Welcome

To

CDRAustralia.org

CDR Report Writing Service Provider

Career Episode 1

❖ Introduction

CE 1.1

The following career episode includes the details of my Bachelor degree project that required the implementation of AC-DC conversion to increase the SRM drive's power factor. During the time, I was in the final year of my Bachelors in Electrical and Electronics Engineering I performed this project at K L University.The project was started in November 2013 and completed in April 2014. The project was based in Guntur India.

❖ Background

CE 1.2

AC to DC, AC to AC, DC to AC, and DC to SC converters are the classification of power electronic converters. In this career episode, the main focus was on the AC to DC converters. As we know, most AC-DC converters require constant DC output voltage that is helpful in many cases. Nowadays, many manufacturers and consumers demand DC output which is possible through AC-DC conversion. The most popular way of achieving this conversion at the levels of lower power is by using a C filter rectifier. At the level of high power, the AC-DC conversion can be achieved by using a phase-controlled rectifier having LC filter.

CE 1.3

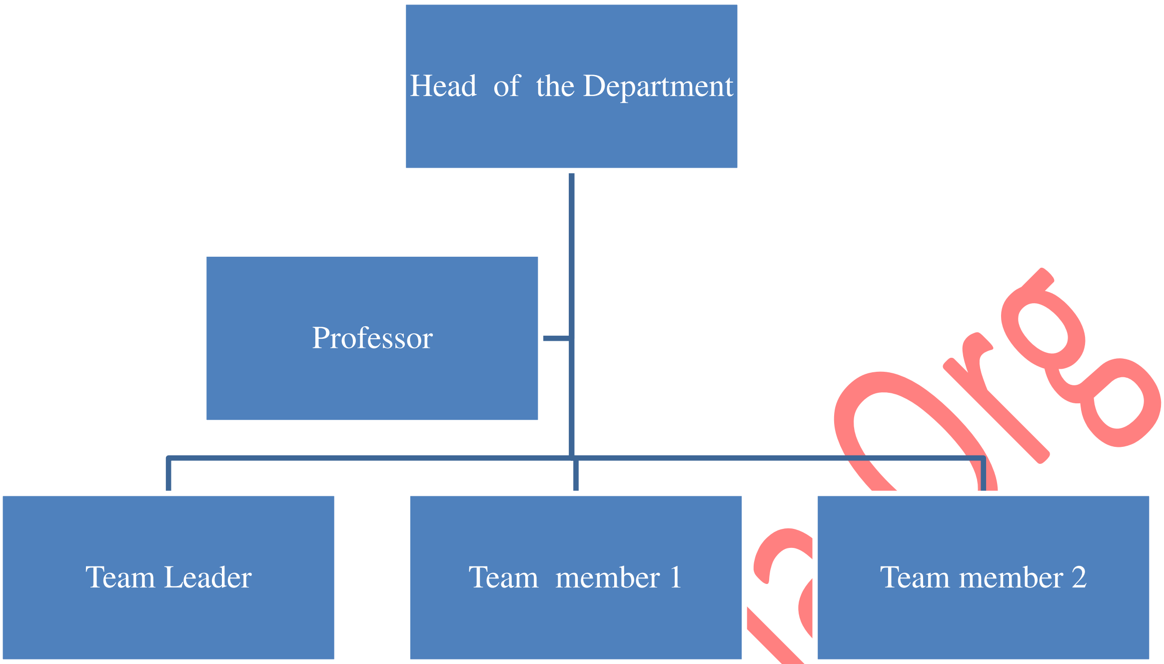
As significant as rectifiers are for carrying out the AC-DC conversion, they draw an unwanted AC line current that produces harmonics. Due to this reason, there are power quality issues concerned with the source end and rectifiers. In the line current, harmonics were existed and it results voltage distortion at common coupling point. It caused system power protection, monitoring devices, and malfunction of load. Overheating and interference of the neutral lineare some major issues that are caused by these harmonics.

CE 1.4

The reduction in power factor is caused due to the availability of lower-order harmonics in the input current.The operational power factorinfersusing the volt-ampere rating of the equipment. It affected the source current's quality.The work presented in this report addressed these issues. This project deals with the problems arising out of the conventional techniques used for AC-DC conversion and also some of the existing techniques for rectifying these problems. The scope of this project is to develop a converter which is based on a current source rectifier (CSR) to change the SRM drive's input current and improving its power factor.

