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

Graduation Design Project Proposal Form

Project #E1

Project Title: Design and simulation of CMOS OPAMP

Professor(s) Name(s): Mohammed A ALTURAIGI

Number of Students: Two

Students Qualifications:

Ability of computer simulation of electronic circuits

Statement of Problem

The operational amplifier (op-amp) is a multi-stage amplifier. It is used to meet the characteristics of the ideal amplifier. The ideal op-amp has infinite gain, infinite input impedance, infinite bandwidth and zero output resistance. Of course, those idealities can not be met practically. Practical op-amp therefor is designed to optimize the values of those parameters based on the need and application of the amplifier.

In this project, you will design and simulate a high-performance CMOS operational Amplifier. The CMOS op-amp is a two-stage amplifier and it does not have the low output resistance stage. Such circuit is very popular in implementing op-amps in VLSI circuits where the op-amp is required to drive a small capacitive load as in switch capacitor circuits.

Your op-amp must meet the following minimum performance specifications while driving a capacitive load of C_L = 20 pF:

- A unity-gain frequency (f_t) of 500 kHz or greater.
- A low-frequency gain of 60 dB or greater.
- A phase margin not smaller than 50°.
- A power dissipation of 35 mW or less.
- An input common-mode range (ICMR) and output common-mode range (OCMR) of ±1V.
- A positive and negative slew rate of 0.25 V/μS or greater.

Your op-amp must be constructed under the following constraints:

1- Two DC supplies V_{DD}=2.5V and V_{SS}=-2.5V.

2- Minimum Transistor length is 0.5μm.

Brief Description of the Project

See above

Objectives

(1) Reduce the size.
(2) Reduce power dissipation.
(3) Reduce the delay and
(4) Optimization. .

Technical Approach and Expected Deliverables

Develop a computer simulation program to design the COMS op=amp

King Saud University
College of Engineering

Electrical Engineering Department
Semester 371

E2

Graduation Design Project Proposal Form

Track	Electronic Engineering	Project no	
Project Title	Smart Traffic & car driver Monitoring System		
Supervisor(s)	Prof. M. Abouelela , Dr. Bandr Elmashary		
Number of Students	Two	Students Qualifications	EE401 + EE353

Statement of Problem

The concept of intelligent transportation system (ITS) is gaining interest worldwide including the ministry of transportation in several countries. Traffic Monitoring Systems had been developed and approved by the several ministries of transportation and interior all over in the world. The car's driver behaviors play an important role in avoiding many of routs accidents traffic problems. The challenges of designing and implementation of trustable smart traffic monitoring system are still under research. Sensors that measure the driver behavior, bad behavior identification and communication with central office for driver data processing are some of these challenges.

The proposed monitoring system may measure the following driving bad behavior :

1- Exceeding the speed limits imposed by traffic authorities.
2- Waving: sudden and repeated change in lanes.
3- Repeated sudden stops within predefined time intervals.
4- Proximity: vehicle front is being too close to next vehicle.
5- Crossing red traffic light.
6- Avoiding crowded streets during rush hours.

The focus and objective of this work is to develop a reliable, and low cost µ- controller based monitoring system

Brief Description of the Project

In this work we aim at developing a simple and low cost □-controller based system that increases the efficiency of ITS by rectifying the behavior of vehicle drivers. Several sensors will be used within the car area that can detect driver bad behavior and encode them using µ- controller. The resulted encoded digital messages are transferred to a central office daily. A copy of these messages can be accessed by the driver himself in order to be aware about his bad action .A Web based communication link will be designed and use to connect both car and the central office

Objectives

(1) Understanding different Types of sensors used in measurements and instrumentation .
(2) Design and test adaption circuits that interface several types of sensors with µ- controller .
(3) Learning the principles of using µ- controller in embedded systems and the associated software tools.
(4) Developing a driving software and GUI for the car monitoring system
(5) Design and implementation of a suitable communication link to transfer data to the central office .

Technical Approach and Expected Deliverables

(a) Practicing techniques foe attaching different types of sensors to a μ- controller boards.
(b) Developing the software needed to complete the system operation .
(c) Processing the collected data from sensor and preparing daily report.
(d) Design the webpage that display the behavior of each car driver.
(e) Integrating the above system components into one equipment that can be fixed in the car housing.

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Electrical Engineering Department **Semester: 371**

Senior Design Project Proposal

Project #E3

Project Title: Design and Prototyping of a Digital Tachometer.

Professor(s) Name(s): Dr. Nacer Debbar and Dr. Mohamed Ramy Abdel-Rahman

Number of Students: Two

Students Qualifications:

1- Should have completed EE310 and EE401,
2- Certain knowledge of simulation packages for electronic circuits
3- Certain knowledge of logic design.

