King Saud University
College of Engineering
Electrical Engineering Department **Semester: 371**

Graduation Design Project Proposal Form

Project # P1

Project Title: Design of Capacitor Bank for a Radial Distribution Feeder

Professor(s) Name(s): Nazar H Malik

Number of Students: Two

Students Qualifications: Student should have taken EE340, and EE 448 and have good skills in computer applications for power system problem solutions

Statement of Problem

Electrical distribution systems have primary feeders that are radial, loop, or network. Each type has its advantages and drawbacks. On radial feeder, different load are present which change over time. As a result, the voltage profile at the feeder at different points is not fixed. In addition, due to less than unity power factor, line losses and other performance parameters are affected. Capacitor banks are used to overcome some of these problems. This project deals with the design of such a bank and its effect on the system performance.

Brief Description of the Project

The students should first understand different parameters, which characterize a capacitor bank. Next they should get the data for a radial primary feeder having typical line and load information. Then they should analyze the feeder performance under different loading conditions without the use of a capacitor bank. Finally, they will design a capacitor bank that will result in optimal performance of the system. The group should also look at the cost and benefits as well as other issues such as environmental impact, etc.

Objectives

The design objectives are as follows

1.The selected bank should provide the best overall benefits to the feeder performance
2. The location of the capacitor bank must be best for voltage profile, losses and reactive power requirements.
3. The benefits and costs of the capacitor bank placement should be determined clearly and justified.

4. The effect of the capacitor bank on environment and the effect of environment on the capacitor bank performance should be determined.

5. Applications of the design with any applicable limitation should be provided.

Technical Approach and Expected Deliverables

The group will work out the details provided above using simulation packages and provide a design that meets the stated requirements. Expected deliverable will be a report that addresses all the issues mentioned above.

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Graduation Design Project Proposal Form

Project # 10

Project Title: DC Motor Control using an Arduino

Professor(s) Name(s): Advisor: Dr. Waqar Ahmad
Co-Advisor: Dr. Essam Al-Ammar

Number of Students: Two

Students Qualifications

1. Knowledge of motors and generators.
2. Familiar with C programming, and microcontrollers.

Statement of Problem

DC motor is the most commonly used in industry and robotics. Starting, stopping, reversing the direction, accelerating, and decelerating the motor within pre-defined intervals of time is always necessary without direct human intervention. An Arduino will be interfaced and programmed for this purpose.

Brief Description of the Project

A direct current, or DC, motor is the most common type of motor. DC motors normally have just two leads, one positive and one negative. If you connect these two leads directly to a battery, the motor will .rotate. If you switch the leads, the motor will rotate in the opposite direction.

To control the direction of the spin of DC motor, without changing the way that the leads are connected, you can use a circuit called an H-Bridge. An H bridge is an electronic circuit that can drive the motor in both directions. H-bridges are used in many different applications, one of the most common being to control motors in robots. It is called an H-bridge because it uses four transistors connected in such a way ".that the schematic diagram looks like an "H.

You can use discrete transistors to make this circuit, but for this project, we will be using the L298 H-Bridge IC. The L298 can control the speed and direction of DC motors and stepper motors and can control two motors simultaneously. Its current rating is 2A for each motor. At these currents, however, you will .need to use heat sinks

Objectives

Often, the design has two to four specific objectives. You might consider listing them vertically as follows:

(1) Robotic control,
(2) Motor control, and
(3) Programming and interfacing microcontroller to an electric machine.

Technical Approach and Expected Deliverables

It is design based and industrial oriented project. We will demonstrate the following through this project:

1. Interfacing of Arduino with a DC motor.
2. Starting and stopping the motor, without direct human intervention
3. Accelerating, and deceleration the motor
4. Reversing the direction of rotation of the motor.

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Graduation Design Project Proposal Form

Project # P11

Project Title: *Pre-breakdown and Breakdown Phenomena in Nano- fluid Insulations*

Professor(s) Name(s): *Dr. Usama Khaled*

Number of Students: *Two*

Students Qualifications

Ability of experimental work implementation in the high voltage lab- Background about EE445 or EE446 courses – High grade and qualified students.

Statement of Problem

Nanotechnology deals with characteristics in nanometer size and/or microscopic regions on materials and functional devices.
In the recent past, nano-particle doped composite insulation came into use with a view to further enhance the electrical and dielectric properties.
This project will report dielectric investigations into nano-composites based on a class of metal oxides, (such as Al_2O_3 and SiO_2, ….). In particular, consideration would be given to the electrical pre-breakdown and breakdown under different voltage profiles as a function of the volumetric composition of the nano-particles in liquid insulations.

