Chapter: 03

Electrical Supply Systems:

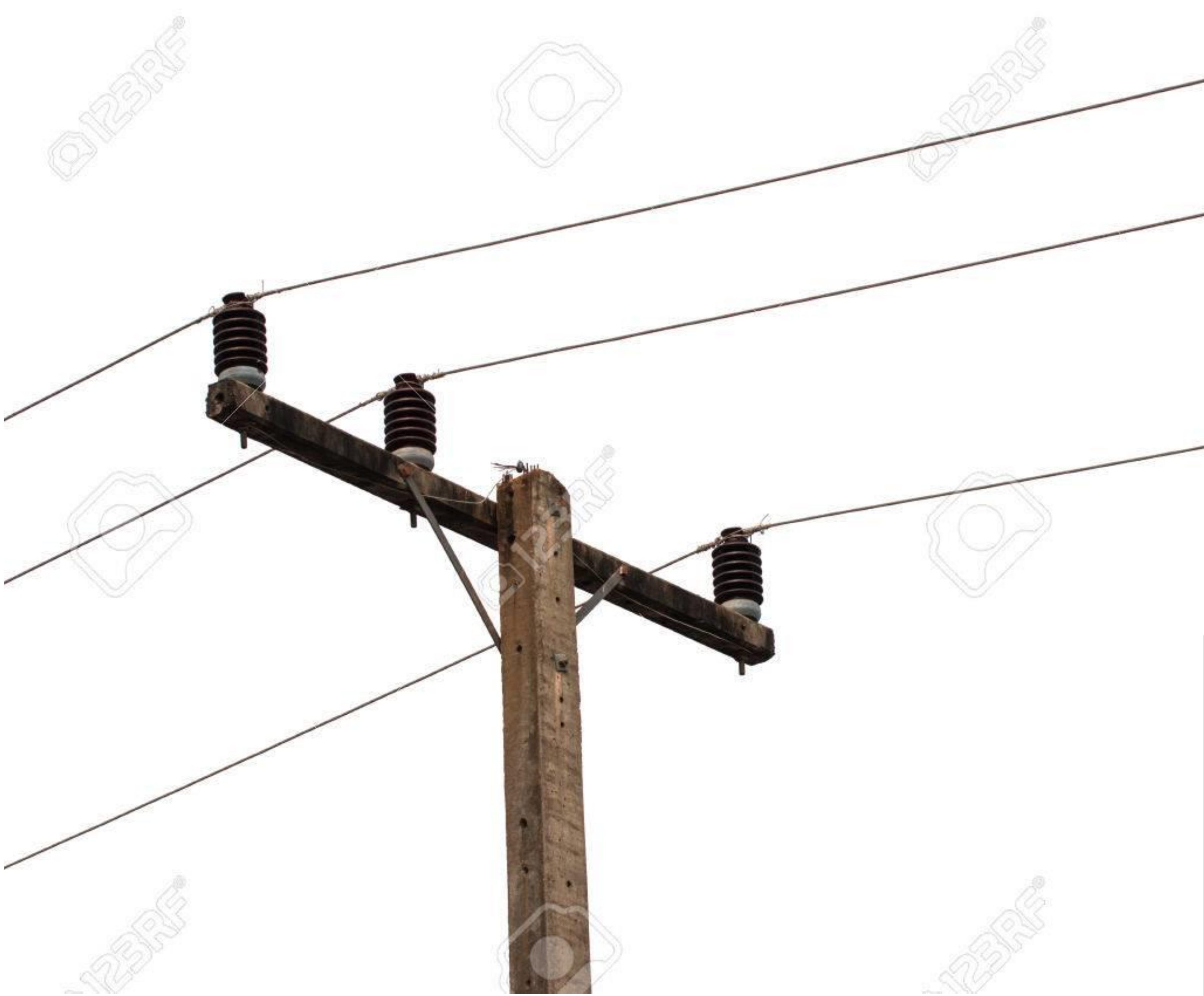
Lecture : 15

TOPIC:

1. AC Distribution – Methods of solving AC distribution problems

Chapter: 03
Electrical Supply Systems:

1. Electric supply system
2. Typical ac power supply scheme
3. Advantages of high transmission voltage
4. Overhead v/s underground systems
5. Requirements of a distribution system
6. Connection schemes of distribution system
7. AC Distribution – Methods of solving AC distribution problems
8. Four wires star connected unbalanced load, Examples.



