

Assignment 2

by William Carey

FILE	15176_WILLIAM_CAREY_ASSIGNMENT_2_177819_1357704925.PDF (388.3K)		
TIME SUBMITTED	26-MAY-2020 01:00PM (UTC+0100)	WORD COUNT	1405
SUBMISSION ID	129130721	CHARACTER COUNT	8797

Course: HNC Electrical and Electronic Engineering
Module: SGEE4000 – Electrical and Electronic Principles
Assignment Title: Three Phase Circuits
Name: William Carey
University number: 1910601
Date Submitted: 25/05/2020
Word Count: 1051 words

Contents

1. Introduction and background theory.....	3
2. Research.....	3
3. Experimental procedures and results	7
4. Discussion of results.....	7
5. Conclusions	7
References	8

1. Introduction and background theory

The purpose of this assignment is to build an understanding of 3 phase AC electrical distribution systems by carrying out research in to the reasons for its use and then using mathematical formulae and other related methods in order to solve engineering problems regarding the same subject. In this assignment there will be descriptions and explanations on 3 phase systems and their purpose as well as finding certain values from a designed 3 phase circuit configured in the star and delta arrangement.

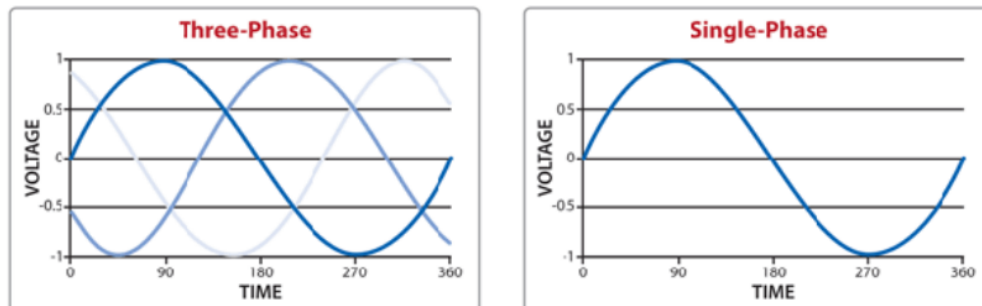
2. Research

Reason for three-phase electrical transmission

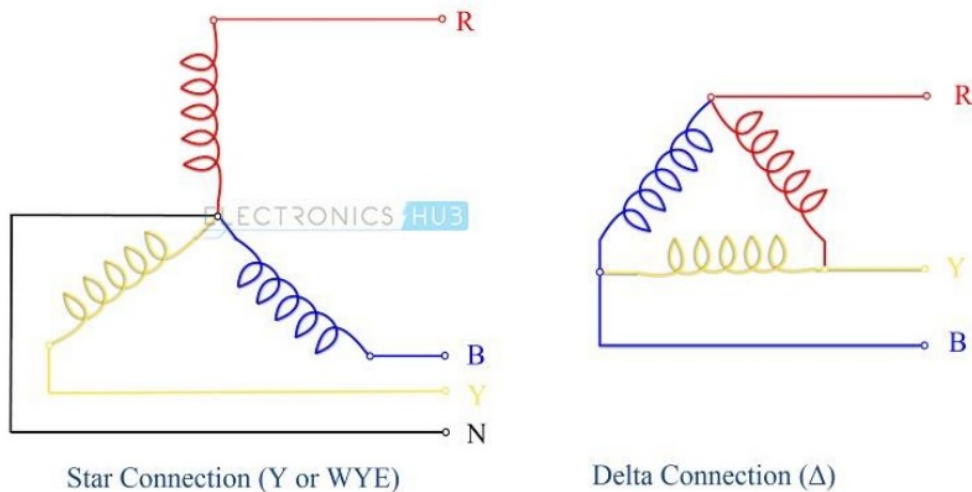
Throughout the entirety of the developed world, electricity is transmitted via three-phase alternating current, the main reasoning behind this is that it holds many more advantages than other potential methods such as direct current.

