4.8 CAPACITANCE OF 3-CORE CABLES

The capacitance of a cable system is much more important than that of overhead line because in cables (*i*) conductors are nearer to each other and to the earthed sheath (*ii*) they are separated by a dielectric of permittivity much greater than that of air. Fig.4.8.1 shows a system of capacitances in a 3-core belted cable used for 3-phase system. Since potential difference exists between pairs of conductors and between each conductor and the sheath, electrostatic fields are set up in the cable as shown in Fig.4.8.1 (*i*). These electrostatic fields give rise to core-core capacitances *Cc* and conductor- earth capacitances C_e as shown in Fig.4.8.1 (*ii*). The three *Cc* are delta connected whereas the three C_e are star connected, the sheath forming the star point.

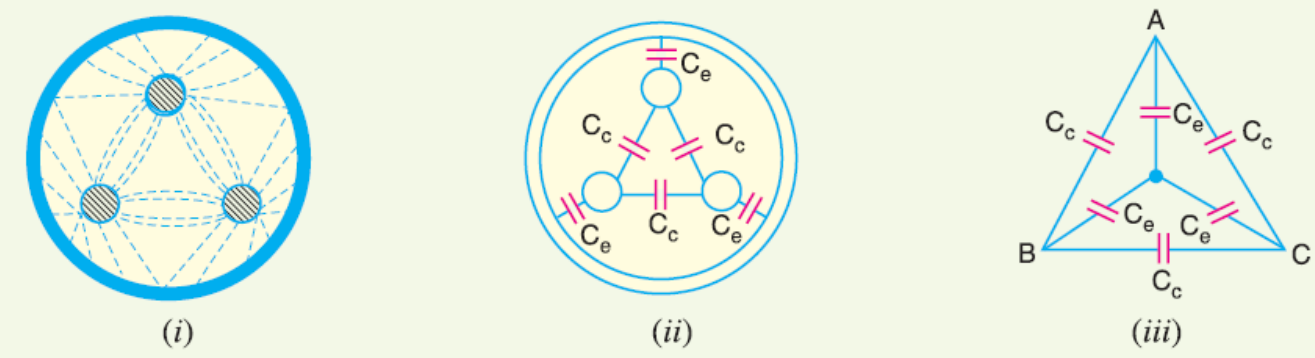

Figure 4.8.1 Capacitance of 3-Core Cables

[Source: "Principles of Power System" by V.K.Mehta Page: 288]

They lay of a belted cable makes it reasonable to assume equality of each *Cc* and each *Ce*. The three delta connected capacitances *Cc* [See Fig. 4.8.2 (*i*)] can be converted into equivalent star connected capacitances as shown in Fig. 4.8.2 (*ii*). It can be easily *shown that equivalent star capacitance *Ceq* is equal to three times the deltacapacitance *Cc i.e. Ceq* = 3*Cc*.

The system of capacitances shown in Fig. 4.8.1 (*iii*) reduces to the equivalent circuit shown in Fig.4.8.3 (*i*). Therefore, the whole cable is equivalent to three star-connected capacitors each of capacitance,

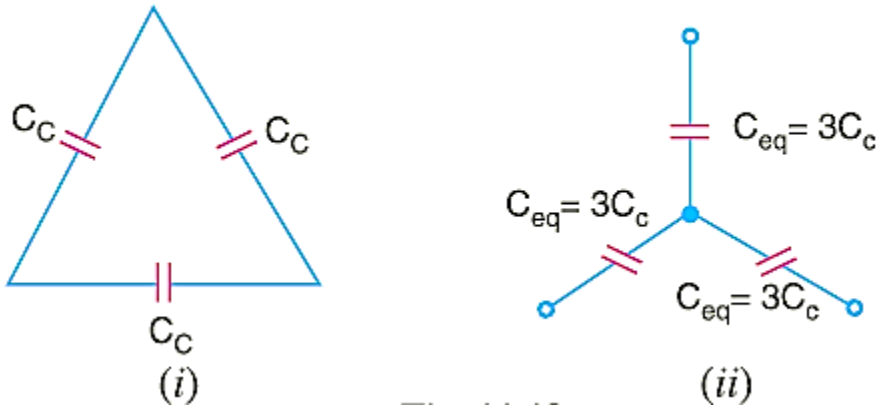

Figure 4.8.2 Delta Connected Capacitor of 3-Core Cables

[Source: "Principles of Power System" by V.K.Mehta Page: 288]

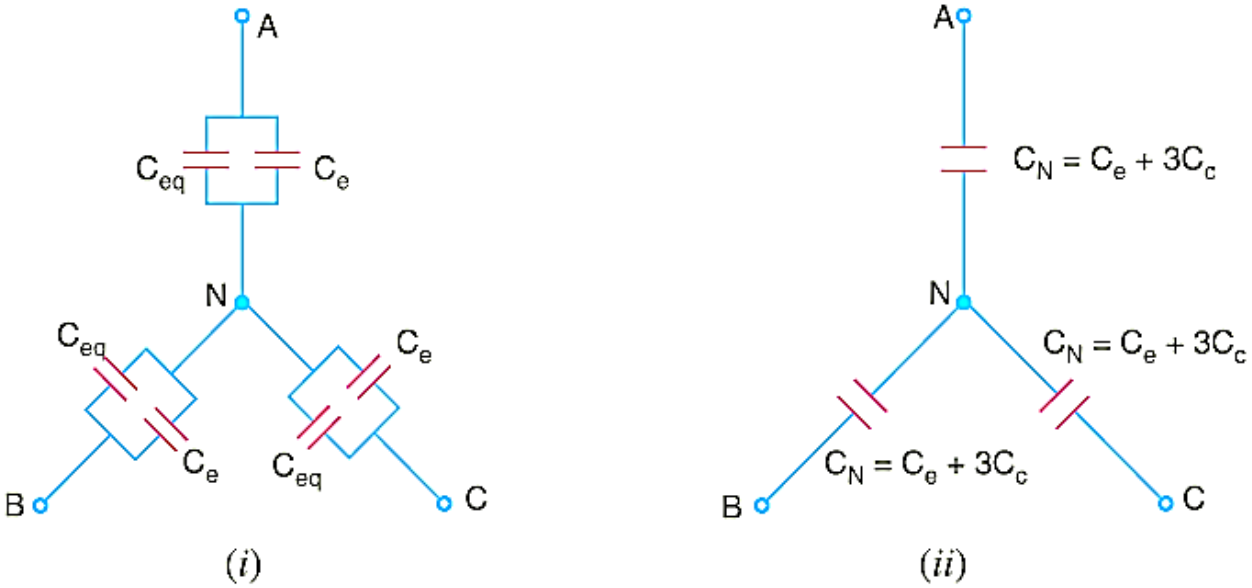

Figure 4.8.2 Star Connected Capacitor of 3-Core Cables

[Source: "Principles of Power System" by V.K.Mehta Page: 288]

$C_N = C_e + C_{eq}$

$= C_e + 3C_c$

If *Vph* is the phase voltage, then charging current I_C is given by ;

$$I_C = \frac{V_{ph}}{Capacitive\ reactance\ per\ phase}$$

$= 2\ \pi\ f\ V_{ph}\ C_N$

$= 2\ \pi\ f\ V_{ph}\ (C_e + 3C_c)$