Brief Description of the Project

1 Measurement of conductivity
- Pure liquids
- Nano- fluids: influence of the type of nano- particles

2 Pre-breakdown phenomena in (a) pure oils and (b) nano-fluids
2.1 Streamer inception: inception threshold voltage, in a point-plane electrodes configuration:
- Influence of radius of curvature of the sharp electrode (point) - Influence of electrodes gap - Influence of the type of voltage - Influence of the concentration of nano- particles - Influence of hydrostatic pressure,… **2.2 Streamer propagation**
- Influence of radius of curvature of the sharp electrode (point) - Influence of electrodes gap - Influence of the type of voltage - Influence of the concentration of nano- particles - Influence of hydrostatic pressure,…

3 Breakdown phenomena in (a) pure oils and (b) nano-fluids
- Influence of the type of voltage
- Statistical analysis of experimental results

Objectives

- The design will consider improvement the dielectric properties performance of high voltage liquid insulators by adding few amounts of specific nano filler into liquid insulation.
- Designing samples for increasing the breakdown voltages values as well as reducing partial discharge occurrence of nano-fluid liquids under all voltage profiles.
- Getting an optimum volume concentration of nano particles in the used nano-fluid insulation.
- The design will help to select suitable nano particles considered for the study that gives the best performance for dielectric properties improvement of high voltage insulation liquids.

Technical Approach and Expected Deliverables

The design will be satisfied by theoretical, analytical and simulation approaches.

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Semester 1st/1437/38H

Graduation Design Project Proposal Form

Track	Power Engineering	Project no	P2
Project Title	Performance of three phase self-excited induction generator under variable conditions		
Supervisor(s)	Prof. Abdulrahman I. Alolah		
Number of Students	Two	Students Qualifications	EE330 + Basic Matlab

Statement of Problem	Environmental concern and rapid depletion of conventional fossil fuels have resulted in extensive use of renewable energy resources for electrical power generation. Better utilization of renewable energy may be achieved by developing small-scale, autonomous power systems in favorable geographic locations. The system cost can be minimized by the use of cage-type, self-excited induction generators (SEIGs).
Brief Description of the Project	(i) Review of renewable energies and methods of energy recovery systems (ii) Advantages of induction generator (iii) Analysis of the system under study (iv) Results verification
Objectives	(1) Understanding renewable energy sources. (2) Understanding concept of induction generator operation. (3) Study of effect of system parameters on output voltage. (4) Design a variable excitation capacitor to fix output voltage.
Technical Approach and Expected Deliverables	(a) Development of a computer program to achieve the required analysis (b) Use of MATLAB, or a similar package, to confirm the analysis of (a) (c) Verify some results experimentally

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Semester 1st/1437/38H

Graduation Design Project Proposal Form

Track	Power Engineering	Project no	P3
Project Title	Analysis of three phase induction motor under balanced/unbalanced supply		
Supervisor(s)	Prof. Abdulrahman I. Alolah		
Number of Students	Two	Students Qualifications	EE330 + Basic Matlab

Statement of Problem	Three phase balanced induction motor is usually designed to operate on three phase balanced supply. Under some conditions, the available supply is just single phase. Three phase induction motor can be operated on single supply by using phase balancer. The simplest phase balancer is a single capacitor which is connected to one terminal of the supply while the other terminal is connected to the supply.
Brief Description of the Project	(i) Review of induction motor theory, advantages and operation (ii) Review of induction motor operation under unbalanced supply (iii) Analysis of the system under study (iv) Results verification
Objectives	(1) Understanding three phase balanced and unbalanced supplies. (2) Understanding concept of induction motor operation. (3) Study of effect of system parameters on motor performance (4) Develop a measure factor for supply unbalance (4) Study of variable unbalance factor on motor
Technical Approach and Expected Deliverables	(a) Development of a computer program to achieve the required analysis (b) Use of MATLAB to confirm the analysis of (a) (c) Verify some results experimentally

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Graduation Design Project Proposal Form (1)

Project Title:
Design of a Scheme for the voltage change to the global standard voltage level of 230/400 volts in the Kingdom of Saudi Arabia.

