CAREER EPISODE 1

Solar Wireless Electric Vehicle Charging System

A) Introduction

[CE 1.1]

Title: Solar Wireless Electric Vehicle Charging System

Duration: [Date] – [Date]

Location: [Location]

Organization: [Organization]

Position: Electrical Engineering

B) Background

[CE 1.2]

My system includes an inductive wireless recharging lane for electric cars as well as a battery swapping/charging facility. I studied that in recent years, as a result of global change, electric vehicles (EVs) powered by renewable energy have gained popularity in both established and developing nations, as these may help cut carbon dioxide emissions.

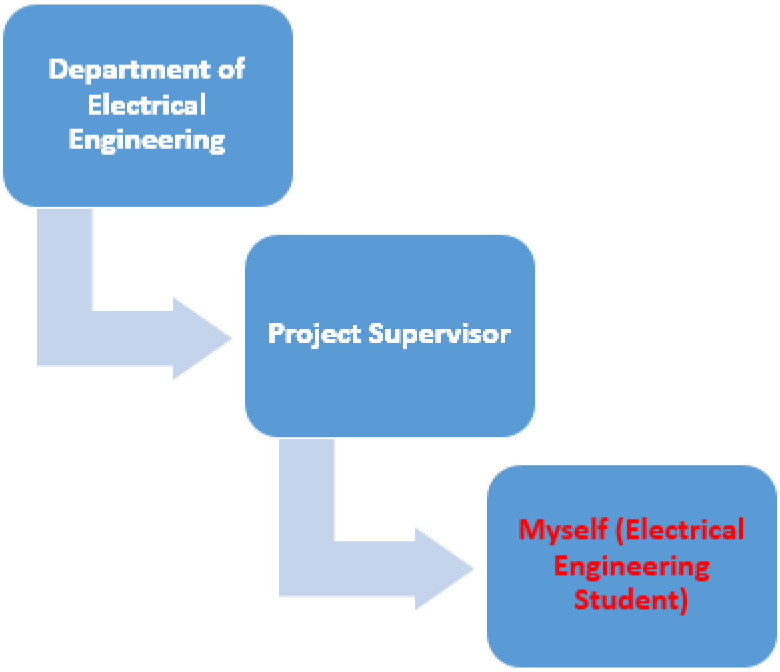
[CE 1.3]

I worked on building the solar wireless vehicle charging system as it was the main objective in the project with the research conducted on factors influencing the concept. I offered wireless power transmission (WPT) as an alternate approach for EV charging to eliminate the limitations of place and time. Through the inductive coupling effect, I charged EVs continuously as long as theydrove1 along the roadway, under which coupled coils were laid.

[CE 1.4]

The work nature was based on the basic WPT system which only consists of two coils, one connected to a load while the other connected to a source. In addition, most of the research only discusses the structure of either the single transmission coils or single receiving coils. I calculated the efficiency of wireless power transmission of inductively coupled coils in the condition of vertical and horizontal deviations. I used a complete system that was smart and internet-connected so the user and the owner could easily monitor or track the system using a Web application. I was the design team part and I worked on the overall theme with the effectiveness of the solar light.

[CE 1.5]Below is the organizational chart:



[CE 1.6] Duties:

- I did the analysis of the issues which were linked with the system's overall performance.
- I evaluated the EVs and EVCS growth inconsistencies.
- I did the effectiveness evaluation of the solar light relaying on the sunshine wavelengths from the solar panel rotations at different angles.
- I worked on addressing several technologies which were examined by applying electrical engineering knowledge.