Statement of Problem

In industrial machines using motors for their operation, it is usually required to monitor the revolution speed of the motor and its direction. This electronic system will tackle such a need to provide the direction of rotation and rpm of motors.

Brief Description of the Project

The project involves the design of a counter that will display the number of revolution per minute (rpm) of a mechanical shaft. Mounted on the shaft is a circular disk that has 60 holes around its edge. A light sensor is interrupted 60 times for each revolution of the disk. The output of the light sensor, a string of pulses, is fed to an electronic system that counts and displays the result. Mounted on the shaft is an analog tachometer that senses the direction of the rotation. The electronic system will also display the direction of rotation of the mechanical shaft.

In the first phase the team will identify the different tasks required by the system. They will then formulate the design problem in block diagram form. Using software packages they simulate the system and re-adjust the design as necessary until a working system that meets all requirements is achieved.

In the second phase, the team will work to implement a prototype of the system. They will shop for needed components and make a cost estimate of the system. The prototype will finally be tested to ensure that the desired results are achieved. In case, the performance is not found to be up to the mark, the design cycle will be repeated.

Objectives

The project is intended to:

1- give students a hands-on experience of designing complex electronic systems,

2- illustrate to students how to use state of the art techniques and technologies learned in the program to realize a working system

3- expose students to projects that are multi-disciplinary in nature: Electronics, mechanical engineering, optoelectronics, digital signal processing, etc.

Technical Approach and Expected Deliverables

System Requirements:

1) The system should use the 60 Hz, 110 power lines for power supply and timing.
2) The system count and display the speed in the range - 999 to +999 rpm.
3) The output display comprises five 7-segment LEDs: the first three LEDs show the rpm value and the second two LEDs show the direction of revolution: the letter C for clockwise or the letters CC for counterclockwise direction.

Deliverables:

- Block diagram of system design
- Simulation of all electronic circuits
- A working prototype

Technical Requirements:

- Good circuit design skills. Knowledge of digital circuits, logic levels, and interfacing of digital ICs is essential. This system requires also some analog design skills related to opamps and signal conditioning.
- Electronic circuit simulation using the available software.

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

Graduation Design Project Proposal Form

Project # E4

Project Title: Design of an optical wavelength meter

Professor(s) Name(s): Dr. Ehab Awad

Number of Students: Two

Students Qualifications: General knowledge in electronics and/ or communications.

Description of the Project:

A wavelength meter is an optical device that can measure the wavelength of light wave. One method to measure the wavelength is optical interferometry. Where two light waves combine to produce another greater or lesser amplitude wave. There are various types of interferometers such as Michelson, Mach-Zehnder, and Fabry-Perot. Those interferometers have many applications in lasers, optical sensors, and optical modulation.

In this project, an optical wavelength meter will be designed and implemented using Michelson interferometer. The students will buy the components and assemble it by themselves. A Laser beam will be used with interferometer to obtain an interference pattern. By controlling the interferometer parameters, different wavelengths of the laser will be determined and their separation will be measured.

Objectives:

In this project the students will learn about:

1- Wavelength meters.
2- Optical interferometry.
3- Michelson interferometer.
4- Laser diodes.

Technical Approach and Expected Deliverables:

By the end of project, the students will:

1- Design an optical interferometer.
2- Build a wavelength meter.
3- Write a technical report.

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Senior Design Project Proposal Form

Project # E5

Project Title: Room vacancy sensing via passive infrared detection for HVAC wireless control

Professor(s) Name(s): Dr. Mohamed Ramy and Dr. Nacer Debbar

Number of Students: Two

Students Qualifications

1. Willing to get involved in extensive experimental work.
2. Should have completed EE310.

Statement of Problem

Energy management and power saving are cruicial issues in today's world. KSA is currenlty taking serious measures, through Vision 2030, towards improving its energy resource management. A heating, ventilating and air conditioning (HVAC) system is considered to be the main source of residential energy consumption in KSA given the country's hot climate. Reduction of residential HVACs usage periods would immensly lower electrical power consumption levels in KSA.

Passive infrared (PIR) motion sensors have emerged as means for providing room vacancy/occupancy status information required to guide wired and wireless switching control of room's electrical modules such as lights and HVACs. PIR motion sensor-guided HVAC control systems are potential means for electric power saving in KSA.

Objectives

1- Design a PIR room motion sensor-guided HVAC wireless control system.
2- Experimental implementation of the system.
3- Testing and characterizing the performance of the implemented system.