The main benefit of using three phase during electrical transmission is that it allows for the electricity to be carried at a higher voltage with a lower current along thinner conductors thus reducing the costs of creating transmission systems (Rahi Systems, 2020)

Simply put, 3 phase electricity is made of three sine wave voltages that are alternating at 120 degrees to each other ensuring a constant signal of power. Three-phase is only used in either distribution or the supply of large equipment requiring lots of power. When it reaches the consumer, it is often reduced down to single phase unless the aforementioned circumstance requires it. The three-phase circuit involves three conductors to carry the current and occasionally a fourth 'neutral' conductor (Csanyi, 2017). All three voltages in the UK run at 50Hz, in other countries it may be different such as America where the frequency is instead 60Hz, the reason for this derivation is largely due to the given countries regulations regarding power distribution and transmission where they would adhere to their own standards that were agreed by the respective countries government, advisory bodies, and industry bodies like Western Power in the UK (Küfeoğlu, et al., 2018). Below is an image depicting the difference between single and three phase waveforms (Nair, 2018):



Three phase electricity is produced by an AC generator through the intersection of coils by an alternating magnetic field (All About Circuits, 2020), there are two main ways that these coils are arranged in an electrical generation circuit, Star (sometimes called Wye) and Delta. There are a number of key differences between these two set ups; physically speaking the star arrangement has 4 conductors being the phases and the neutral and the delta only has the three phases, below is an image depicting these differences (Anusha, 2017) :



The current to single phases from star is often higher than that of the delta due to the physical design. You can attain different voltages from star since you can have a phase to neutral connection unlike delta which is strictly phase to phase. Generally, delta is used for distribution due to its overall higher efficiency, star is also occasionally used for this same purpose but much less so. star connections can be used for greater distances than delta. And finally, star connections are used to provide power to applications where lower starting currents are needed, whereas delta is used where high torque is required (Electrical4U, 2019).



Power factor

Power factor is essentially a measure of efficiency for a particular process, equipment, or system and has no unit of measurement, it is simply portrayed as a number. It is calculated through the division of the true power over the apparent power and is often depicted as a triangle (Evans, 2018).

Apparent power is the total amount of power being applied to the system, real (or true) power is the power that is being used for the process and reactive power is considered waste power lost through heat and resistances.

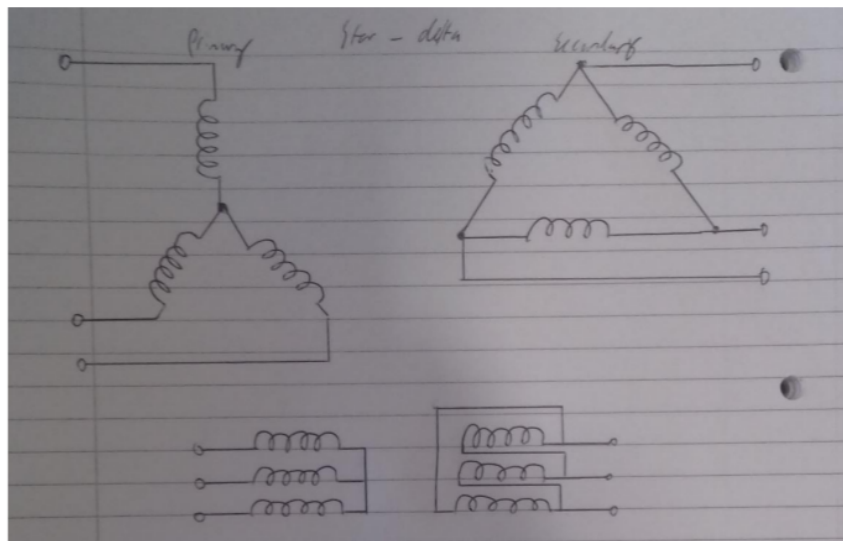


Power factor is displayed between 0 to 1 and the desired number depends on the type of circuit this equation is being applied to since it requires reactive power which is considered wasted power and true power. So, for example in a resistive circuit a power factor of 1 would be considered perfect which is only attainable when the reactive power is 0. However, it should be noted that the maximums are never attainable since no system is 100% efficient and 0% efficiency essentially means the system is not functioning (All About Circuits, 2020)

