

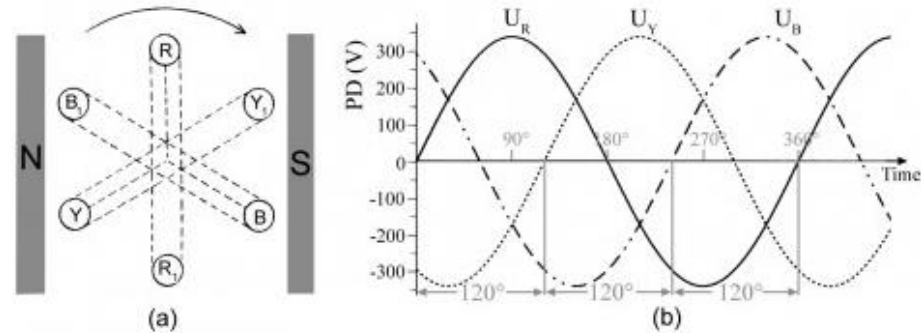


<b>SUBJECT and GRADE</b>	<b>Electrical Technology Grade 12</b>	
<b>TERM 1</b>	Week 6	
<b>TOPIC</b>	Three Phase Generation lesson 2	
<b>AIMS OF LESSON</b>	This lesson is about the understanding of 3-phase generation with reference to: how 3-phase is generated, wave and phasor diagrams representation of 3-phase systems, difference between star and delta as well as schematic and diagrammatic representation of star and delta systems.	
<b>RESOURCES</b>	Paper resources	Digital resources
	Electrical Technology Textbook Grade 12 (pg. 92-98)	YouTube links and web pages for this lesson <b>See end of lesson for links</b>
<b>INTRODUCTION</b>	<ul style="list-style-type: none"> <li>This lesson is about the understanding of 3-phase systems with reference to 3-phase generation, waveform of 3-phase system, phasor diagram of 3-phase system, star and delta connected 3-phase systems. You must also know the difference between a schematic and diagrammatic representation of 3-phase systems.</li> </ul>	
<b>CONCEPTS AND SKILLS</b>	<p>Generation of 3-phase supply system</p> <ul style="list-style-type: none"> <li>A 3-phase system is generated when 3 coils are placed <math>120^\circ</math> apart and then rotated in a uniform magnetic field, producing 3 single phase voltages <math>120^\circ</math> apart.</li> <li>These coils are rotated in anti-clockwise manner through the magnetic field.</li> <li>Since the stator windings are <math>120^\circ</math> apart, the magnetic field of the rotating rotor induces voltages that are separated in phase by <math>120^\circ</math></li> <li>Each phase produces a sinus waveform when rotor is rotated.</li> <li>When coils are rotated anti-clockwise, we assume a (R-Y-B) phase sequence, phase "R" is the starting phase, followed by "Y" <math>120^\circ</math> later then followed by "B" <math>120^\circ</math> later.</li> <li>In a normal star connected generator the 3 coils are connected to a common point, the neutral point (N)</li> <li>The 3 phases are labelled R phase, Y phase, B phase and N for the neutral point. These phases can also sometimes be referred to as <math>L_1</math>, <math>L_2</math> and <math>L_3</math> or <math>VL_1</math>, <math>VL_2</math> and <math>VL_3</math> respectively.</li> </ul>	

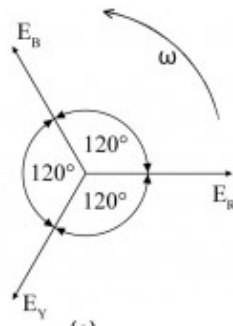
Do you know?

- 3-phase generation waveforms and phasor diagrams
- Star and delta connected systems
- The difference between a schematic and diagrammatic representation.

## Three phase waveform representation



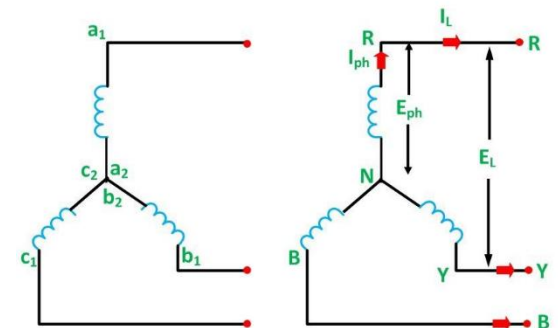
## Phasor representation of a 3-phase system