14.2 Methods of Solving A.C. Distribution Problems

In a.c. distribution calculations, power factors of various load currents have to be considered since currents in different sections of the distributor will be the vector sum of load currents and not the arithmetic sum. The power factors of load currents may be given (*i*) *w.r.t.* receiving or sending end voltage or (*ii*) *w.r.t.* to load voltage itself. Each case shall be discussed separately.

(*i*) Power factors referred to receiving end voltage. Consider an a.c. distributor *A B* with concentrated loads of I_1 and I_2 tapped off at points *C* and *B* as shown in Fig. 14.1. Taking the receiving end voltage V_B as the reference vector, let lagging power factors at *C* and *B* be $\cos\phi_1$ and $\cos\phi_2$ *w.r.t.* V_B. Let R_1, X_1 and R_2, X_2 be the resistance and reactance of sections *A C* and *CB* of the distributor.

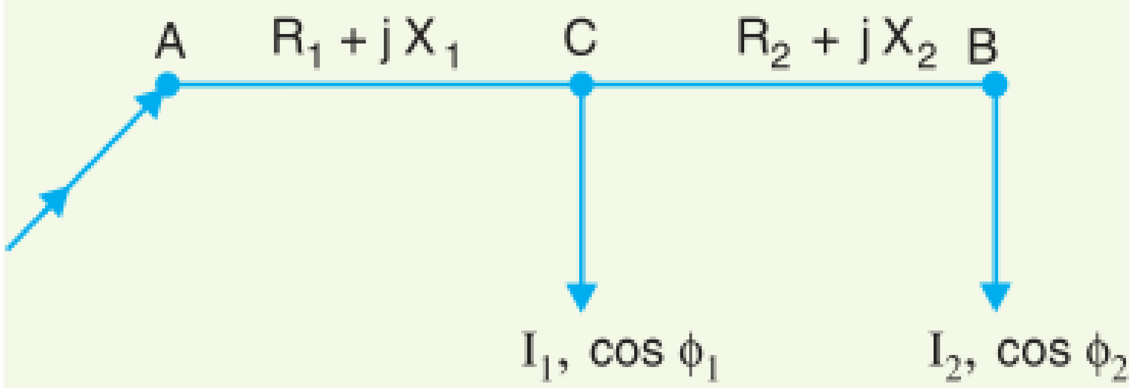


Fig. 14.1

Impedance Calculation

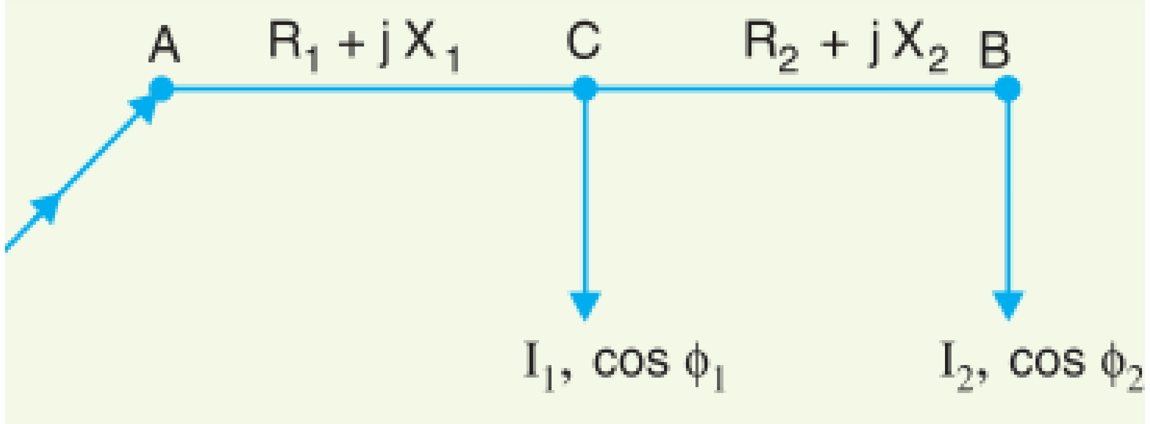


Fig. 14.1

Impedance of section AC, $\overrightarrow{Z_{AC}} = R_1 + j\,X_1$

Impedance of section CB, $\overrightarrow{Z_{CB}} = R_2 + j\,X_2$

Load Current and Section Current

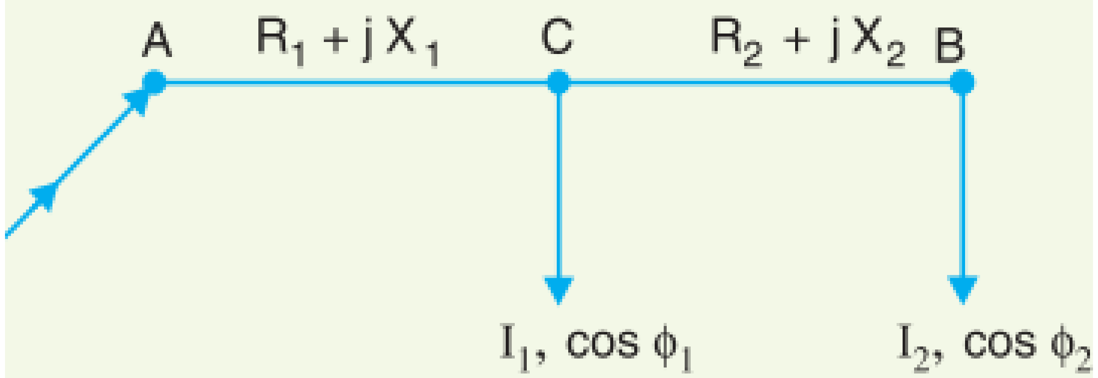


Fig. 14.1

Load current at point *C*, $\vec{I_1} = I_1(\cos\phi_1 - j\sin\phi_1)$

Load current at point *B*, $\vec{I_2} = I_2(\cos\phi_2 - j\sin\phi_2)$

Current in section *CB*, $\overrightarrow{I_{CB}} = \vec{I_2} = I_2(\cos\phi_2 - j\sin\phi_2)$