CE 1.5

Project Hierarchy



❖ **Personal Engineering Activities**

CE 1.7

I initiated my project tasks by conducting an in-depth study of the project scope and make myself familiar with the SRM Concept. As the SRM is an interesting device that can be used for variable speed drive applications, it is also advancing speedily due to its distinguished features like simple construction and usage. It’s one of the reasons why my team chose to work with it. Torque ripple was induced by a low power factor which resulted in undesired vibrations and noise disturbance which should be removed from the motor drive system. To eliminate these problems, I studied the methods of reducing torque ripple and came up with two effective solutions,i.e. modification in motor design and application of control methods. I also researched methods for power factor improvement to enhance the competitiveness of the system and reduce distribution losses. I studied the conventionalSRM converter which consisted of a large filter capacitor with a front-end and a low power factor (PF) diode bridge rectifier that also gave large current harmonics and less system efficiency. All these factors existed because the device was drawing a pulse current from the input side of AC source.

CE 1.8

For low-cost battery-powered applications, I designed a battery charging circuit which had switched reluctance motor coupled with the circuit. It provided high efficiency and reliability along with less manufacturing expenses. For the system design, I proposed a power converter that consisted of two stages and a current rectifier that acted as anasymmetrical converter in the input stage. This scheme was set to enhance the power factor.I also installed a large filter capacitor with a front-end in the converter so that when the switched reluctance motor in the regenerative mode, this batter would charge it.I designed the two-stage converter in order to validate prominent reduction of the supply current's THD value. Then, I calculated the line drawn aquality of current and significant improvement of the power factor.

CE 1.9

To achieve success in this project, I considered conventional SRM and analyzedits characteristics to make a better comparison with the SRM proposed in this project. The SRM doubly salient construction presented a non-linear operation upon evaluation. I also concluded from this finding that torque and flux were functions of position and current. During this study, I faced a complication regarding magnetic saturation. I noticed that this factor was a hindrance to obtaining high performance of SRM. So to reduce this complexity, I accurately modeled the physical characteristics. In this case, I neglected phase mutual coupling and focused on the SRM graphical curves to get an idea of the rotor positions and also the phase currents.

CE 1.10

I analyzed the conventional SRM drive with a unipolar converter thoroughly. The simple conventional system contained a three-phase diode rectifier, an asymmetric bridge converter,and a bulk DC link capacitor. The low power factor in this system was produced due to the charging and discharging of the capacitor which drew pulsating AC line current. This greatly reduced the efficiency of the drive system and increased the power line's reactive power. To overcome this problem in the conventional system, I designed a two-stage converter. In the first stage, the front end converter performed the function of the controllable rectifier diodes and eradicated high input line harmonics while enhancing the power factor. In the second stage, phase winding energizing was performed by the machine side. The modified SRM device contained a CSR with six bi-directional self-commutating switches. At this point, I did not implement short-circuiting to the main filtering capacitors,and the circuit towards the output current was not opened.

CE 1.11

I evaluated the current reference vector by considering two limiting vectors and used an equation to define resulting output of space vector with line-voltage. I applied the Space Vector Modulation (SVM) switching technique to the CSR to express the desired current vector depending on the voltage vector. Using the same approach, I determined unit power factor and calculated the duty cycles of the switching state vectors. For this project, I used DC link capacitors to charge the battery when the switched reluctance motor was in regenerative mode. I representedthis operation in the form of a schematic diagram. The angles for turn off and turn on mode varied the RMS value and DC link current ripple.

CE 1.12

In this project, I performed simulations and developed MATLAB/SIMULINK models.Using a simulation, I demonstrated the proposed method, observed the results, and illustrated the results. According to the results, I concluded that the conventional system had low power factor problem which affected the power quality and economic condition. I also verified that the proposed SRM drive developed in this project solved this problem. The proposed SRM drive with current source rectifier (CSR) overcame the problem of low power factor and also improvedthe system stability. It had the battery charging capability in the regenerative mode of operation which was a unique feature of this proposed SRM drive. The graphical representation of input voltage and current waveforms for SRM drive were demonstrated clearly,and I explained that the conventional SRM system suffered from the low power factor problem while the proposed SRM drive whose waveforms werealso observed resolved this issue.

