iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** I **Month of publication:** January 2018

DOI: http://doi.org/10.22214/ijraset.2018.1137

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor :6.887
Volume 6 Issue I, January 2018- Available at www.ijraset.com

A Novel Scheme of Three to Five Phases Transformer Connection

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Abstract: ***A novel scheme of three to five AC multiphase transformer to convert into DC power through modelling. The whole modelling has been simulated by using MATLAB Software. Multi-winding transformer block was taken from the sim-power system block library and turn ratios set in the dialog box then simulated. The complete design and simulation of the proposed work is presented in this paper. Now we have mentioned the simulation results only for RL load. Five phase transmission system can be developed for the generation of bulk power transfer. As per need of the induction motor under a loaded condition is used to proof the viability of transformation system. In five phase's, each phases shifted from the order by 72° (360°/5) and got the sin wave voltage/current. The connection scheme was expanded by using the modelling and simulation approach to prove the viability of the implementation.***

Keywords: ***Multi-winding transformer, Multiphase system, Multiphase transmission, Three-to-Five***

I. INTRODUCTION

A transformer is a static device that transfers electric power from one circuit to another without a change of frequency. The physical basis of a transformer is mutual induction between two circuits linked by a common magnetic flux. It is often used to raise or lower voltage and also for impedance transformation [1].The transformer is an important element in the development of high-voltage electric power transmission. Transformers can be classified into various types (step up, step down and matching transformers) according to ratio of the numbers of turns in the coils (turns ratio), as well as whether or not the primary and secondary are isolated [2].

Multiphase i.e. More than three phase systems are the focus on research recently due to their inherent advantage compared to the three phase counterparts. It has applicability of explored to electric power generation in multiphase systems [3-5] transmission [4-6] and utilization [7-8]. The research on eleven-phase transmission system was initiated due to the increasing a rising cost of right way for a transmission corridors, environmental program, and various stringent licensing laws [9]. Six-phase transmission lines can provide the same power capacity with a lower line voltage and smaller towers as compared to a standard double circuit three-phase line [4]. The dimension of the six-phase smaller towers may also lead to the reduction of magnetic fields and electromagnetic interference [9-10]. Normally no-load test, blocked rotor and load tests are performed on a motor to determine its parameters. Although the supply is used for multiphase motor drives obtained from multiphase inverters could have more current ripples, these are the controlling methods available to lower the current distortion below 1%, based on application and requirement [11-13].

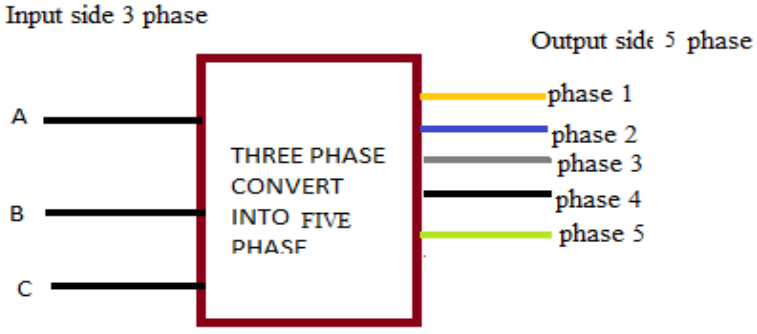

Fig. 1. Block diagram representation of the proposed system

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We know that from the theory multi-phase motors are invariably supplied by ac/dc/ac converters. Thus, the multiphase electric drive is limited for the modeling and control of the supply systems [13]. Our main work is to develop static transformation system to change the phase number from three to five-phase (where n>3 and odd). Now we, are generating a novel phase transformation system which convert three phase to five-phase supply [14].

In Multiphase, system six phase and twelve phase is found to produce less ripple with a high frequency in an AC-DC rectifier system. Thus six and twelve phase transformers are designed to feed a number of pulses rectifier system and technology has matured [15]. Recently, twenty four phase and thirty six phase transformer systems have proposed for supplying a number of pulse rectifier systems [12-16]. These designs are also available for an odd number of phases, such as five, nine and eleven etc.

In this paper we have proposed a special transformer connection scheme to get a balance five-phase output supply from the balance three-phase input supply. The expected application areas of the power transformer are the electric power transmission system and power electronic converters (AC-DC and AC-AC), and the multiphase electric drive system. The block represented of the proposed system is shown in figure 1.The fixed voltage and fixed frequency available grid supply can be transformed to the fixed frequency Five-phase output supply. The output however, may be made variable by inserting the autotransformer at the primary side. The input and output supply can be arranged in the following manner [20] as below.