Technical Approach

- Survey will be conducted on PIR motion sensors and their concept of operation; and wireless switching control engineering methods for HVACs.
- Design and implementation of a PIR room occupancy sensing system that wirlessly controls an HVAC switching module. The system will sense and determine the room vacancy status and will automatically turn OFF the HVAC when no motion is detected in a room. The HVAC should be manually turned ON.
- The deisgn should be considerate of using low cost commercial-off-the-shelf (COTS) electronic/electrical components. The design should also be considerate of having a proper form factor.
- System integration and testing.

Expected Deliverables

- System block diagram with design and operational concept details.
- A working prototype for a PIR motion sensor-guided HVAC wireless control system.

King Saud University
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Electrical Engineering Department **Semester: First 1437/1438**

Graduation Design Project Proposal Form

Project # E6

Project Title: Analysis and design of the solar cells

Professor(s) Name(s): Dr. Abu Syed Mahajumi

Number of Students: Two

Students Qualifications

Must have the excellent grade in EE-310 course.

Statement of the Problem

Fossil fuels are the main and cheapest source of energy. However, they are also responsible for carbon emissions which have severe adverse effects on the global environment. There has been significant effort expended towards developing a clean energy source with minimum carbon emission. In order to prevent the further increase of carbon dioxide concentration in the atmosphere, alternative forms of energy production must be developed. Solar cells are a promising source of clean energy as they convert sunlight into electrical energy and hence have the least impact on the environment. They can provide almost permanent power at a low operating cost and are virtually non-polluting. At least 50 TW of the carbon-free power production capability will be required by 2050 to stabilize the carbon dioxide content in the air. Nathan Lewis at Caltech has performed a systematic analysis of all of the currently viable forms of carbon-free power (including nuclear, solar, wind, geothermal, and traditional fossil fuel plants using carbon sequestration) and has concluded that solar energy is the only currently viable form of energy abundant enough to meet the requirements that the planet will face in the next half century.

The motivation for this work is the solar cell working principle, i.e. the p-n junction solar cell, and solar cell conversion efficiency, nanostructured single junction solar cells. With conventional p-n junction solar cells, the main limitation is its light absorption capability which is low when compared to that of thin-film solar cells. Also the characterization of solar cells included the I-V curve, curve shows the short circuit current, open circuit voltage and fill factor. The spectral response of the solar cell one of the vital characteristic and it shows the capability of conversion efficiency.

Brief Description of the Project

This project is mainly focused on solar cell device characterisation analysis rather than the material properties of III-V semiconductor. The I-V characteristics for the compound semiconductor solar cells were measured in temperature range 77-300K. Other important measurements will perform for the external quantum efficiency (EQE) of nanosturctured single junction solar cells. The devices will further characterised with I-V-T (current-voltage with temperature) measurements at different ranges of temperature to extract ideality factor and non-ideal characteristics.

Objectives

At present, the demand of energy resources is increasing and it is very important to come up with innovative ideas to save and reduce the energy usage. There are various renewable energy sources are available like solar, wind, biomass, ocean thermal to generate an electricity for daily needs. The sun's energy is the best option to generate an electricity and it is available everywhere in the world. Electricity from the sun can be produced through the solar cell.

1. To understand the basic principle of the solar cells.
2. To understand the nanostructured (n-type and p-type layer) of III-V semiconductor materials and the single junction solar cells.
3. To design the highly efficient solar cells (theoretical) and simulation of solar cells model.
4. Finally to work out the all parameters of single junction solar cells.

Technical Approach and Expected Deliverable

The novel idea of GaSb Quantum Dots (QDs)/ Quantum Rings (QRs) stacked layers single junction solar cells have been attracted the photovoltaics scientist in the recent times. Initially need to the investigation of the optical properties of a type-II material interface between GaSb/GaAs using optimum growth temperature for QDs/QRs; and two different GaSb deposition thickness (1.5ML and 2.1ML). The photoluminescence spectra of the stacked epilayers confirmed that the dominant radiative recombination mechanism was band-to-band in the GaSb QDs/QRs stacked layers. Excellent structural quality is obligatory for high efficiency.

The composition of the QRs should be close to 100 % GaSb with high purity GaAs centres.

The most important part of the investigation would be the properties of multi-layer QDs/QRs single junction solar cells to obtain an understanding of the operation and characteristics of the devices.

King Saud University
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Electrical Engineering Department **Semester:**

Senior Design Project Proposal Form

Project # E7

Project Title: Design and Implementation of a PV-Powered Smart LED Lighting Set

Professor(s) Name(s): Mohamed Abbas

Number of Students: Two

Students Qualifications
Knowledge of basic analog circuit simulation/ design and Semiconductor devices .