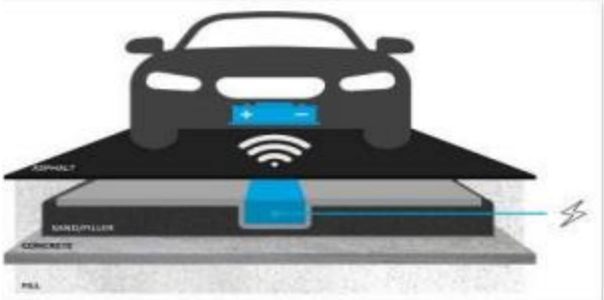
C) Personal Engineering Activity

[CE 1.7]

I worked on the placement of a large number of units in charging points increasing the power demand. As a result, if I used more power from the grid, the system would become overloaded, resulting in voltage fluctuation, voltage management challenges, peak demand concerns, reliability, and predictive modeling, among many other problems. I examined that each of these issues influences the total performance of the system, which was inconsistent with the growth of EVs and EVCS. I collected the greatest effectiveness and energy from the solar light based on the wavelengths of the sunshine investigated by rotating the solar panel at different angles. I worked on PV panels that have the potential to charge electric vehicles (EVs) sustainably. Then, I utilized the solar energy potential in office towers for EV charging at work~~, in~~. In addition to making use of the extended parking time at work, a path for the implementation of vehicle-to-grid (V2G) technologies was opened. I investigated and ~~compares~~compared several systems topologies for EV-PV charging. My proposed system, conversion topology, isolator, and bidirectional energy capabilities of power conversions that integrate the EV and PV for V2G operations were compared. That document discusses the core terminology of charging points, including such charging infrastructure kinds and levels.

[CE 1.8]

I addressed these concerns, several technologies were examined, as well as a short outline of lithium-ion type batteries for charging techniques and the Power Saving Electricity Grid. To overcome the limitations of place and time, I presented wireless energy transmission as an alternate approach for EV charging. I installed the inductive coupling action that allows EVs to be charged constantly as they drive down the highway, where linked coils are. The simplest WPT setup comprises simply two coils, one linked to the demand and the other to the supply. Furthermore, I obtained that many studies solely examine the construction of single transmitting coils or single reception coils. I estimated the effectiveness of wireless energy transmission of inductive connected coils in terms of vertical and horizontal variations. I achieved progress in systems with multiple transmissions and numerous recipients. Based on the foregoing, my study proposes a modest prototype of a "charging-on-the-way" lane made up of numerous spiral coils. I evaluated the connection efficiency while the movable receiving coil goes along the specified wireless charging lane.



[CE 1.9]

I planned the size of the solar power infrastructure such that it could deliver enough power to meet the needs for electric vehicle charging lanes. This charging aimed particularly to overcome the conventional fueling method. I investigated various technologies for renewable energy and EV charging station climates to optimize their effectiveness. Aid in the improvement of air quality. It would cut pollutants that contribute to global warming and pollution while also boosting human safety and minimizing environmental harm. I examined that wireless car charging while driving results in less waiting time. These were Non-renewable energy was plentiful and inexpensive.

Whenever I used remote recharging to its full potential, a variety of benefits were available, which include:

Complete independence: The usage of self-governing cars has yet to be fully recognized since these were still being developed. In any event, I examined that if there was no compelling need to halt charging independent automobiles, those who could continue to drive inconclusively - or at least until repairs were needed. I employed that might increase the extent and efficacy with which things.

No charging station needed: I examined that there was no compelling need to integrate a connection with wireless charging, implying it was a simpler solution. Users could go about their day without worrying about charging the automobile, and it would take care of itself.

Smaller battery packs: I discussed that the increase in charging points suggests that the size of the rechargeable battery could be reduced. That reduces the cost and weight of the automobile.

[CE 1.10]

I found that the fundamental principle of remotely recharging was the same as the transformer functioning standard. There were also transmission and collectors in remote charging. I converted a 220V 50Hz Ac power into a high recurrence transferring load and that high recurrence AC was supplied to the transmitting loop, where it creates a substituting appealing ground that cuts the beneficiary curl and creates the creation of an Ac power yield in the recipient curl. In any case, I maintained the reverberation recurring between transmitter and receiver was critical for efficient remote recharging. I incorporated remuneration devices on both sides to maintain the resonant frequency. Finally, I maintained that the AC command at the receive side was rectified to DC to the battery via the Battery Management System. (BMS).