A. Input Star, Output Star.
B. Input Star, Output Polygon.
C. Input Delta, Output Star.
D. Input Delta, Output Polygon.

The input has being three-phase system the windings are connected in a usually fashion. The Polygon output connection may be derived following a similar approach. The output/secondary side connection is discussed in the following subsections.

II. WINDING ARRANGEMENT OF FIVE PHASE STAR OUTPUT

In this case winding arrangement three separate cores designed with individual carrying primary and two secondary coils. In this designed the phase difference will be 72 Degree Six terminals of primaries are connected in an appropriate manner resulting in delta polygon. Modelling and Simulation, Eighteen terminals of secondaries is connected in star-heptagon output. The turn ratios are different in an individual phase. The input phases are designed given with letters “x”, “y”, and “z” and the output are designated with letters are “A”, “B”, “C”, “D” and “E The (delta-star) three phases to five phase winding connection designed model are shown in figure 4. In this value of Va = Vx Three-phase voltages may be defined as.

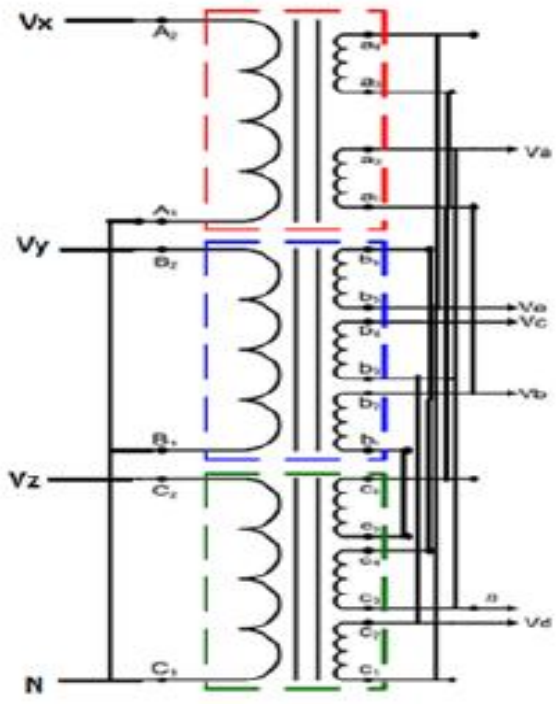

Fig. 2. Proposed transformer winding arrangement (star-polygon)