CE 1.13

Using input phase current frequency spectra in the power factor correcting, I illustrated the improvement in current THD value. Through the frequency spectra of the input phase current for both cases, I showed that the proposed converter greatly improved the THD of the current by correcting the power factor and allowing speed control via controlling the link voltage using the modulation index. As in usual cases of motor, there was limited torque allowed by the max current, and speed due to the voltage available. As the shaft speed increased, I noticed a current limit region persisted till the rotor reacheda speed on which the motor'sback-EMF gave the limitation of DC bus voltage and no current was noticed in the winding, and neither ant torque was from the motor. I concluded that this point was called the base speed and beyond this point, the shaft output power remained constant and at its maximum value. At the higher speeds, there was an increase in the back-EMF and the output power of shaft began to drop. I characterized this region by multiplying the torque with square of speed remained the constant.

CE 1.14

I worked along with my team members. I developed the plan and accordingly divided the tasks among the team. I hold leading position and successfully lead my other members and completed the tasks within the time limit. I also coordinated with the Supervisor and received a great help. His timely guidance helped me in improving my technical knowledge. I under his guidance followed the safety rules while carrying each task. I made sure that I have maintained the highest ethical standards. I behaved well with my team and listened to their suggestion as well.

CE 1.15

I have great writing skills, which I utilized in preparing the project report. I used the MS Word and write the complete project activities, design details, and calculations. I used the MATLAB software for performing the simulations. I also gave the final Presentation using the PowerPoint. While carrying out the project design activities, I followed the electrical standard of IEEE.

❖ **Summary**

CE 1.16

In the concerned project,the project regarding a power converter was discussed and implemented successfully. It was based on a current source rectifier (CSR) which aimed at improving the power factor of the SRM drive. The CSR based converter also helped in achieving the energy saving capability in regenerative mode of operation by using the DC link capacitors. The simulations and spectra clearly illustrated the improvement in THD value and the front-end capacitors were successful in charging the battery under regenerative mode of operation of the motors. The control algorithm and switching operations were implemented on DSP-equipped SRM.

Career Episode 2

Introduction

CE 2.1

In my second episode, I would like to explain a project about the “reducing the electrical oscillation in the wind farm.” During the time, I was completing my Engineering in Electrical and Electronic Engineering from the KL University, India. I worked on this project from Month/ Year and completed it in Month/ year.

Background

CE 2.2

Lately, Electrical Engineers have been showing akeen interest in the topic of power quality. This is quite a crucial subject that has been infested with problems like harmonic distortion and reactive power compensation. Companies and high-scale operating industries demand good quality electrical energy because if the energy supplied to the loads is of low quality, the products and apparatus that are associated with these loads like microcontrollers, computers, motors, etc. will be heavily affected. The companies contributing towards the information technology is in dire need of high-quality electrical energy,or the market will suffer. Custom Power Equipmentis brought to use in solving quality issues. To date, the components being used to discard harmonics are capacitors and passive filter. These components also recompensed the reactive powere required in the factories. To provide unity power factor operations, PWM based converters are used for controlling the motors. However, it is not appropriate to rely solely on capacitors and filters to reduce the harmonics. For this reason, Active Power Filter (APF) is being researched to fiter the harmonics. The compensation of loads like Diode Bridge Rectifier and Thyristor Bridge feeding an inductive load that gives a representation of current source at a common coupling point can be performed by connecting APF and load in shunt.