Batteries Capacity: I examined that as storage capacity (expressed in kWh) increases, so does recharging time. Larger batteries would take more time to charge since a lesser capacity takes more time to charge.

State of Charge (SOC): I worked on the SOC of the car battery shows whether it has been completely charged or destroyed, partially loaded or terminated, and the time required to capacity the batteries varies correspondingly.

The vehicle's highest charging rate: The electric car may only charge to a specific point before being shut off. For instance, I did not be recharged a battery with a high charge capacity of 22kW to a 50kW recharging outlet.

Charge point maximum charging rate: I obtained that the length of recharging was mostly governed by the power of the outlet with which the car battery was connected. When I utilized a 7kW plug to recharge 22kW batteries, it charges at the same rate as a 7kW power supply, resulting in a longer recharging period.

[CE 1.11]

I designed the Battery Swapping Station (BSS) to solve the issue of charging time and the acute demand for a charged automobile. In a BSS car, I promptly replaced expired automotive batteries or automotive rechargeable power with a fully charged one, minimizing the amount of time waiting for the vehicle's batteries to charge. As a result, I obtained that the BSS monitors the battery's life duration with the help of the BMS. It assesses the energy capacity of the batteries in addition to the SOC level. There were various challenges to address while deploying a BSS. I addressed one of the key issues that were the construction of power packs that were designed in a way that these could be easily and rapidly removed and reattached from automobiles. Another concern was the brand compatibility of the rechargeable batteries.

[CE 1.12]

I worked on a project that might have a single standard construction to build interchangeable battery packs for both BSS and EVs. I found that technology also has some concerns with battery degeneration and sovereignty, which was the main obstacle in BSS technologies.

D) Summary

[CE 1.13]

In that concept, I showed a simple model of a remote recharging way, and the assessment would show that route could provide a scaled-down model with remote energy transfer for EVs, making charging-in-transit a possibility, to begin with. Because of low move efficiency, further efforts would focus on simplifying the remote charging process.

[CE 1.14]

Moreover, I obtained that some kind of control method might be incorporated within the suggested architecture. I worked on curls, for example, which would not be fuel till the automobile was identified by location sensors.

[CE 1.15]

Achieved the required outputs with the implementation consistently maintained in the Electrical Engineering field and it acquired the mandatory work outcomes.

CAREER EPISODE 2

High Power 3 Phase Inverter

A) Introduction

[CE 2.1]

Title: High Power 3 Phase Inverter

Duration: [Date] – [Date]

Location: [Location]

Organization: [Organization]

Position: Electrical Engineering Student

B) Background

[CE 2.2]

I worked on the growing presence of single-phase distribution producers and unequal loads in the electric current network may cause three-phase volts to become imbalanced, culminating in higher losses and warming.

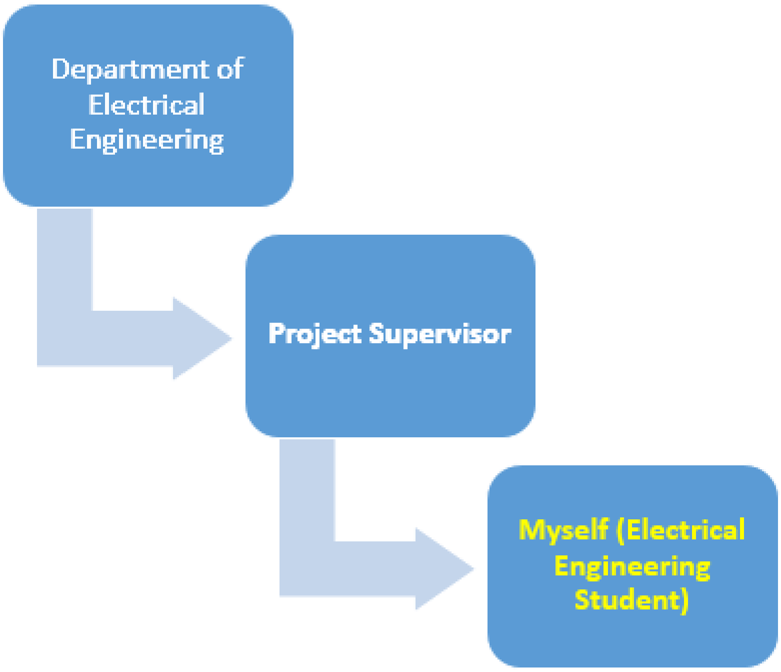
[CE 2.3]