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A. Case-1 Star Connection

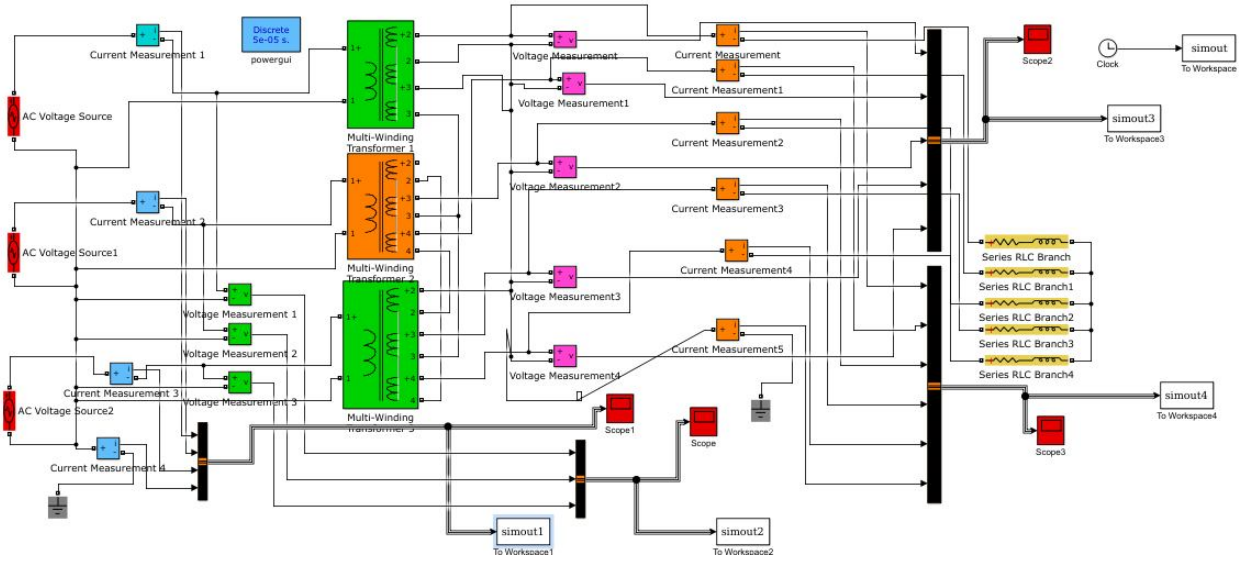

Fig 3: Simulation Diagram of Star to Star Connection

III. WINDING ARRANGEMENT OF FIVE PHASE DELTA OUTPUT

Three separate cores are designed with each carrying one primary and three secondary coils, except in one core where only two secondary coils are used. Six terminals of primaries are connected in an appropriate manner resulting in star and/or delta connections and the 16 terminals of secondary's are connected in a different fashion resulting in star or polygon output. The connection scheme of secondary windings to obtain a star output is illustrated in Fig. 2. The construction of output phases with requisite phase angles of 72 degrees between each phase is obtained using appropriate turn ratios, and the governing phasor equations are illustrated in (1)–(10). The turn ratios are different in each phase. The choice of turn ratio is the key in creating the requisite phase displacement in the output phases.

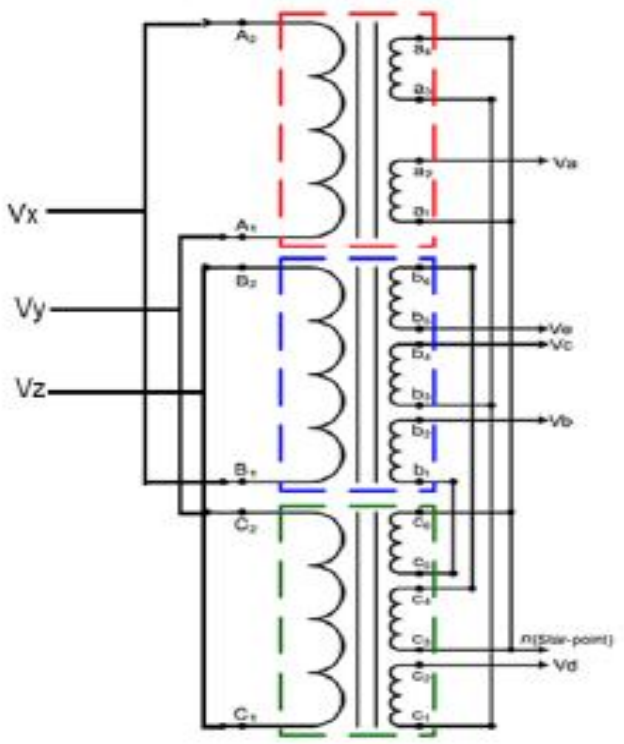

Fig.4 Proposed transformer winding arrangement (delta-star)

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B. Case-2 Delta Connection

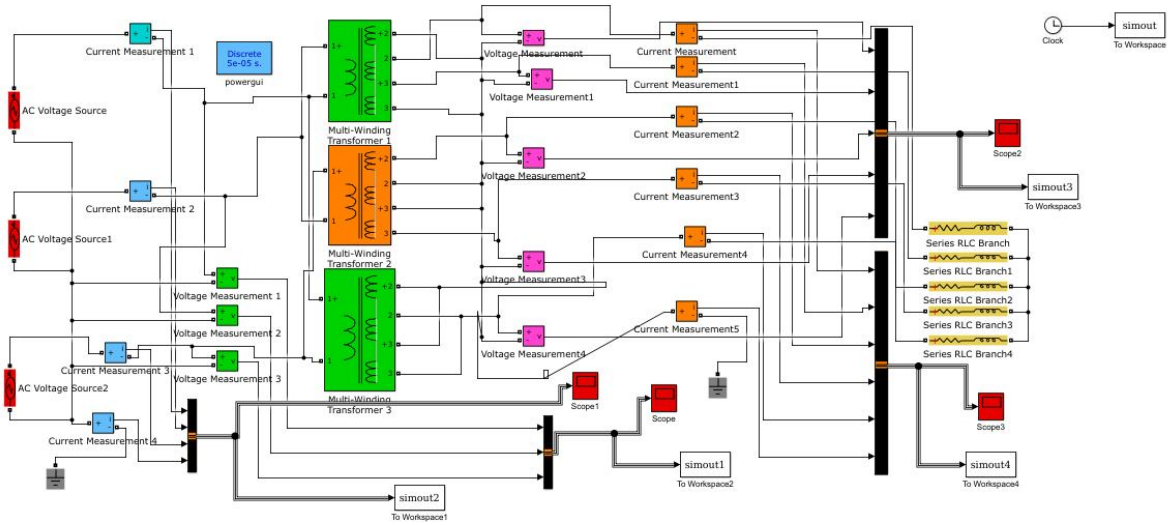

Fig 5: Simulation Diagram of Star to Delta Connection

IV.MATLAB SIMULATION & RESULTS

The new designed/structure is at the first using "Sim power system" block set of the MATLAB/Simulink sofware. Multiwinding transformer block is chosen from the sim-power system block library and the turn ratios are set in the dialog box and the simulation is run. The resulting input and output current and votage waveform. The output will be unbalance if input is unbalanced and also if the input is balance then output is also balance. The three phase output from five phase input supply can also be obtain in similar fasion.