Professor(s) Name(s): Abdullah M. Al-Shaalan عبد الله محمد الشعلان **P4**

Number of Students: Two

Statement of Problem

Kingdom of Saudi Arabia (KSA) is one of the few countries in the world that uses the dual distribution voltage (127/220 volts) at homes where standard voltage 127 volts is used for household appliances (like lighting, refrigerators, fans and other small power devices) and the 220 volts is used for higher power devices (like air conditioners, electric ovens, kitchen facilities, pumps). Only 9% of the countries in the world use this dual-distribution voltage while more than 70% use the 220/380 volts, and many of which are planning to adopt or change to the international standard voltage 230/400 volts being recommended by the International Electrotechnical Commission (IEC); the organization that prepares and publishes global standards for all electrical, electronic, and related technologies. Six percent (6%) of the countries of the world use voltage 110 volts, while the remaining 15% uses various voltage levels. Therefore, KSA has set a change plan through a transition period of 15 years to consume all the electrical appliances operated on 127 volts and adapting with implementing appliances designed for the new targeted voltages levels 230/400 volts.

Brief Description of the Project:

The proposed project will search for an appropriate design scheme for gradually abolishing the existing 127 volts and shifting to adopting 230/400 volts during the said government transition period for voltage change. The suggested scheme procedure comprises the following steps:

1) Modifying the electrical wirings in residential and commercial buildings to conform to the unified international voltage 230/400 volts.
2) Identifying all the required changes in the distribution network at homes and commercial buildings including changes in the wiring, sockets, electric meters and meter circuit breakers.
3) Replacing all installations having a single voltage 127 volts and replacing them with a dual voltage 127/220-volt device. Yet, it is preferred that the replacement is a single voltage 220 volts device to facilitate future transition to the unified international distribution voltage of 230/400 volts.
4) Investigating the impacts of voltage change upon the frequency of 50 hertz designed for appliances imported to the KSA from other countries, while the frequency in the KSA is 60 Hertz.
5) Preparing the change to 230 volts at the right time (at the start of the final stage) while taking into account that all switches, circuit breakers and switches plugs (if any) are bipolar type separating electric loads of the two lines at the same time, and not only the separation of one line.

Objectives:

The change in utilization voltage will, hopefully, facilitate the following objectives:

1) Abolishing usage of dual voltages (127 volts and 220 volts) in the electrical installations in buildings.
2) Ability to use small sizes of wires and cables and distribution panels in the distribution network which will lead to enormous savings in electrical installation costs at residential homes and commercial buildings.
3) Avoidance of risks of plugging appliances to the wrong voltage due to the existence of two different voltages.
4) Achieving of conformity of Saudi standards specifications with international standards.
5) Improving the performance efficiency of electrical appliances and increasing their useful operation lifetime.

Technical Approach and Expected Deliverables

The technical approach that will be adopted and applied in dealing with this type of project will be through adopting the criteria processes set by the Ministry of Water and Electricity and the IEC. The expected deliverables that will, hopefully, accrue from this project can be stated as follows: 1) Using the internationally-adopted standard voltage 230/400 volts which became the standard voltage applied in most of countries around the world, 2) decreasing the incidences of accidents (electric shocks, damage to electrical appliances, and outbreaks of fires) when appliances are mistakenly plugged into the wrong voltage due to the presence of dual-voltages 127 and 220 volts in the home, 3) No need to use adaptors to connect electrical devices to power source which weaken the levels of security and safety, 4) Ceasing of electrical appliances that are not designed for 220 volts or 230 volts from the entry into the KSA markets, 5) Easy application of certificates of conformity with the Saudi standard specifications because the voltage ratings of the imported equipment are similar to the voltage ratings used in the Kingdom, 6) No manufacturing obstacles are involved in the production of devices with operating voltages of 220 volts and 230 volts volts being encountered by exporting factories to the Kingdom that require additional cost to the consumer.

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Graduation Design Project Proposal Form (2)

Project Title: Design of a Power Factor Correction Controllers for Increasing Power Transfer Capability of the Saudi Electricity Company Interconnected East-Central System.

Professor(s) Name(s): Abdullah M. Al-Shaalan عبد الله محمد الشعلان **P5**

Number of Students: Two

Statement of Problem:

A study of the dynamic capability of the Saudi Electricity Company - Eastern Operating Area (SEC-EOA) power system, and its effect on increasing the power transfer limit of the interconnection between SEC-EOA and Saudi Electricity Company - Central Operating Area (SEC-COA) is the concern of this project. Such a study is highly needed since inadequate or forced outages, impose undesired limitations on the operation adequacy and service quality of power systems. In some cases, they continue to grow causing system separation if the system is exposed to capacity deficit or severe outages. This work is also important to SEC-EOA in extending the power transfer capability through the SEC-EOA / SEC-COA interconnection transmission line. One of the possible, and may be the more, effective solutions to remedy such a problem is to install power factor correction facilities in selected positions along the transmission lines interconnecting the two SEC operating areas.