CE 2.3

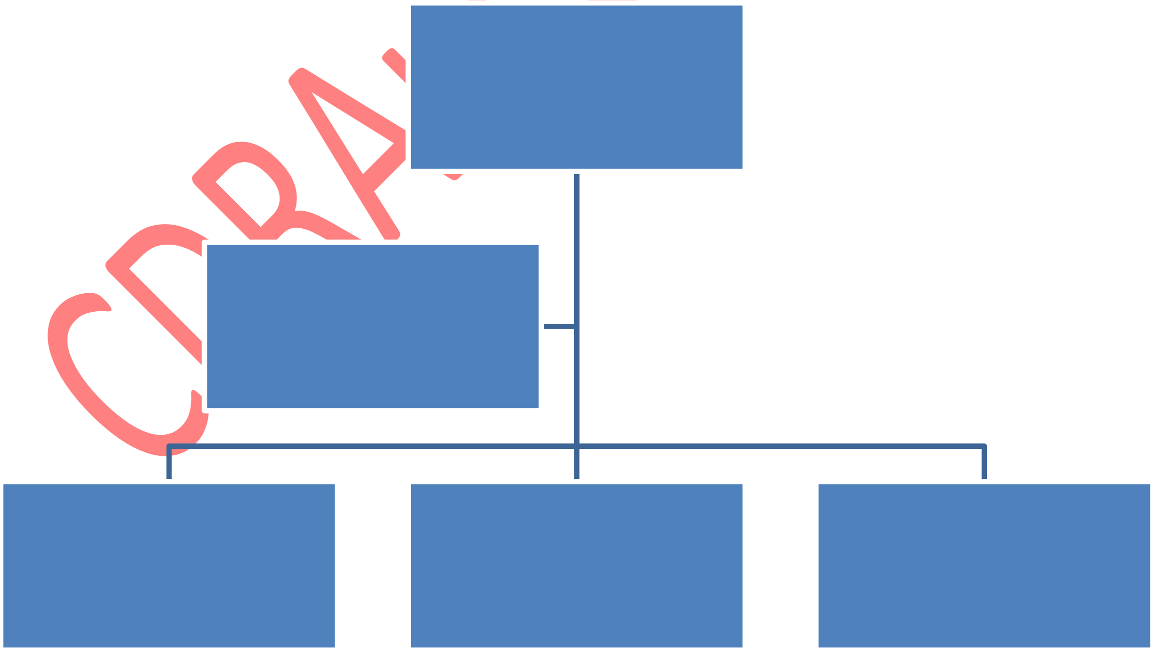
In this project, the effects of oscillations in power systems have been explained. The study aimed to reduce to these effects and throw light on the problem of harmonic distortion. It is one of the major problems that has a bad impact on the power quality and introduces disturbances in the power system. To enhance the quality of power, harmonic reduction techniques were implemented,and the same were simulated. This report also entails the procedure to model wind farm system linked with a VSC and elaborates the modes of oscillation that the system included. These modes were categorized according to the ratio of frequency and damping. Identification of the oscillatory modes of collector system was performed,and it was concluded that they contain low damping with frequency ranging from 100 Hz to 500 Hz. Due to the VSC-HVDC harmonic generation, they were in close proximity to harmonics of power frequency which made them even more important. The operating situation of the wind farm determined the damping in the modes of medium frequency. Due to these prevailing conditions, the wind farm operations constantly varied. It was also discovered that VSC controller parameters greatly affect the damping in the medium frequency ranges. The presence of these modes was confirmed by time-domain analysis results.

CE 2.4

I have carried out below mentioned tasks in the completion of the project;

CE 2.5

Project Hierarchy



Personal Engineering Activity

CE 2.6

I started off with conducting a detailed literature review and clear my concepts on the electrical oscillation. In the present work of wind farm system, I studied two farm works of capacity 465MW,and 165 MW with each wind farm labeled as WF1 and WF2, respectively. I studied the components of this system and acknowledged that the components for the wind farm included a DFIG, a pad-mounted transformer, and a wind turbine. I developed a schematic diagram that represented the 5MW WTG based on the DFIG which was used for the development of wind farm mechanism. I energized the DFIG rotor using arotor-side converter (RSC) and grid-side converter (GSC) and also stepped up the voltage of DFIG to 33kV using a step-up transformer. I demonstrated the high-voltage network of the system along with the interconnected medium-voltage strings. I made connections of the wind farm system with the common coupling point and VSC using a 132 kV cable. To connect the PCC with main AC grid, I used an HVDC link. I assumed the cable distance between transformer terminals of wind farm system and PCC. Then, I separated the wind farms into two areas namely, area 1 and area 2. I adjusted and regulated the voltage and frequency of the PCC using VSC.

CE 2.7

To perform the analysis of the system, I developed four test cases. WTGs in all the four cases were functioning above rated wind speed and had a certain value for the pitch angle. The first test was the base test where WTGs of both the wind farms were operating. In test 2, the second WF was closed,and just five WTGs of this WF was in working condition, present at the end of the string. Their selection was made to keep the 33 kV cable energized. For test 3, I partially closed WF2 A2. In WF1 A2, just eleven WTGs were working that were present at the end of the strings. Rated output was produced by the WTGs present in WF1 A1 and WF2. Last but not the least, for test four, I partially closed WF1 A1 and WF2 A2. The working WTGs in WF1 A1 was ten, while in WF1 A2 there were eleven working WTGs present at the end of the strings. Rated output was produced by WTGs in WF2.