I avoided voltage imbalance, distributing network managers attempting to install bigger DG units using three-phase connections rather than single-phase interconnections. I linked the DG modules to the three-phase distributing network, numerous configurations were feasible.

[CE 2.4]

I covered the three-phase converter and its functioning. I required a three-phase inverter to achieve the three-phase outputs of a circuit with dc as the input energy. I made up that because the inverters of changing components, how the change occurs in the inverter determines the needed outputs.

[CE 2.5]



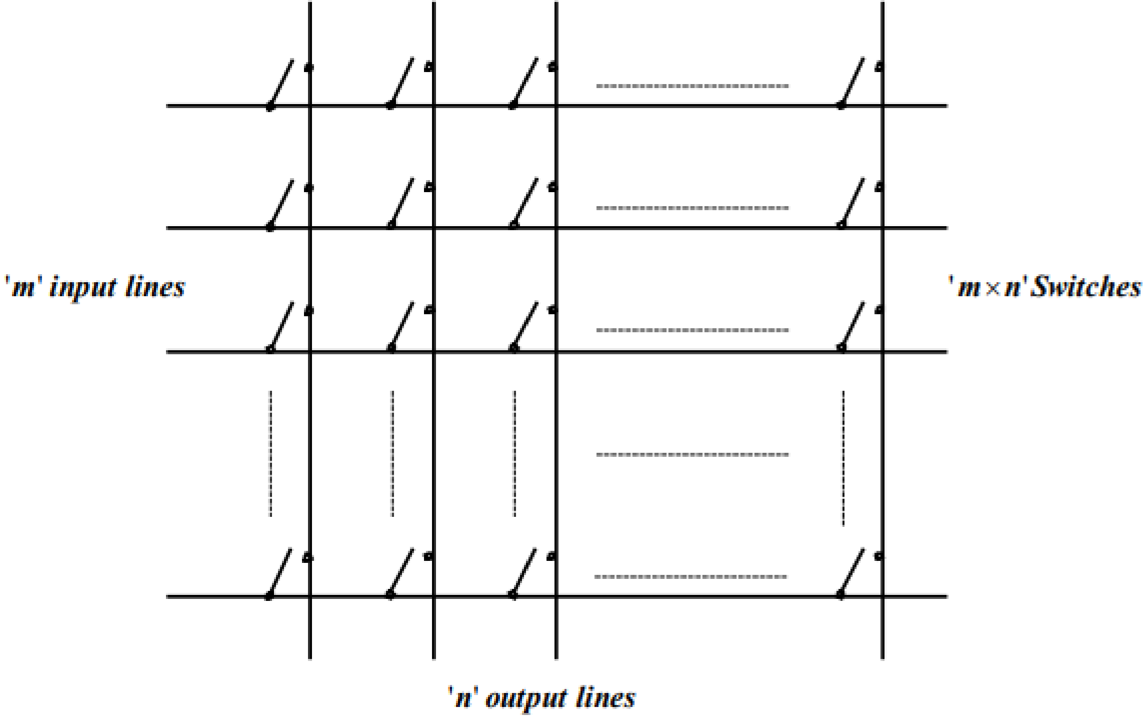
[CE 2.6] Duties:

- I worked on shifting the circuits for the conversions of energy which was linked with the inputs and outputs.
- I worked on linking the power storage devices in the circuit and these were associated with the sole matrix at the outputs and input ends.
- I worked on examining the power storage devices with the indirect switch matrices circuit and these were modeled accordingly in the work.
- I cascaded the two main switch matrices network with the components storage in between.