Case-1 Star Connection

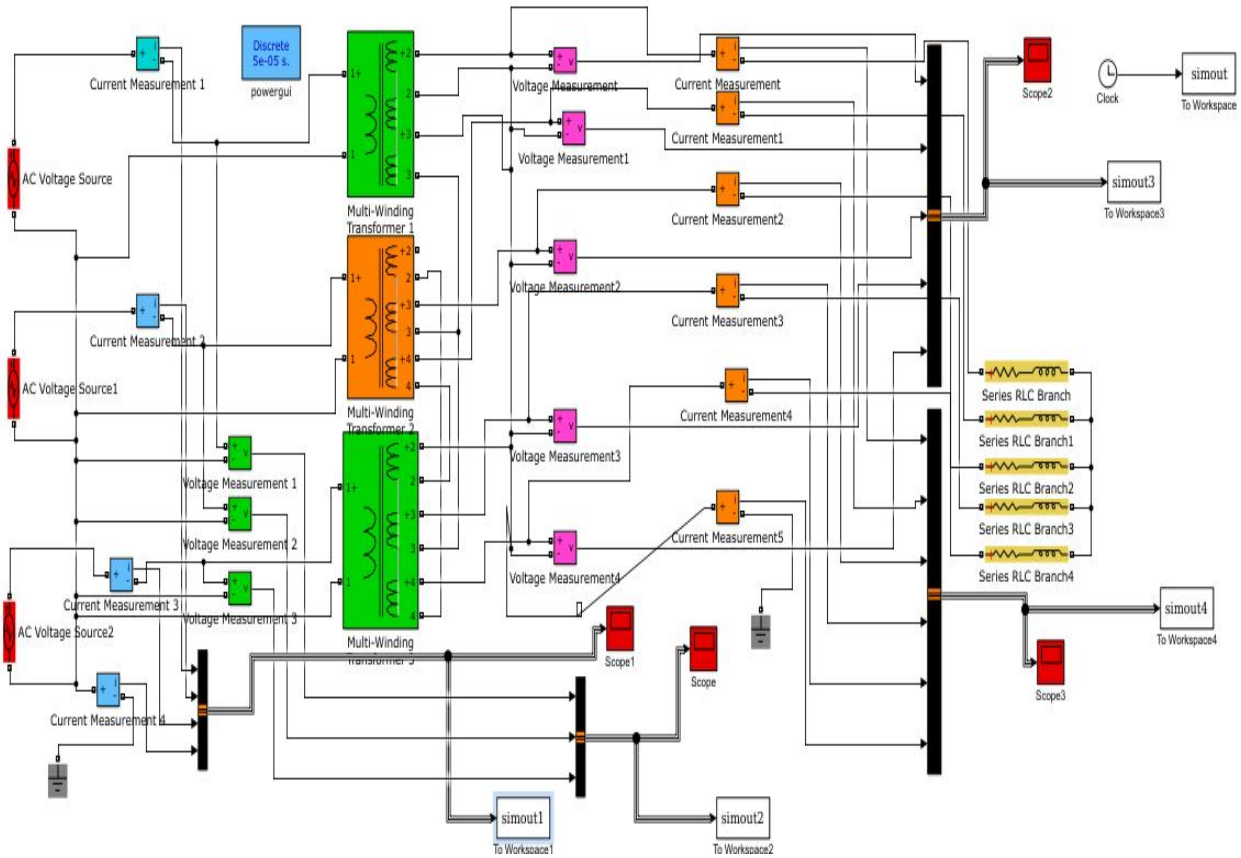

Fig 6: Simulation Diagram of Star to Star Connection

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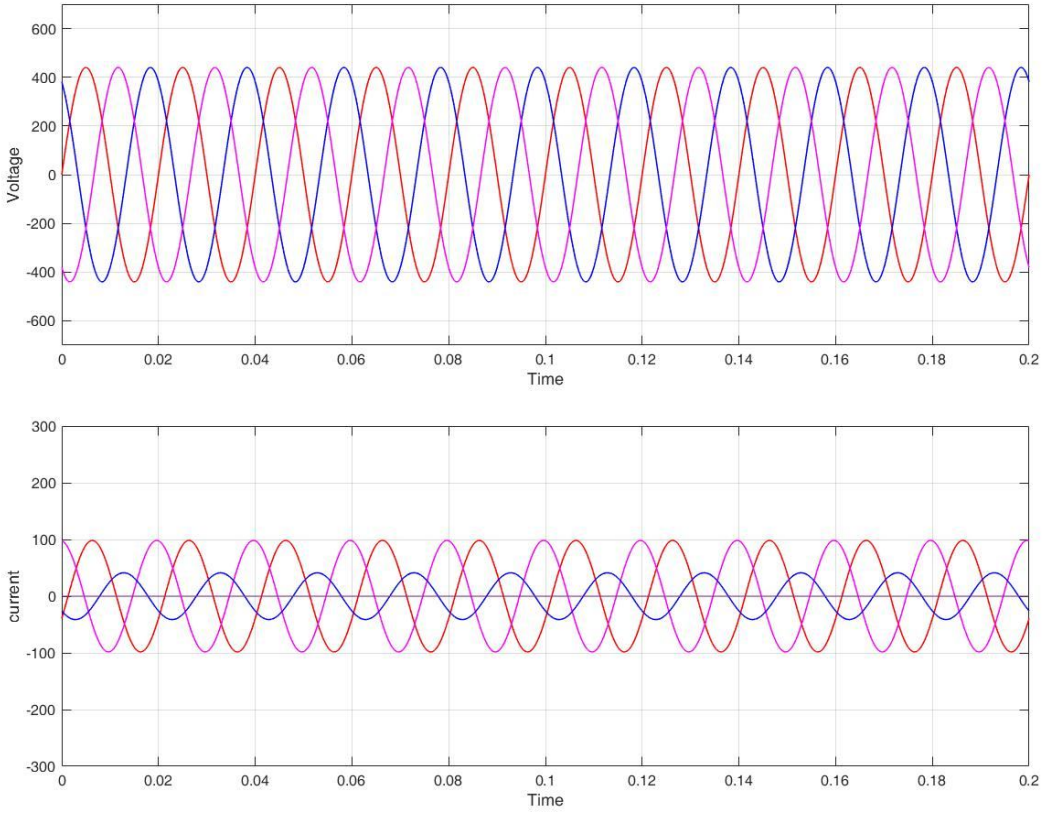