CE 2.8

When the grid is integrated with the wind power,power quality issues were produced. These issues included the compensation of reative power and voltage regulation. In the generations based on wind power, induction machines are mostly utilized as generators. These generators drew reactive power from the connected grid which is why wind power was a main concern for me in such power systems. Introducing the wind power heavily affection the power quality of the system. I searched a few online resources to resolve this issue and found that power electronic technology provided the best solution for the above mentioned concerns. Normally, rectifiers were used as a non-linear load in such systems or other devices like fluorescent lamps, welding machines, etc were accounted as loads too. After conducting a detailed analysis, I discovered that these power systems were disturebed by a switching action. Some of the frequency components in the power system were multiples of the frequency components in the current which is why the current waveform was distorted from sine-shaped wave to another shape containing harmonic currents.

CE 2.9

To reolve this issue, I searched and discussed the problem with my teammates and came up with the solution of using shunt capacitors to recompense the reactive power in power systems.

Synchronous condensers were also a viable choice to reduce this issue. The shunt capacitors could be connected to mechanical switched or thyristor switches. But the shunt capacitor involved some issue too. I found that there was a direct relation between the supplied reative power and voltage square. If the voltage decreased, the power supplied by the capacitor also decreased. I used STATCOM to solve this problem and it was helpful in reducing the harmonics and compensating reactive power. This device is a reactor based converter which is very powerful. A controllable voltage source conveter wad integrated with it which controlled the output voltage of the grid and acted as the supplier or absorber of the reactive power. I developed a block diagram which demonstrated the connections of the equipment with the grid system. The STATCOM was linked at the point of common coupling for recompensing the reactive power requirements of the system. Ultimately, it reduced the problem of harmonics.

CE 2.10

I used the STATCOM converter in a control technique to enhance the quality of power and compensate the deviations in the power system. To complete the tasks of this project, the STATCOM control scheme that I used interfaced the grid and the wind turbine together to improve the performance of electrical power. I generated DC voltage using the solar cells for the STATCOM operation. In a three-phase system, when multiple electrical loads were utilized, an imbalance in the current was generated which produced power that is unreliable. To avoid this situation, STATCOM controller is quite useful that is why I used STATCOM control technique. I compared the reference voltage and DC link capacitor,and the result that was attained was converted into orthogonal vectors. A STATCOM is one of the compensated devices which is a combination of power electronic converter along with reactor. I constructed the converter using fully controlled devices such as GTO, IGBT or MOSFET.

CE 2.11

During the project, I performed different calculations as per the need. I calculated the total harmonic distortion value by diciding the sum of squares of amplitude of harmonic with the square of the amplitude of fundamental and multiplying with 100. I also performed numerical for determining the velocity and power relation. I next measured the wind capacity. I always focused on the maintaining the safety during the project activities. I followed the safety standards and tried to reduce the negative impact of the sensitive activities. While working on radiation omitted equipment, I always make sure that I used goggles and gloves for protection. I abide by all the safety standards that are necessary to be followed.

CE 2.12

I lead the team of two more engineers in this project. I showed my leading skills by managing the tasks efficiently and distributed the tasks equally among all the members. I was involved in the designing part and rest, I have distributed the tasks among the team equally. I planned each activity of the project. I arranged group discussions for discussing the design and technical issues. I also organized meeting with my project supervisor. When there was an issue, I wrote an email to him and sought his permission to arrange a meeting. I prepare the points of discussion and together with my other team members discussed with him the issues in detail. We took his opinions consider them in the project and brainstormed on the issue to develop a solution

CE 2.13

I showed high considerably with the engineering standards which I have shown in this project. I followed the IEEE standards while designing the power circuits. In this project, I used MATLAB and AutoCAD Software for performing the simulation and circuit designs. I also worked on the MS Word for writing the project report. My report was as per the quality standards, I mentioned each task in details and presented the diagrams and simulation results.

Summary

CE 2.14

I carried out all the tasks in a timely manner. I produced quality results. I efficiently showed my software skills which I used for various purposes. This project increased my learning through researching and browsing,and I was able to from my knowledge. I improved my communication abilities by conducting meetings and preparing the reports. I completed the project objectives on time and got anappreciation for all my hard work.

Career Episode 3

❖ **Introduction**

CE 3.1

In my final career episode, I would like to discuss my university project of designing a Constant Motor Speed Control. I undertook this project while completing my Graduation in Electrical Engineering from University of…. The project was started in Month/ Year and completed in Month/ Year.

❖ **Background**

CE 3.2

Motors are the indispensable equipments at high-operating factories, industries, and even households. A large number of these devices are constantly being used in the industrial facilities to accelerate productivity. The electric motor is a significant source of power to date and have wide-ranging functions and performances. As crucial as DC motors seem, controlling their speed is equally important as some applications demand speed control. Speed control means to change the drive speed of the motor intentionally to a fixed value that is desirable to carry out certain work processes.