Brief Description of the Project:

A high power factor is generally desirable in a transmission system to reduce transmission losses and improve power system transfer capability to serve the receiving loads. It is often desirable to adjust the power factor of a system to near 1.0. When reactive elements absorb reactive power near the load, the apparent power is reduced. Power factor correction may be applied by an electrical power transmission company to improve the reliability and efficiency of the transmission network. Power Factor Correction (PFC) is a widely recognized method of providing additional capacity to the system and, in the meantime, minimizing wasted energy, improving the efficiency of power system components and reducing the electricity costs. Therefore, in this project, PFC facilities will be applied in order to bring the power factor of the tie-line, under consideration, closer to 1 by supplying reactive power of opposite sign, adding capacitors or inductors that act to cancel the inductive or capacitive effects of the load, respectively. For example, the inductive load of a transmission line may be offset by locally connected capacitors. If a load had a capacitive value, inductors (also known as *reactors* in this context) are connected to correct the power factor.

Objectives:

There are several objectives that can be gained as a results of undertaking this project, namely:

1) Enhancing and extending the transfer capability of the SEC-EOA/SEC-COA power in order to avoid system collapse after possible major capacity deficits or severe outages.
2) Increasing the capacity transfer capability and efficiency of the tie-line interconnecting between the two operating areas under study which yield more active and utilized power and less reactive and wasted power.
3) Additional system capacity (electric power) can be achieved without supplying it from the source (electric company.
4) Developing a set of recommendations that will be useful for the power systems planning and operation engineers in Saudi Arabia based on the obtained results in items 1 – 3. These recommendations will be invaluable for the interconnection projects that will take place in near future in the Kingdom and in Gulf area.

Technical Approach and Expected Deliverables:

The design method proposes an automatic power factor correction unit that consists of a number of capacitors switched by means of contactors. These contactors are controlled by a regulator that measures power factor in an electrical network. Depending on the load and power factor of the network, the power factor controller will switch the necessary blocks of capacitors in steps to make sure that the power factor matches the selected value. Instead of using a set of switched capacitors, an unloaded synchronous motor can supply reactive power. The reactive power drawn by the synchronous motor is a function of its field excitation. This is referred to as a *synchronous condenser*. It is started and connected to the electrical network. It operates at a leading power factor and puts vars onto the network as required to support a system's voltage or to maintain the system power factor at a specified level.

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Graduation Design Project Proposal Form

Project # P6

Project Title: Remote control of power transformer

Professor(s) Name(s): Dr. A.ALARAINY

Number of Students: Two

Students Qualifications

Students should have good background in control and power

Statement of Problem

Nowadays remote controlling becoming very common in power system. This project deals with change remotely the transformer parameters especially tap changer .This will need control scheme and communication system.

Brief Description of the Project

The students are requested to design the various elements of the remotely controlled system. Then they will build it in the HV lab and tested on real transformer

Objectives

(1) Understanding the theory behind the subject
(2) Know how to do the designing steps
(3) Building of the proposed system
(4) Test of the system and study its performance.

Technical Approach and Expected Deliverables

- Literature search of the project topics
- Design the control unit.
- Design the communication unit
- Design and Build the whole system
- Build the various component of the system
- Test the built system in real transformer
- Report

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Graduation Design Project Proposal Form

Track	Power Engineering	Project no	**P7**
Project Title	**Design of a Photovoltaic-Powered Desert Air-Conditioner**		
Supervisor(s)	Prof. Saad M. Alghuwainem		
Number of Students	2	Students Qualifications	

Statement of Problem	For cooling of homes, farms, and rest areas in remote desert areas of the Kingdom, where no grid electricity is available
Brief Description of the Project	(i) Review of photovoltaic energy systems (ii) DC operation of desert air-conditioners. (iii) Analysis of the system under study (iv) Results verification
Objectives	(1) Understanding photovoltaic energy sources. (2) Understanding concept of desert air-conditioners. (3) Matching of system components for optimum operation.
Technical Approach and Expected Deliverables	(a) Development of a computer program to achieve the required analysis (b) Use of MATLAB, or a similar package, to confirm the analysis of (a) (c) Build a prototype system