Fig 7: Simulation Result of voltage and Current Input Star to Star Connection

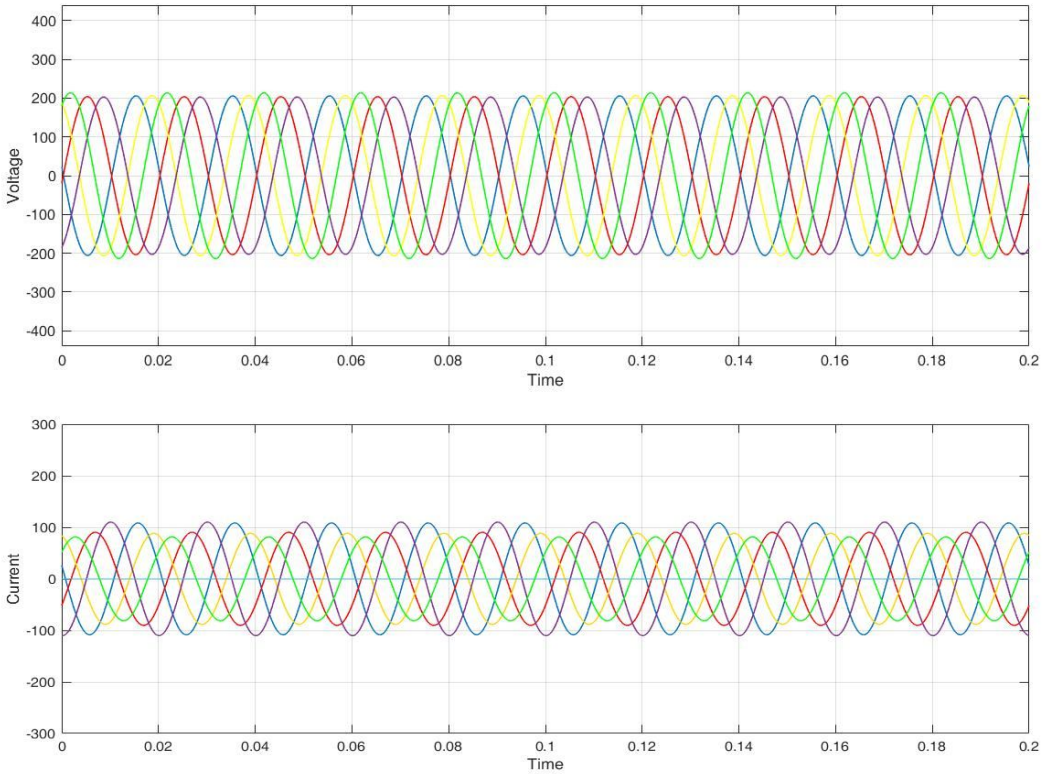

Fig 8: Simulation Result of voltage and Current Output Star to Star Connection

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Case-2 Delta Connection

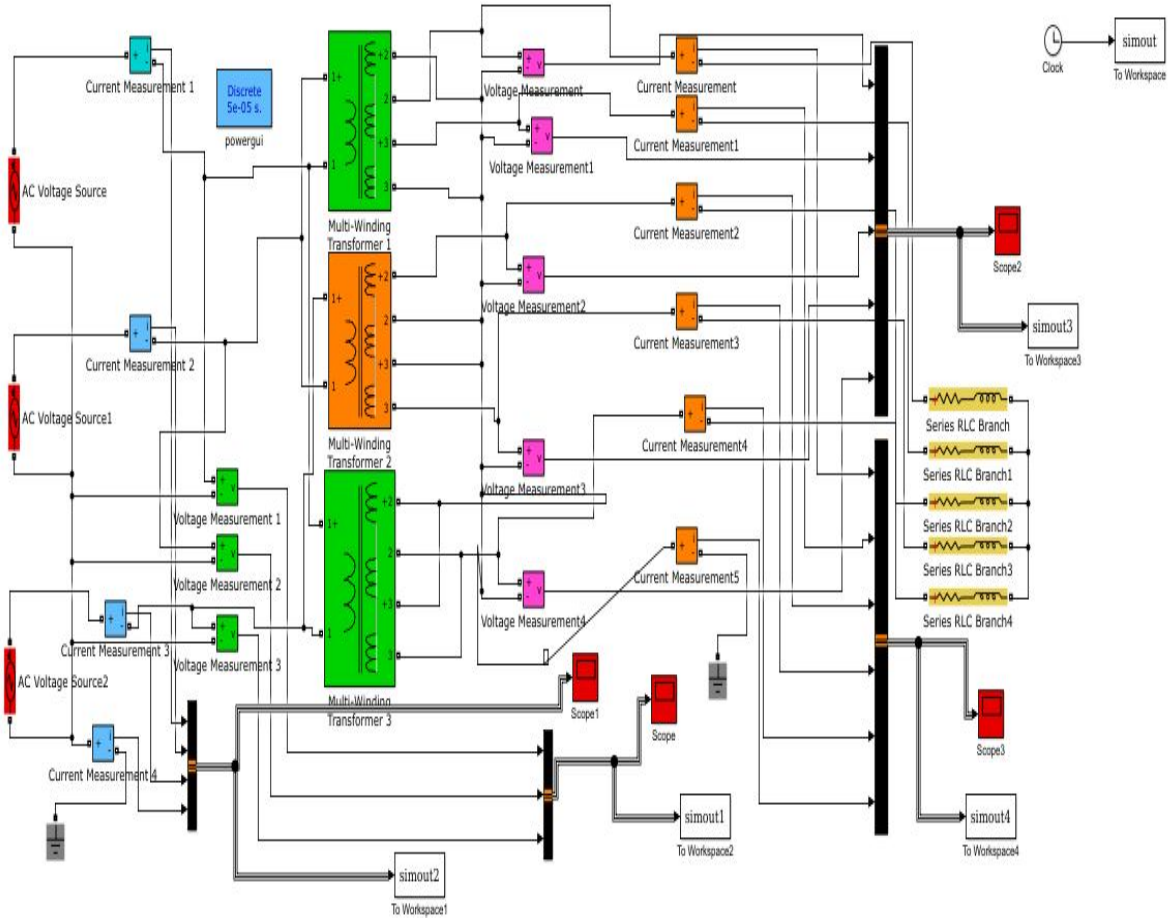

Fig 9: Simulation Diagram of Star to Delta Connection

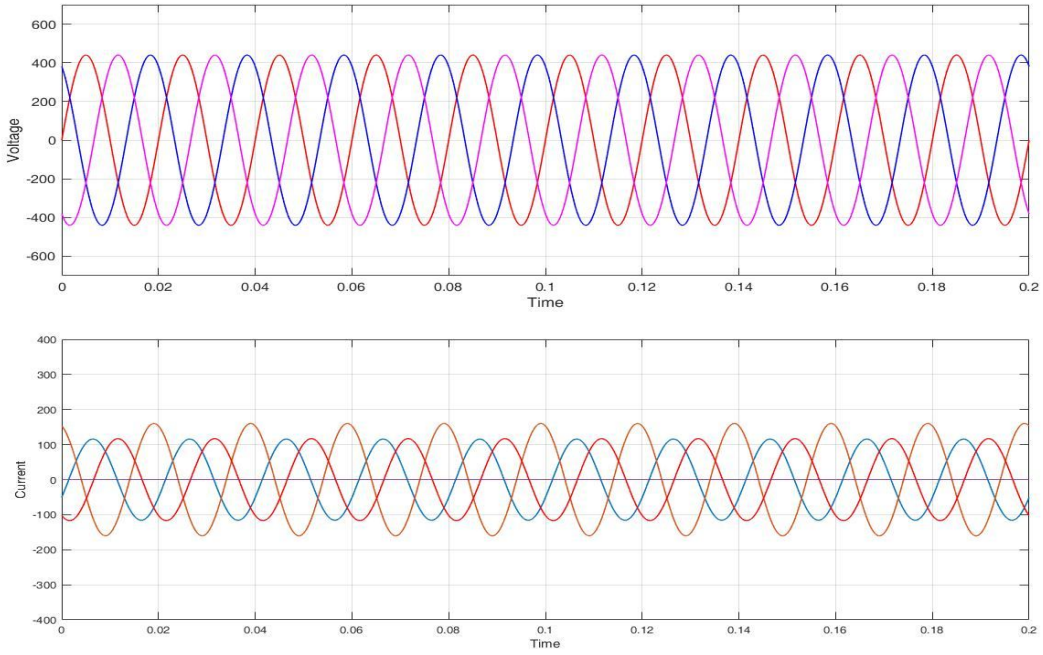