C) Personal Engineering Activity

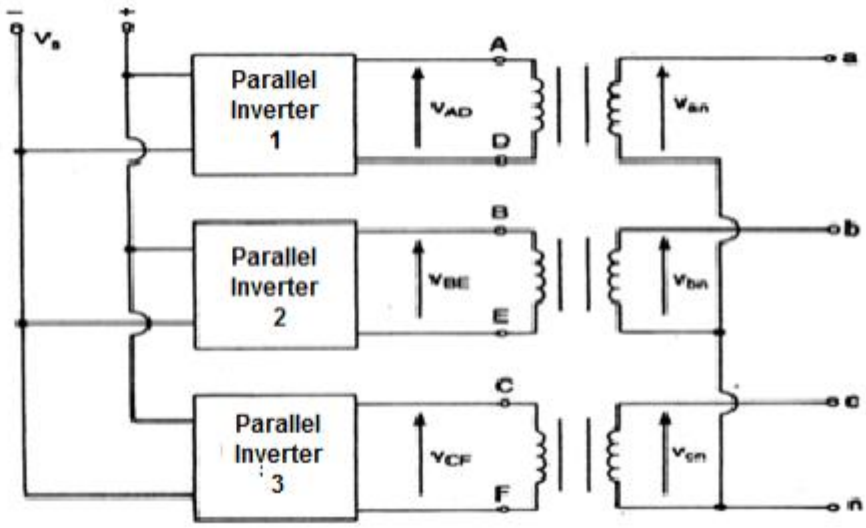
[CE 2.7]

I understood that there were certain switching devices between the supply and the demand, the quantity of them depending on the circuits or the kind of load. In any event, the complication limits the number of changing devices. Even the most complex circuit contains one switch connecting an input line to an outputs channel. I required the amount of shifting circuits for energy conversions was equal to'm n' if a conversion has 'n' inputs and outcomes. The circuit's'm n' changing gadgets could be configured as per their interconnections. I obtained the design that indicates a matrix, as seen in the figure below.



Direct switching matrix circuits: I linked any power storage devices in these circuits that were sole to the matrix at the inputs and outputs ends. I get storing components essentially to be a component of the origin or demand. A direct switch matrix circuit would be an instance of a full wave converter with outputs filtering.

I implemented the schematic diagram of the three-phase inverter which is shown below:



[CE 2.8]

I worked on inverse switch matrices converters, also known as embedded converters, which connect the energy storage devices inside the matrices framework. I examined that in such cases, there were typically very few power storage devices, and indirect switch matrices circuits were frequently modeled as a cascade of two main switch matrices networks with storing components in between. I investigated that switching matrix was a simple technique to arrange gadgets for a certain purpose. It also aids in concentrating efforts on three primary issue areas. I considered every one of these aspects to create viable energy electronics systems. I added a basic building block of a phase-leg capacitor-clamped converter. I worked on the circuit that was known as a flying capacitance inverter because separate capacitors restrict the gadget voltage to a single capacitance-voltage level. I obtained the output voltage that could be in one of five states: Vdc 2, Vdc 4, 0, + Vdc 4, and + Vdc 2. I gave that there were numerous switching configurations to produce the required voltage level, voltage synthesizing in a five-level flying capacitance inverter was more flexible than in a diode-clamped inverter. For example, there were four possible voltage levels Van = Vdc 4:

$S_1, S_1', S_2', S_3' \ (V_{a0} = V_{dc} - \frac{3V_{dc}}{4})$

$S_4, S_2', S_3', S_4' \ (V_{a0} = \frac{V_{dc}}{4})$

$S_3, S_1', S_3', S_4' \ (V_{a0} = \frac{V_{dc}}{2} - \frac{V_{dc}}{4})$

$S_2, S_1', S_2', S_4' \ (V_{a0} = \frac{3V_{dc}}{4} - \frac{V_{dc}}{4})$

[CE 2.9]