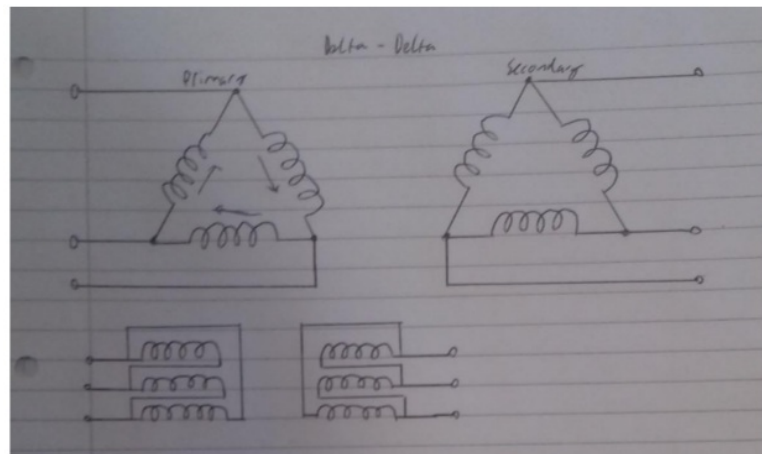
Working out the power factor of a given system is very useful for understanding if the system is performing as desired since it displays the efficiency and would give an indication as to if the components used are the correct values. If the power factor isn't at the desired number then this shows that the system requires improvement.

Star and Delta arrangements when applied to transformers

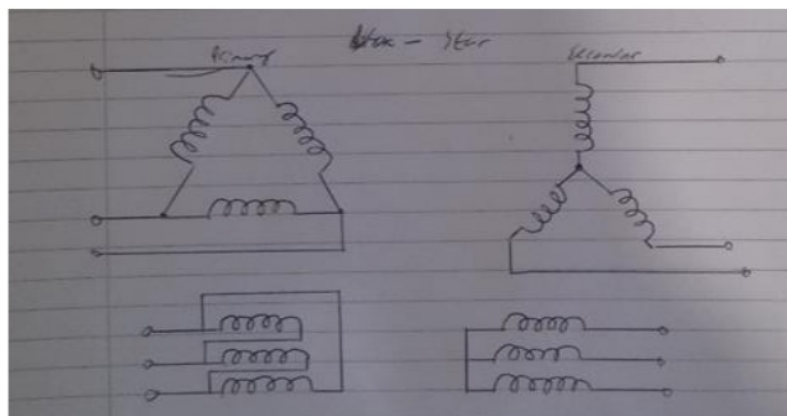
A transformer requires an AC source in order to carry out its purpose of either stepping up or stepping down a voltage via inductance. Transformers prove incredibly useful for transmission and distribution of three phase supplies as they can change the properties of the supply through the output side of the transformer depending on how it was connected. The next few images are drawings of each of these connections and the purposes they primarily serve:



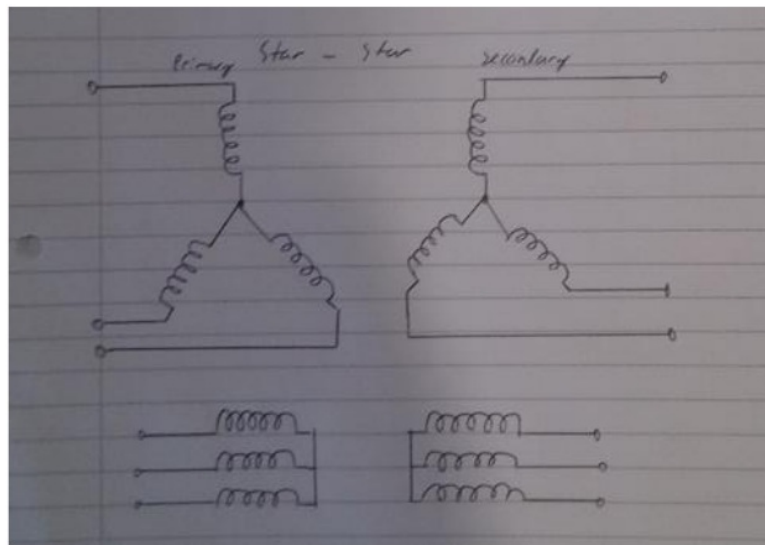
The main use for star-delta configured transformer is in the use of distribution as a step down transformer, this is because of the primary sides neutral point being used for earthing making it safer and better at handling higher loads especially during faults (Daware, 2014)



Delta-Delta configured transformers are used in circumstances where there are high current with low voltages. These aren't as commonly used as the star-delta or delta star configurations due to its niche properties but it proves very useful for not having to replace a transformer where it experiences long term high current stress (Parmar, 2012)



The delta-star transformer is used heavily in distribution systems, most notably at the start of a transmission system where it steps up the three-phase electricity for long range transmission (All About Circuits, 2020)



Finally, the Star-star transformer, this the least common of them due to the difficulties it causes under unbalanced loads however it basically operates in the opposite way to the delta-delta in that it is used in smaller transformers where high voltages pass through (Parmar, 2012).