Fig 10: Simulation Result of voltage and Current Input Delta to Star Connection

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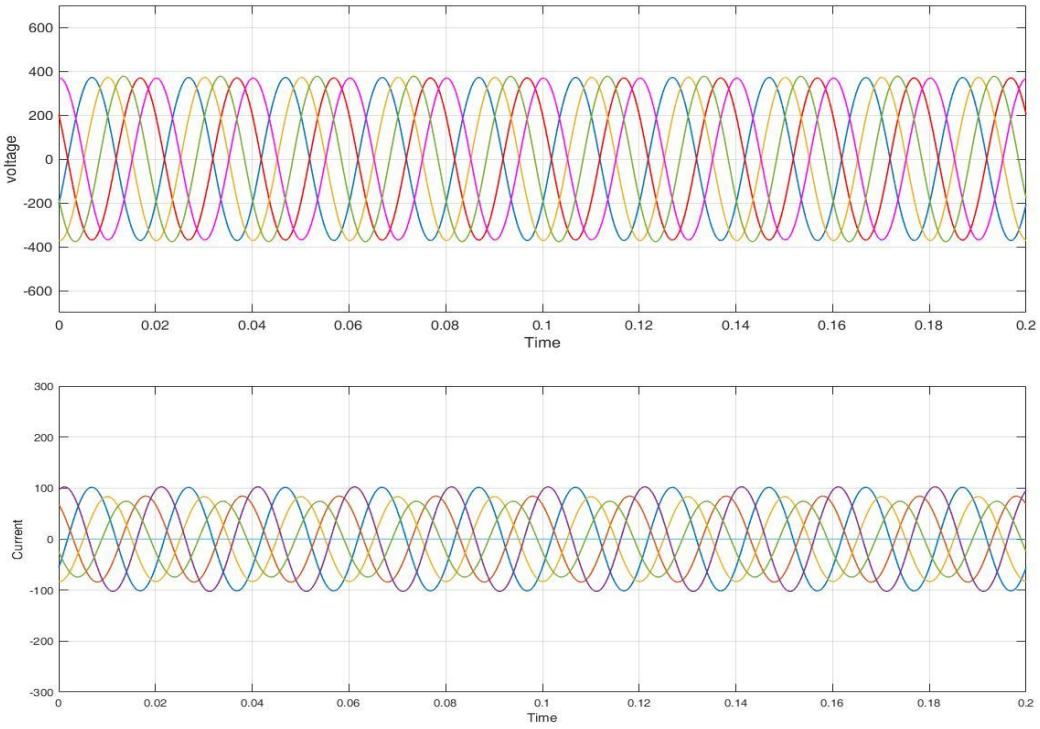

Fig 11: Simulation Result of voltage and Current Output Delta to Star Connection

V. CONCLUSIONS

This paper proposes a new complex transformer connection scheme to transform three phase grid power to an five-phase output supply. The new connection scheme and the phasor diagram along with the turn ratios are illustrated. This method required the main data of transformer, the phase shifting and as well as the winding connections of the transformer. The five-phase induction motor under a loaded condition is used to prove the viability of the transformation system. The 3/5 AC multiphase transformer has been simulated by using MATLAB simulation software, which has been proved to be powerful tools to simulates such a typical connection transformers.

