Lecture-6

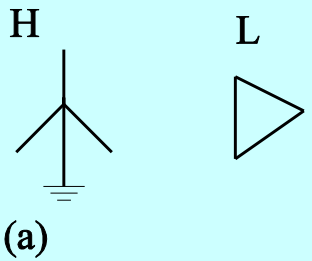
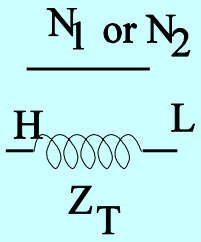
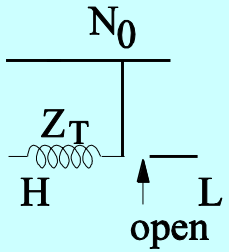
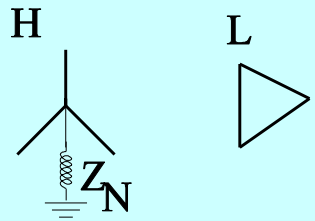
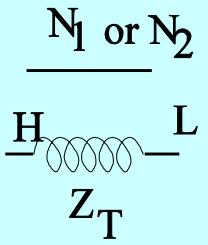
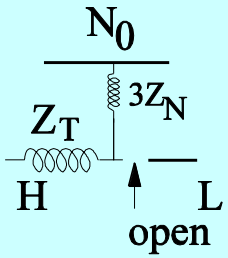
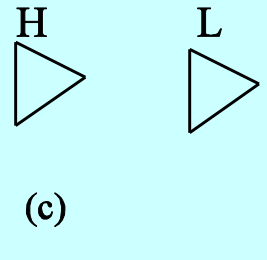
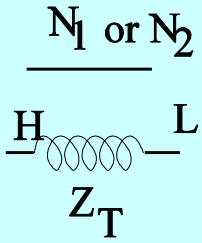
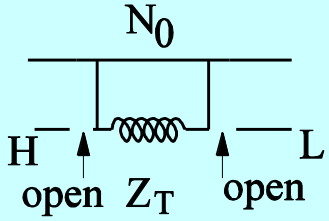
phase shift in star-delta transformation, sequence impedances.

Topic Covered

- Modeling
- Transformer connections
- Modeling of Synchronous Generator

Modeling Aspects for Static Apparatus

- Transmission Lines, feeder cables etc
- Two winding and Three Winding Transformers
  - Positive sequence Data = Negative sequence Data.
  - Zero Sequence Data different
    Rule of Thumb for Lines---
    Zero Sequence Data about Three Times Positive Sequence Data.
  - Zero Sequence Modes of Transformers.

Transformer connections	+ ve/- ve sequence connections	Zero sequence connections
		
		
		

