2}{2 \times 1600} = 7 \text{ m}$$

As seen from fig. clearance of the lowest point O from the water level.

$= 30 - 7 = 23m$

The Horizontal distance of mid-point P from the reference point O is $x = (250 - 122) = 128m$.

The height of the point P above O is

$$d_{mid} = \frac{w x^2}{2T} = \frac{1.5 \times 128^2}{2 \times 1600} = 7.68m$$

Hence, clearance of mid-point above water level

$23 + 7.68 = 30.68m$

$$St = \frac{WtL^2}{8T}$$

$$= \frac{2.27 \times (300)^2}{8 \times 1030}$$

$$\boxed{St = 24.793\ m}$$