Statement of Problem

With the increasing price of electricity, It became necessary to minimize the waste electricity as much as possible. In many situations, one can notice that lightening is unnecessarily high , especially in vacant roads, corridors etc... The problem become prominent when the source of electricity is of limited capacity. for example, in rural areas, where the connection to traditional grid is difficult, solar energy is harvested using solar cell modules and stored in batteries for night use. Therefore, smart utilization of the battery power is essential. Solar cells are a promising source of clean energy as they convert sunlight into electrical energy and hence have the least impact on the environment.
The motivations for this project is to provide a reasonable mean of standalone lighting set for the remote areas where the utilization of the conventional electrical grid is extremely difficult and prohibitively expensive. The students in this project will design a PV- Based smart LED lighting set. The system presents a carbon-dioxide free energy provider for highly efficient lighting set. It is suitable for rural as well as urbanized areas.

Objectives
In two phases (semesters), the team of this project is requested to :
Phase one
1- Undertstand the components of PV-based smart LED lighting set.
2- Design and implement the different parts of the system
3- Build a complet set for PV-based LED lighting system

Technical Approach

1- Study the characteristics of PV Module including:

- 1.1 Cell string design (Simulate and measure single and multi-cell strings)
- 1.2 PV Module Design (Simulate and measure single and multi-string Module)
- 1.3 Study of the effect module tilt angle (Measure the IV Ch/cs of a Module at different tilt angle)
- 1.4 Selection of the best tilt angle to obtain the maximum average power from the module. (the best tilt angle that gives the highest output power from step 3)
- 1.5 Theoretical study of module fabrication (optional)
- 1.6 Document this Part

2- Deign of optimized voltage regulator.

- 2.1 Proposing and discussing varieties of regulator circuits
- 2.2 using CAD to simulate the proposed circuits to meet the required specs.
- 2.3 Assemble the component on bread board for pre-final test
- 2.4 Prepare PCB using Eagle and assemble the components in a form which an easy to connect.
- 2.5 Document this Part

3- Design of an optimized battery charging and control Circuitries.

- 3.1 Proposing and discussing varieties of battery charging units.
- 3.2 using CAD to simulate the proposed circuits meet the required specs.
- 3.3 Assemble the component on bread board for pre-final test
- 3.4 Prepare PCB using Eagle (for example) and assemble the components in a form which is easy to connect.
- 3.5 Document this Part

4. Design the sensing and control circuit of lighting set

- 4.1 Design and simulate the electronic circuitry needed for the sensing and control of LED Lamps.
- 4.2 Implement the the system using off-shelf componenet.
- 4.3 Document this Part

5. Assemble the complete System

- 4.1 Assemble the system components (PV Module, Charging and Control board, Battery and Led Lamp).
- 4.2 Test the system.
- 4.3 Finalize the whole Document

Expected Deliverables

Prototype of PV-based smart LED lighting set.

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

Senior Design Project Proposal Form

Project # E8

Project Title: Design and Implementation of Smart Home Automation and Monitoring System

Professor(s) Name(s): Mohamed Abbas

Number of Students: Two

Students Qualifications

Basic knowledge of analog/digital circuit simulation/ design.
FPGA or Microcontroller programming

Statement of Problem

Keeping eye on home while we are away is a concern of many people. In addition, turning some appliances on and/or off remotely is required at many situations. For example, sometimes it is required to turn on the air-condition before arriving home to keep convenient transition between car and home. Another example, with the increased life stresses, we sometimes are not sure whether we turn off the light or not ., etc.... Therefore, having a remote home mentoring and control system become important application. In this graduation project, the team is requested to design a smart home automation and monitoring system using the cellular communication system.

Objectives

In two phases (semesters), the team of this project has to fulfill the following:
Phase one
1- Understand the and plan a complete image of the idea.
2- Design and hardware implementation of a secured telecommunication swtich.
Phase two:
3- Build the home network of appliances to be controlled with the switch.
4- Build the monitoring system
5- Test the complete system.

Technical Approach

Phase one

- Understanding the communication protocol/signals through group of lectures and self-reading tasks.
- Proposing the design of a telecommunications switch' schematic and simulating the system using MultiSim (or any other available CAD tool).
- Hardware implementation of the switch using FPGA or microcontroller.

Phase two

- Build an exemplar home appliances network connected with the switch of phase one.
- Test the automation system using cell phone.
- Build the mentoring system.
- Integrate the monitoring and automation systems.

Expected Deliverables

- Phase one.
  Prototype of the telecommunications switch.

- Phase two

A complete home automation and monitoring system.