Current in section *AC*, $\overrightarrow{I_{AC}} = \vec{I_1} + \vec{I_2}$

$= I_1(\cos\phi_1 - j\sin\phi_1) + I_2(\cos\phi_2 - j\sin\phi_2)$

Voltage Drop Calculation in Each Section

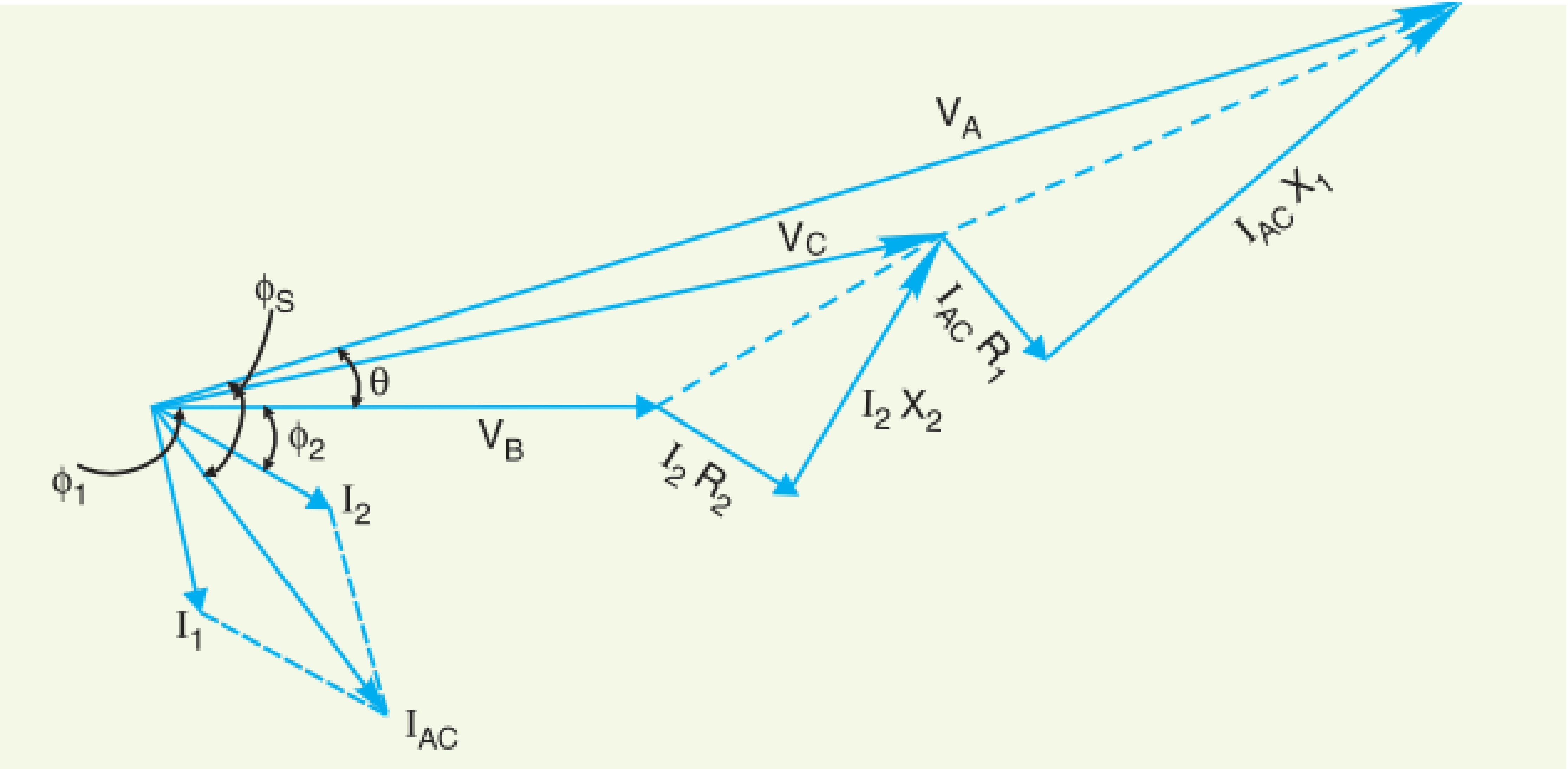
Voltage drop in section CB, $\overrightarrow{V_{CB}} = \overrightarrow{I_{CB}}\,\overrightarrow{Z_{CB}} = I_2(\cos\phi_2 - j\sin\phi_2)(R_2 + jX_2)$

Voltage drop in section AC, $\overrightarrow{V_{AC}} = \overrightarrow{I_{AC}}\,\overrightarrow{Z_{AC}} = \left(\overrightarrow{I_1} + \overrightarrow{I_2}\right) Z_{AC}$

$= [I_1(\cos\phi_1 - j\sin\phi_1) + I_2(\cos\phi_2 - j\sin\phi_2)]\,[R_1 + jX_1]$

Sending end voltage, $\overrightarrow{V_A} = \overrightarrow{V_B} + \overrightarrow{V_{CB}} + \overrightarrow{V_{AC}}$

Sending end current, $\overrightarrow{I_A} = \overrightarrow{I_1} + \overrightarrow{I_2}$



V_A
V_C
ϕ_S
θ
V_B
ϕ_1
ϕ_2
I_2
I_1
I_{AC}
$I_2 R_2$
$I_2 X_2$
$I_{AC} R_1$
$I_{AC} X_1$

Thank You