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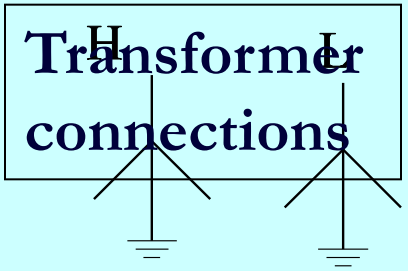
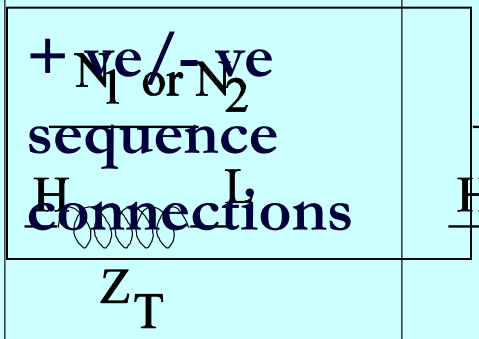
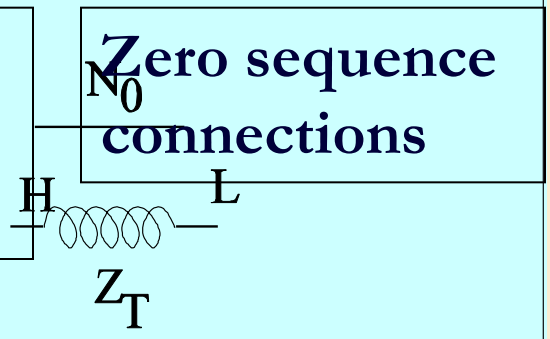
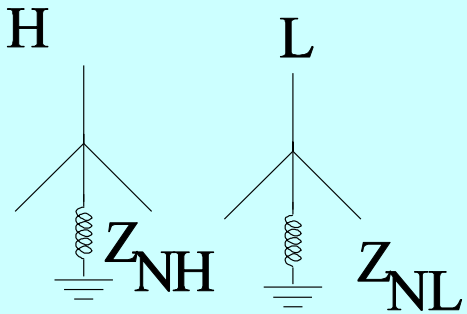
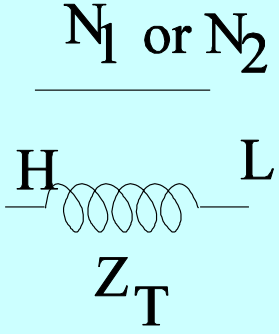
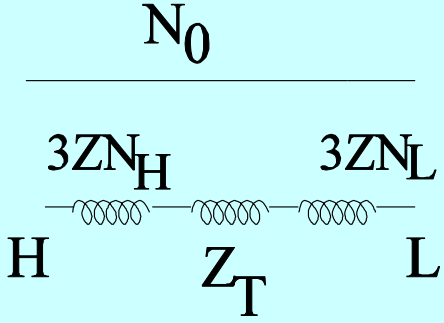
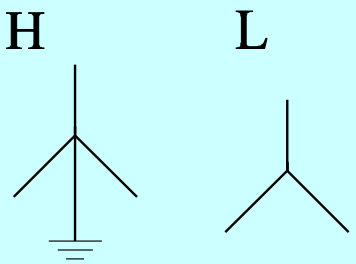
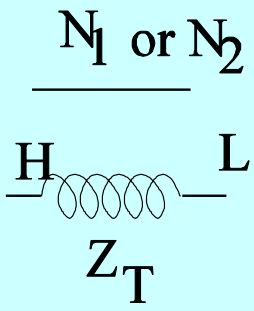
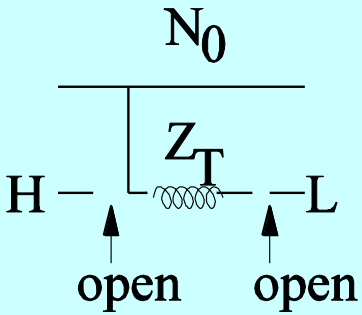
		
(d) 		
(e) 		
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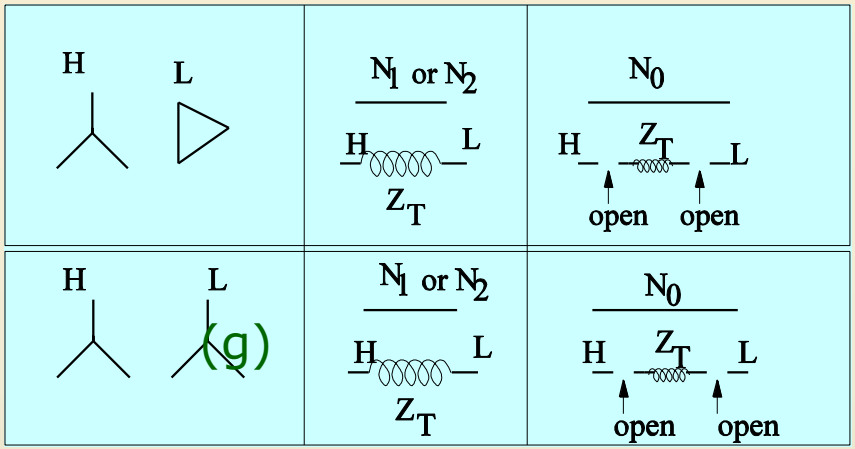

(g)

(h)

Modeling of Rotating Machines
Modeling of Synchronous Generator

- Xd" = Subtransient reactance; determines the current during the first cycle after fault occurs. In about 0.1 s reactance increases to
- Xd'= Transient reactance; assumed to determine current after several cycles at 60Hz. In about 0.5-2 s reactance increases to
- Xd=Synchronous reactance; this is the value that determines the current flow after a steady state condition is reached.
- Synchronous generator data available from manufacturers includes two values of direct axis reactance – $X``_{dv}$ and $X``_{di}$. The $X``_{dv}$ value should be used for short – circuit calculations.

Modeling of Synchronous Motors and Condensers

- During fault motor acts as a generator to supply fault current
- The rotor carrying the field winding is driven by the inertia of the rotor and load. Stator excitation is reduced due to drop in voltage.
- The fault current diminishes as the rotor decelerates
- The generator equivalent circuit is used for synchronous motor.
- The constant driving voltage and three reactance X d", Xd' and Xd are used to establish the current values at three points in time.
- Synchronous condensers can be treated in same manner as synchronous motors.