CE 3.3

The simplicity of the controls is one of the most important factors of a DC motor which is why we used the DC motor in this project. The implementation of linear control in DC motor was quite basic to study control techniques and construction of motors so our project supervisor thought it as the best way of learning. In the motor, the speed was proportional to the voltage and the torque was proportional to the current. The conventional way of achieving speed control in DC motors was by varying the supply voltage and using lossy rheostats to obtain a voltage drop. It also meant that if the load changes, the speed of the motor will also change. The main objective of or project was to design to circuit for controlling the speed of a DC motor.

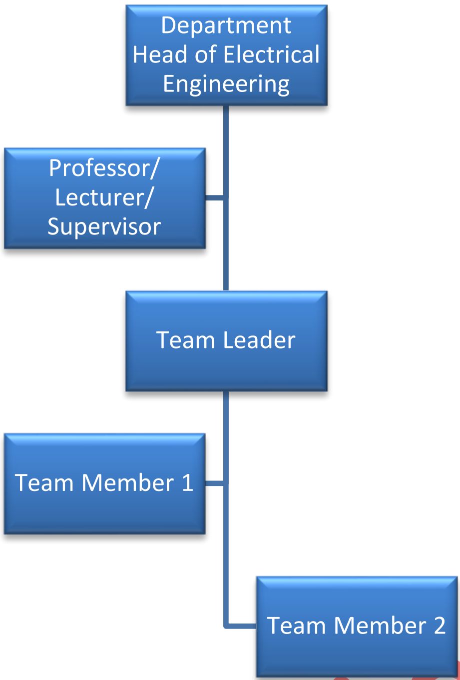
CE 3.4

During this project, I executed the tasks mentioned below;

- Studied the basic engineering principles and techniques behind controlling the motor speed
- Defined the objectives of the project and clarified the scope to the team members
- Searched a listed the components suited best for this project
- Collected the bills of all the purchased components and tabulated the costs of each component in MS-Excel
- Prepared a proposal of the project and requested funding from the electrical engineering department
- Divided the tasks of the project and allotted them to each member of the team
- Monitored the performance of the team members and reported it to the project supervisor
- Assisted my team members in complex situations and displayed qualities of teamwork
- Reported the progress and complications of the project to the supervisor and paid heed to his valuable advice
- Arranged weekly meetings of the team with the supervisor and resolved all the issues in that meeting
- Selected the components wisely and downloaded datasheets to fulfil the specifications of each component
- Tested the components in the simulation software and noticed the output waveforms
- Compiled the project's procedure in a reported and submitted it in the department

CE 3.5

The project team, including me, consisted of the following members;



- **Personal Engineering Activity**

CE 3.6

I began this project by researching the data related to the techniques and methods used in this project. The project required basic engineering knowledge so I read linear control system books for beginners. Some of the books were recommended to me by my supervisor while some of the material I searched online via web browsing and online libraries. The studying material helped me in developing basic knowledge regarding control systems and control processes. I thoroughly studied the construction of a DC motor and came across old and new methods of speed control. I shared the books and online sites with my teammates to ease their study.

CE 3.7

After studying control methods, I was clear about designing the circuit so I began with selecting the suitable components. The components that I connected with the DC motor were; a battery with maximum 30 volts, a 10k ohm linear potentiometer, LM741 OP-Amp, BD139 transistor, 1N4002 diode, and capacitors of values 100 nF and 470 uF. I consulted the pin configurations of all the IC components to design the circuit properly. For designing the circuit, I connected the potentiometer to Vcc and ground and connected the central i.e output terminal of the potentiometer with the non-inverting input of the OP-Amp. The output of the OP-Amp was connected to the base of the transistor and the output of the transistor was supplied to the 470 uF capacitor, the other terminal of which was grounded. I connected the transistor’s emitter with the motor which was in parallel to the diode and 100 nF capacitor. This arrangement was fed back to the inverting terminal of the OP-Amp.

CE 3.8

In this project, I used single supply voltage that was approximately up to 18 Volts DC and fed the voltage control from the potentiometer to the non-inverting input of the OP-Amp. I used the OP-Amp as a follower voltage. The pass transistor connected in series helped the output current in boosting. The emitter follower configuration was used to accomplish this project. Here, I have faced an issue of maintaining a constant voltage, which was fluctuating across the motor. Therefore, to resolve this problem, I connected the emitter voltage in a feedback loop with the inverting output and this negative feedback maintained the balance of the inputs. I applied the same voltage to the non-inverting input as that of the inverting input by means of the control. This ensured a continuous voltage throughout the motor.