## Star connected 3-Phase system

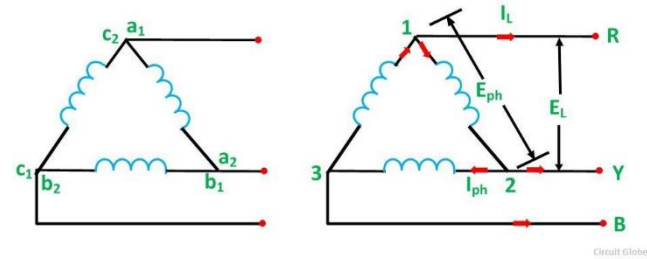
- In a star connection the three common ends of each phase are connected at a common terminal called neutral(N)
- The other ends are connected to the three-line voltages
- In a balanced system, no current is flowing in the neutral wire
- The line voltages are 1.73 times the magnitude of the phase voltages and leads the phase voltages by  $30^\circ$
- In a star system the following applies:

- The line current = the phase current ( $I_L = I_{PH}$ )
- The line voltage is 1.73 times the phase voltage ( $I_L = \sqrt{3} V_{PH}$ )



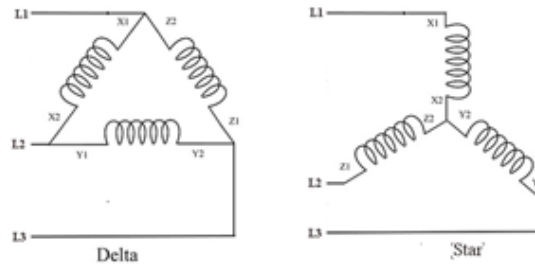
### Delta connected 3-phase system

- In a delta connected system the three ends of the coils are connected in series to form a closed loop.
- In a star system the following applies:
  - The line voltage = the phase voltage ( $V_L = V_{PH}$ )
  - The line current is 1.73 times the phase current ( $I_L = \sqrt{3} V_{PH}$ )

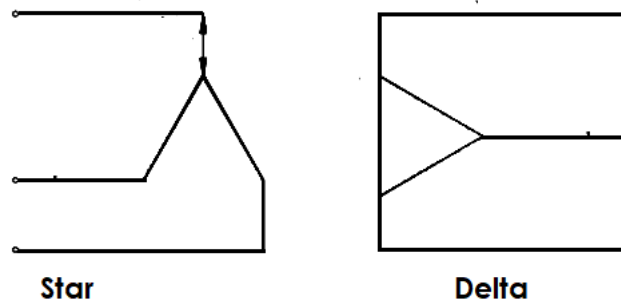


Difference between schematic and diagrammatic representation.

Diagrammatic representation of 3-phase system

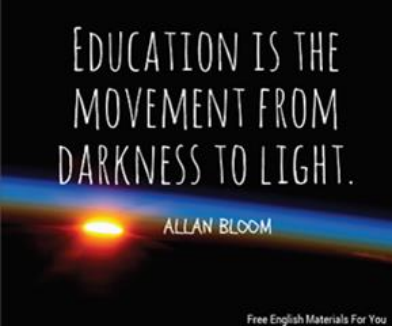


Schematic representation of a 3-phase system



### ACTIVITIES/ ASSESSMENT

**NB:** It is important that you do all the questions on your own first, before you consult any resources. Refer to end of chapter activity and do all the questions related to this section of the work. (pages 108-109)

	Time per question (1 mark = 1 minute)
<b>CONSOLIDATION</b>	<ul style="list-style-type: none"> <li>• The work done in the lesson was about 3-phase generation, waveform of 3-phase system, phasor diagram of 3-phase system, star and delta connected 3-phase systems. You must also know the difference between a schematic and diagrammatic representation of 3-phase systems.</li> <li>• It is important that you work through these concepts a few times to try and understand them fully.</li> <li>• It is always a good thing to write down and summarize these concepts to remember them.</li> <li>• Congratulations on completing this lesson.</li> </ul> 
<b>VALUES</b>	The understanding of how 3-phase electricity is generated, will help us understand electricity better as well as appreciating it more as an energy source.
<b>YouTube links and web pages for this lesson</b>	<a href="https://www.youtube.com/watch?v=4oRT7PoXSS0">https://www.youtube.com/watch?v=4oRT7PoXSS0</a> (3 phase generation) <a href="https://www.raritan.com/landing/three-phase-power-explained">https://www.raritan.com/landing/three-phase-power-explained</a> (3 Phase generation) <a href="https://www.youtube.com/watch?v=tFaDfOap2fs">https://www.youtube.com/watch?v=tFaDfOap2fs</a> (3 phase generation) <a href="https://www.youtube.com/watch?v=Kn70Tc9fFIU">https://www.youtube.com/watch?v=Kn70Tc9fFIU</a> (difference between star and delta connection) <a href="https://www.youtube.com/watch?v=A0E_A0COZ8w">https://www.youtube.com/watch?v=A0E_A0COZ8w</a> (star connection) <a href="https://www.youtube.com/watch?v=i_VHSIx-xO8">https://www.youtube.com/watch?v=i_VHSIx-xO8</a> (delta connection) <a href="https://www.youtube.com/watch?v=3ktxtdW6UAE">https://www.youtube.com/watch?v=3ktxtdW6UAE</a> (Star/Delta connections)