In Future I have to work new connection scheme three to seven phase multi-winding Transformer for better Efficiency, Less Power Loss, Good Power Factor and Harmonics Redution

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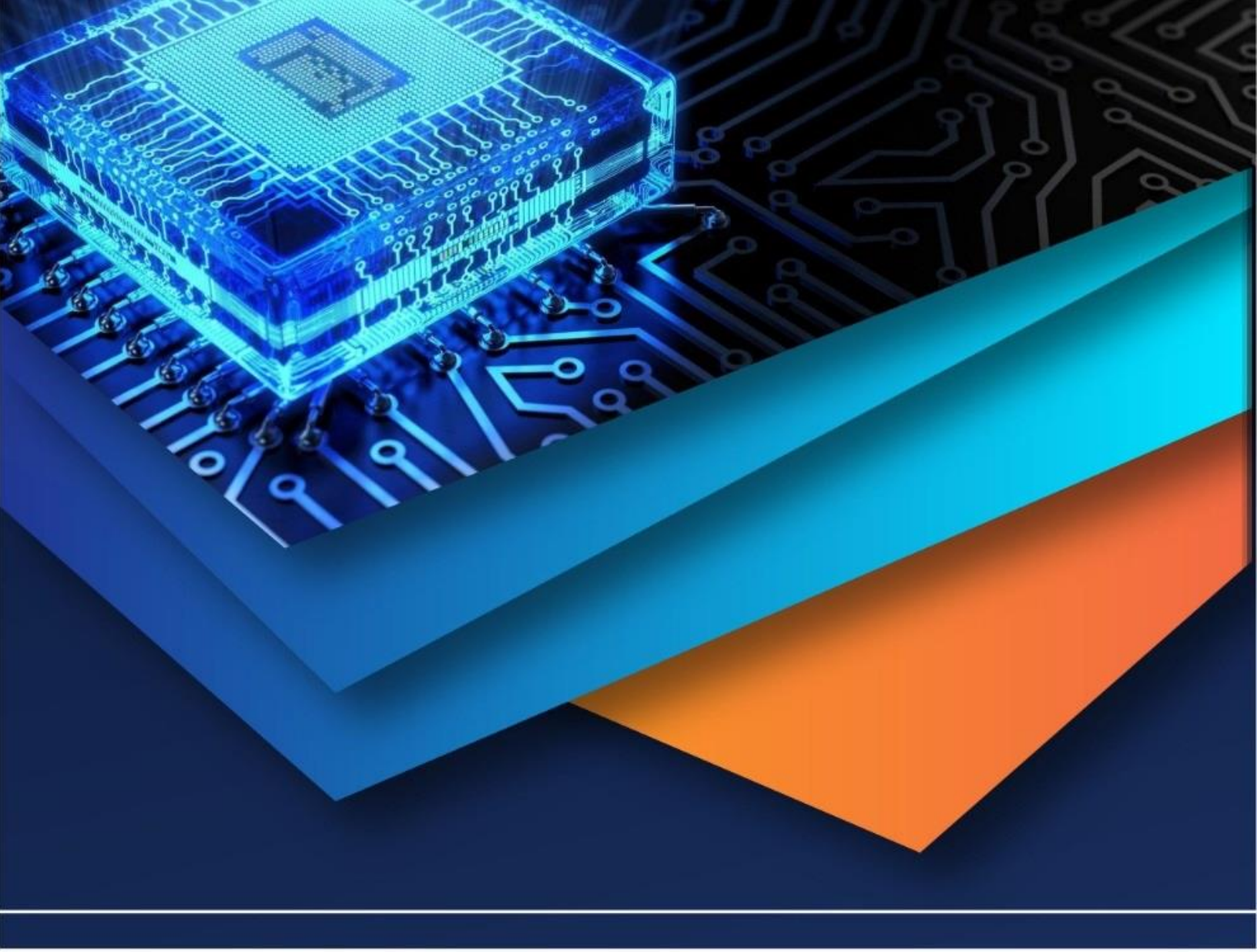

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