CE 3.9

I simulated this circuit in the Proteus software before making connections to ensure the safety of the components. The simulation results showed constant voltage which meant that the motor speed was maintained and it was independent of mechanical load to the motor. However, I calculated the current drawn by the motor under unloaded condition which led to incorrect reading of the motor drawn current which resulted in transistor failure. After discussion with my team fellows, I measured the current drawn by the motor under loaded conditions as my supervisor told that this was the correct value of the current that was to be supplied by the series pass transistor. I tested the circuit again and the problem was resolved.

CE 3.10

I performed a number of calculations using electrical engineering formulas and basic laws of engineering. I determined the transistor dissipation in the transistor by taking the product of collector-emitter voltage and emitter current. The value that I obtained after performing the calculations indication the limit for the transistor as above this dissipation value the transistor would heat up and get damaged. BD139 was able to handle only 8 Watts of maximum power, 1 Amp of maximum current, and 80 Volts of collector-emitter voltage, so I had to be very careful. Alternative power transistor could also be utilized in this project for instance, TIP31C. When the power supply was removed, the rectifier dissipated any back EMF from the motor.

CE 3.11

I used the Kirchhoff's Voltage and Current Law to perform loop and nodal analysis on the circuit that I designed. The calculations were recorded in the report that was finalized in the end and submitted to the faculty of electrical engineering department. The results of theoretical analysis that I performed were compared with the computerized simulations. In this way I determined the efficiency of my circuit and demonstrated the proximity of calculated results with the measured results. Other formulas and power equations that I used were very basic.

CE 3.12

I worked along with my other two team members. We worked with coordination. I had arranged team discussion meetings and also arranged once in a weekly discussion with the supervisor to get the work done at a quick pace. At the end of each day, I made progress submissions to the supervisor so he can guide us better on how fast or slow we should take things. We communicated all the issues and problems with each other and devised perfect solutions. If at any point we were unable to solve those issues, only then we bothered our supervisor as he had a very busy schedule.

CE 3.13

Throughout this project, I was very cautious about circuit protection. Component failure is the main issue in all electrical circuits and it is quite common, hence it is necessary to take precautionary measures beforehand. I used necessary safety measures to prevent my circuit from failing. I used a circuit breaker with the main power supply and installed high ampere fuses before each component of the circuit so if an excess of current was drawn, the fuse would open the circuit and the components would remain unaffected. I used IC bases with all the ICs while testing out the circuit. The bases also helped me to solder the IC onto the PCB without overheating the ICs. These safety steps not only helped me to save the components, but also the cost of the project.

CE 3.14

I cared a lot for my team during the tenure as they were quite helpful and respecting towards me so I was always concern about keeping them safe. I taught one of my teammates to solder properly without getting burned and the proper way of holding the soldering iron. I requested the department to provide us with safety equipment and protective wear such as rubber gloves so we do not come in contact with the voltage. The circuit was tested in the presence of all the team members so everyone could monitor if the task was carried out properly and reach for help in case of any shock hazard.

CE 3.15

I have a good command of English language. Therefore, I was given the task to prepare project reports and other documents including project proposal, funding application, etc. I prepared each report carefully as per the report writing standards of my university. After I gave a proper shape to the final report, I passed it on to my group members for proofreading. Each member made modifications of their own and the final report was submitted to the department. The chairman of the department shared good remarks about the report and I was also praised by the supervisor.

CE 3.16

I watched tutorials and attended workshops for learning the Proteus software as it was mandatory to simulate the circuit before implementing it on hardware. It was also necessary for PCB designing. The waveforms that I generated in the software gave me a better idea of the duty cycle and I was able to compare the results with the calculations that I initially performed. I gained proficiency in Proteus software after completing this project.

- **Summary**

CE 3.17

Control and automation techniques are highly popular nowadays which is why I was very thrilled to work on this project. I feel proud of myself and my team to have accomplished this project before the deadline approached. We were blessed with the constant support of our family, teachers, class fellows, and seniors. Our approach in this project was quite simple and cost-friendly. The project of control motor speed control was a fruitful experience that paved way for future benefits and instilled the qualities of a competent engineer and circuit designer in me.