3. Experimental procedures and results
4. Discussion of results
5. Conclusions

References

All About Circuits, 2020. <https://www.allaboutcircuits.com/textbook/alternating-current/chpt-1/what-is-alternating-current-ac/>. [Online]

Available at: <https://www.allaboutcircuits.com>

[Accessed 25 may 2020].

All About Circuits, 2020. <https://www.allaboutcircuits.com/textbook/alternating-current/chpt-10/three-phase-transformer-circuits/>. [Online]

Available at: <https://www.allaboutcircuits.com>

[Accessed 25 may 2020].

All About Circuits, 2020. <https://www.allaboutcircuits.com/textbook/alternating-current/chpt-11/calculating-power-factor/>. [Online]

Available at: <https://www.allaboutcircuits.com>

[Accessed 25 may 2020].

Anusha, 2017. <https://www.electronicshub.org/comparison-star-delta-connections/>. [Online]

Available at: <https://www.electronicshub.org>

[Accessed 25 may 2020].

Csanyi, E., 2017. <https://iaeimagazine.org/magazine/features/calculations/basic-three-phase-power-measurements-explained/>. [Online]

Available at: <https://iaeimagazine.org>

[Accessed 22 may 2020].

Daware, K., 2014. <https://www.electricaleasy.com/2014/05/three-phase-transformer-connections.html>. [Online]

Available at: <https://www.electricaleasy.com>

[Accessed 25 may 2020].

Electrical4U, 2019. <https://www.electrical4u.com/three-phase-circuit-star-and-delta-system/>. [Online]

Available at: <https://www.electrical4u.com>

[Accessed 25 may 2020].

Evans, P., 2018. <https://theengineeringmindset.com/power-factor-explained/>. [Online]

Available at: <https://theengineeringmindset.com>

[Accessed 25 may 2020].

Küfeoğlu, S., Pollitt, M. & Anaya, K., 2018. *Electric Power Distribution in the World: Today and Tomorrow*. [Online]

Available at:

https://www.bennettinstitute.cam.ac.uk/media/uploads/files/Electric_power_distribution.pdf

[Accessed 25 may 2020].

Nair, A. G., 2018. <https://www.quora.com/What-is-three-phase-power>. [Online]

Available at: <https://www.quora.com>

[Accessed 25 may 2020].

Parmar, J., 2012. <https://electrical-engineering-portal.com/delta-delta-transformer-connection-overview>. [Online]

Available at: <https://electrical-engineering-portal.com>
[Accessed 25 may 2020].

Parmar, J., 2012. <https://electricalnotes.wordpress.com/2012/04/30/star-star-connection-of-transformer/>. [Online]

Available at: <https://electricalnotes.wordpress.com>
[Accessed 25 may 2020].

Rahi Systems, 2020. <https://www.rahisystems.com/blog/understanding-the-benefits-of-three-phase-power-distribution/>. [Online]

Available at: <https://www.rahisystems.com>
[Accessed 22 may 2020].

Assignment 2

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

Instructor

29/100

PAGE 1

PAGE 2

PAGE 3

PAGE 4

 **Comment 1**
Advantages?

PAGE 5

 **Comment 2**
Power triangle?

PAGE 6

PAGE 7

PAGE 8

PAGE 9

GRADING FORM: NEW CSG-RUBRIC

WILLIAM

29

1. ENGAGEMENT WITH LITERATURE



A wide range of reference material informs the research which covers the point well and is sufficiently detailed, although key images such as power triangle are missing. Use a range of credible sources such as books and journals and avoid quora etc. 7/10

7

2. KNOWLEDGE AND UNDERSTANDING



Knowledge of basic principles demonstrated in the research task, which is the only task completed, good understanding and accurate content but lacks depth in some areas. 11/20

11

3. COGNITIVE AND INTELLECTUAL



NA

4. PRACTICAL APPLICATION



NA

5. TRANSFERABLE SKILLS



Research is accurate, coherent and well organised,
report is incomplete. 11/20

11