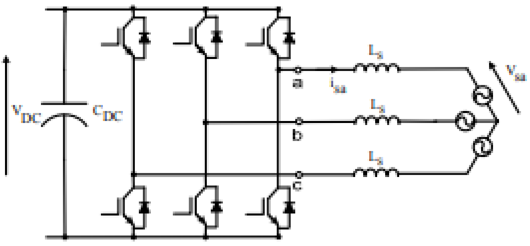
I examined that it was feasible to regulate the capacitance charges by carefully selecting capacitor configurations, but that was complicated management. Capacitor clamping, like diode clamping, necessitates a significant number of mass capacitors to control the voltage. I created the resultant phase voltage by adding the voltages produced by the various cells. I accomplished that by successively attaching the capacitance to the ac side through the 4 switching devices. The output ac value fluctuates between 2Vdc and +2Vdc with five levels. I adjusted the connecting angles at various inverter levels resulting in the lowest harmonic distortions. The cascaded inverters require separate dc supplies for practical energy exchanges.I designed an independent dc supply that was highly suited for different forms of renewable power such as fuel cells and photovoltaics that supply separate dc sources. I limited applicability that was further by the requirement for distinct dc sources. Among all multilevel inverters, the cascaded inverter uses the fewest components to accomplish the same amount of voltage levels. I examined that because each level has the same architecture, modularized circuit designs and packaging were feasible. I used that there were no additional clamped diodes or voltage-adjusting capacitance needed. I employed another benefit of such an architecture would be that soft switching eliminates the usage of bulky and lossy resistor-capacitor-diode subbers. However, the requirement for distinct dc sources restricts its use.

[CE 2.10]

Usually, the switch current iq has a train of pulse with various widths. I calculated the switching RMS flow accurately, calculate the RMS value for each pulse separately, then square the pulsing RMS values and take the square root of the total of these squares to get the switching RMS current. That looks to be a rather complex procedure. Nevertheless, I reduced the problem by assuming a sufficient high converter frequency. Following these assumptions, I calculated the switches and diodes RMS currents using a dual total, the inner of which accounted for the swapping period and the outside for the phase of the line.

$$\frac{1}{T_s}\int_{\lambda}^{\lambda+T_s} i_q^2 d\lambda=\left\langle i_q(t)\right\rangle^2 d(t)$$

I examined that averaging throughout a switching period was analogous to measuring switching power squares across a switching cycle. In PWM operations, I supposed the inverter output power to be sinusoidal (see Fig. below). The mean power of the switches across a switching period was the same as the inverter AC line power.



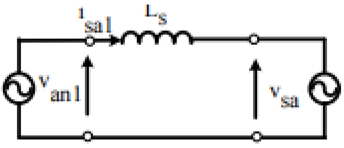
Due to the stored charge in the semiconductor, diodes have switching losses. However, I used that because of rapid recovery diodes in inverter circuits, those inefficiencies were normally neglected. I estimated typical switch turn-on and turn-off energies as a linear equation of switching power. As a result, I provided the power loss of switching by:

$$P_{avg\_sw} = \frac{1}{T_s}\int_0^{T_s} \frac{(e_{on}+e_{on})}{T_s} dt = \frac{I_{DC}(k_{on}+k_{off})}{T_s}$$

[CE 2.11]

I calculated RMS and mean currents using computer-aided analysis. For example, in a computer-aided methodology based on the Fourier series methodology, the RMS and mean currents of voltage supply inverters were calculated. I studied another computer-aided study, that time based on the relationship between the line, switching, and diode currents. I examined that in general, these procedures were difficult, time-consuming, and inaccurate. Furthermore, these approaches were ineffective in highlighting the important elements that influence the RMS, mean, and peak currents. Moreover, my approaches have significant flaws, reducing their dependability.