PROFESSIONAL ENGINEER

Summary Statement

Competency Element	A brief summary of how you have applied the element	Paragraph in the career episode(s) where the element is addressed
PE1 KNOWLEDGE AND SKILL BASE		
PE1.1 Comprehensive, theory-based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	I completed my project activities by applying the fundamental principles of science	CE 1.7, CE 1.8, CE 1.9, CE 1.11, CE 2.6, CE 2.7, CE 2.8, CE 2.9, CE 2.10, CE 3.7, CE 3.8, CE 3.9
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics and computer and information sciences which underpin the engineering discipline	I completed mathematical calculations pertinent to the project requirement	CE 1.10, CE 2.11, CE 3.9, CE 3.10, CE 3.11
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	I used different software for completing my tasks effectively	CE 1.11, CE 1.14, CE 2.13, CE 3.9, CE 3.16
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	I continually searched for new advanced strategies and emerging problems in my engineering discipline	CE 1.6, CE 2.6, CE 3.6, CE 3.16
PE1.5 Knowledge of contextual factors impacting the engineering discipline	I coordinated with my team and together we achieved all the tasks I managed different activities of the	CE 1.12, CE 1.13, CE 2.12, CE 3.12, CE 3.14

	project in an efficient manner	CE 1.16, CE 1.13, CE 2.6, CE 2.12, CE 3.7
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the specific discipline	I completed the project design by following the engineering norms and principles	CE 1.7, CE 2.6, CE 2.7, CE 3.7
	I followed the engineering national and international standards	CE 1.14, CE 2.13, CE 3.15
	Being aware about the safety standards, I followed the safety precautions and procedures	CE 1.13, CE 2.11, CE 3.9, CE 3.13, CE 3.14
	I successfully managed each task of the project	CE 1.16, CE 1.13, CE 2.6, CE 2.12, CE 3.7
PE2 ENGINEERING APPLICATION ABILITY		
PE2.1 Application of established engineering methods to complex engineering problem solving	I successfully resolved the complex technical situation implementing my knowledge	CE 1.8, CE 1.9, CE 1.11, CE 2.8, CE 2.9, CE 2.10, CE 3.8, CE 3.9
PE2.2 Fluent application of engineering techniques, tools and resources	I followed the fundamentals of engineering standards	CE 1.14, CE 2.13, CE 3.15
	I made use of various computer based programs for calculation and design	

		CE 1.11, CE 1.14, CE 2.13, CE 3.9, CE 3.16
PE2.3 Application of systematic engineering synthesis and design processes	I proficiently implemented my technical understanding in solving complicated engineering problems	CE 1.8, CE 1.9, CE 1.11, CE 2.8, CE 2.9, CE 2.10, CE 3.8, CE 3.9
PE2.4 Application of systematic approaches to the conduct and management of engineering projects	I deliberately managed complicated engineering tasks being a part of team and efficiently lead them	CE 1.12, CE 1.13, CE 2.12, CE 3.12, CE 3.14
PE3 PROFESSIONAL AND PERSONAL ATTRIBUTES		
PE3.1 Ethical conduct and professional accountability	While performing various activities of the project assignment I constantly ensured to comply with various engineering standards I was aware about the safety standards and always observed them while carrying different activities	CE 1.14, CE 2.13, CE 3.15 CE 1.13, CE 2.11, CE 3.9, CE 3.13, CE 3.14
PE3.2 Effective oral and written communication in professional and lay domains	I finally prepared the project reports keeping in my mind documentation norms I energetically participated in meetings to discuss the progress of project and different issues	CE 1.14, CE 2.13, CE 3.11, CE 3.15 CE 1.14, CE 2.12, CE 3.12
PE3.3 Creative innovative and proactive demeanour	I performed research and studies and utilized them in the completion of the project tasks	CE 1.6, CE 2.6, CE 3.6, CE 3.16
PE3.4 Professional use and management of information	Being aware with documentation	CE 1.14, CE 2.13, CE

	norms, I preparedproject reports	3.11, CE 3.15
PE3.5 Orderly management of self, and professional conduct	I managed the project activities by efficiently planning the tasks I used my research techniques to deal different situations that I encountered during the projects	CE 1.6, CE 2.6, CE 3.6, CE 3.16 CE 1.6, CE 2.6, CE 3.6, CE 3.16
PE3.6 Effective team membership and team leadership	As a crew leader, I apprehend the team dynamics and leadership. I led my group by way of an example and guided them to obtain most useful overall performance	CE 1.12, CE 1.13, CE 2.12, CE 3.12, CE 3.14