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Graduation Design Project Proposal Form

Project # P8

Project Title: Study of Partial Discharge Characteristics for Different Defect Types in Gas Insulation System Using Spectrum Analyzer

Professor(s) Name(s): Dr. Yasin Khan

Number of Students: Two

Students Qualifications: The students should have basic knowledge of electrical power and having good academic background in High voltage/power systems

Statement of Problem

The high reliability, less maintenance and compact size of Gas Insulated Switchgears (GISs) have made them the primary choice for many electrical utilities. However, sometimes insulation defects inside GIS can be a serious threat to safe operation of GIS and can lead to costly disruption of supply. As insulation failure usually starts with partial discharge (PD) activity, this study investigates the differences in PD characteristics in SF_6 gas among different types of defects. The defect types considered in this study are particles in a gas gap, particles adhered on a spacer surface and spacer/electrode detachment. Different experiments will be made for sequential PD measurements for different defects shapes in the presence/absence of insulators. The PD phase characteristics, PD pulse number and PD current will be analyzed for the different defect types. Experimental results will be used for correct identification of defects based on considered PD characteristics.

Brief Description of the Project

Gas insulated switchgears (GISs) have been widely used in the electric power grid with substantial growth since the early seventies. GIS is based on the principle of complete enclosure of all energized parts in a grounded metallic encapsulation insulated with SF_6 gas. Therefore, any defects that are introduced in GIS during manufacturing or operation affect and inhibit the full potential of GIS by affecting the insulation characteristics. As insulation failure usually starts with PD activity; several studies have been performed to use PD measurements as a diagnostic method for detecting defects and preventing major insulation breakdown. PD activity in GIS can arise from protrusions on the conductor, free conducting particles, particles fixed on spacer, floating components and spacer defects. The extreme field intensity caused by these defects may produce PDs and eventual failure of the system. PD Characteristics for different defect types in simulated GIS will be measured using spectrum analyzer and the data will be analyzed that will help in improving the design of GIS equipment.

Objectives

The project have the following objectives:

(1) Design of experimental setup and acquisition of components required.
(2) Experimental investigation, analysis of results and recommendations.

Technical Approach and Expected Deliverables

The students should understand the main types of the insulating materials used as insulation in the MV/HV transmission system, factors affecting the efficiency of insulating materials, causes and effects, measuring the output characteristics in the laboratory, data acquisition and analysis.

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Graduation Design Project Proposal Form

Project # P9

Project Title: Design of Free Electrical Energy Generator

Professor(s) Name(s): Dr. Abdulhameed Alohaly, Dr. Yasin Khan

Number of Students: Two

Students Qualifications: The students should have basic knowledge of electrical power and having good academic background in Matlab / C++ languages and related technologies.

Statement of Problem

Unfortunately, even with all of our modern technological advancements, there's still a huge number of people living in extreme poverty. Most of the poverty can be directly linked to a lack of cheap and abundant energy. According to the IEA, "Modern energy services are crucial to human well-being and to a country's economic development; and yet globally 1.2 billion people are without access to electricity. Even in many places with access to power, it's not cheap enough or abundant enough to lift the population above the poverty line. Access to energy is the defining limit on the ability of any given population to pull itself out of poverty by increasing its productive capacity.

All real wealth comes from the ground. Wealth starts as raw materials that are transformed by human intervention into usable goods that improve the quality of the human condition. Extracting and transforming resources from the planet takes a tremendous amount of energy. The cheaper and more abundant the electrical energy resources at our disposal, the cheaper and easier it is to extract and transform resources; which ultimately means cheaper and more abundant goods and services for all of humanity.

Brief Description of the Project

A motor of 750 watt capacity will be used to drive a series of belts and pulleys which form a gear-train which produces over twice the rotational speed at the shaft of an 1500 Watts electrical generator. The intriguing thing about this system is that greater electrical power can be drawn from the output generator than appears to be drawn from the input drive to the motor. That energy increases as the diameter of the flywheel increases. It also increases as the weight of the flywheel increases. The proposed system will be self-powered and can power other electrical equipments as well.

Objectives

The project have the following objectives:

(1) Comprehensive literature review
(2) Design/acquisition of components required for development of prototype system
(3) Development of prototype system

Technical Approach and Expected Deliverables

The students should understand the main components of the self energy generation and its application, factors affecting the efficiency of self energy generations, causes and effects, measuring the output characteristics of system in the laboratory, data acquisition and analysis.

Expected dileverables is design and development of an efficient self energy generation system.