In my work, the approach for calculating RMS, peak, and average currents was as follows: I began, control strategies were classified as PWM or square wave. I calculated the accompanying currents for each mode: RMS, mean, and peak. I described the per-phase comparable circuits of the essential elements of the inverter's output voltage, flow, and load voltage. The Phasor diagram depicts the relationships among the volts and currents depicted in Fig. below.

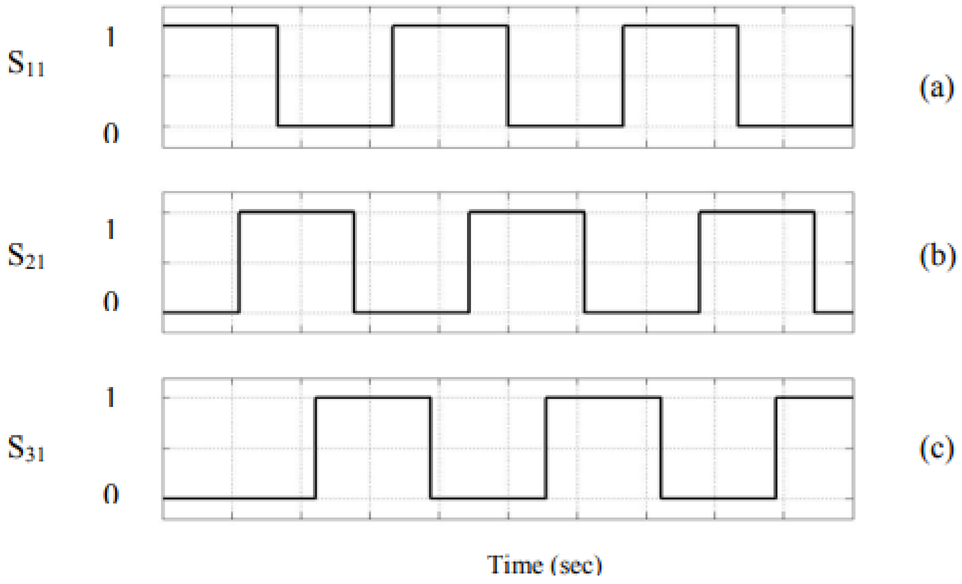


Normally, the switching voltage iq has a train of pulses with various widths. I computed the switching RMS current accurately, calculate the RMS value for each pulse separately, then square the pulsing RMS values and take the square root of the total of such squares to get the switch RMS flow. That looks to be a rather complex procedure. However, by supposing a sufficiently high switching rate, I reduced the issue. Following that concept, I calculated the switches and diode RMS currents using a dual integration, the inner of which accounted for the switch phase and the outer for the phase of the line.

I estimated the diode RMS flow using the same methods as the switch RMS current; but, the switching duty cycle must be substituted with the diode equivalent. Luckily, the diode duty ratio was proportional to the switches duty ratios:

$$d'(t) = 1 - d(t) = \frac{1 - M\sin(\omega t)}{2}$$

I obtained the switching signal generation for the system:



[CE 2.12]

I estimated the diode's RMS current estimates by (12) and acquired them by simulation. The inverter's performance in medium-high power applications was mostly drafted from PWM into squared modes. I did these to reduce/eliminate switch costs, hence increasing performance. All the work activities were modeled appropriately during the project and it led to accomplishing the core work outputs.

D) Summary

[CE 2.13]

I examined that because of their simplicity, the split dc-link and four-leg inverters were the most fascinating topologies. These topologies enable three-dimensional control, which was useful for active filtering purposes.

[CE 2.14]

I worked on multilevel inverters that offer the benefit of creating exceptionally low-distortion output volts, producing lower common-mode voltages, and drawing power with exceptionally low distortion, but with a difficult architecture. I addressed a huge number of parts and a difficult control approach. Nonetheless, the multilayer inverter would be crucial in the near.

[CE 2.15]

I accomplished the set work outcomes with the practices being made in the electrical engineering field and this helped achieve the mandatory work outputs.