ENGINEERING CAPSTONE DESIGN CONFERENCE

SCHEDULE OF EVENTS

7:30 a.m.	**Breakfast**
8:00 a.m.	**Welcome:** Dr. Rafic A. Bachnak, Director, Penn State Harrisburg School of Science, Engineering, and Technology
8:10 a.m.	**Featured Speaker:** David P. Wirick, General Manager, ArcelorMittal Steelton LLC
9:00 a.m.	**Student Presentations** **Rooms for Presentation** *Civil Engineering and Technology Partners* Auditorium, Olmsted Building *Electrical Engineering* E-264 Olmsted Building E-265 Olmsted Building *Mechanical Engineering* C-211 Olmsted Building C-212 Olmsted Building E-253 Olmsted Building E-254 Olmsted Building E-258 Olmsted Building For a list of projects, visit: http://harrisburg.psu.edu/calendar/event/engineering-capstone-design-conference
12:30 p.m.	**Lunch**
1:00 p.m.	**Featured Speaker:** Rob Shaddock, Executive Vice President and Chief Technology Officer, TE Connectivity
1:30 p.m.	**Student Project Exhibition and Lab Tours**

CIVIL ENGINEERING AND TECHNOLOGY PROJECTS

Auditorium, Olmsted Building

Moderator: Dr. Shashi Marikunte
Project: Civil Engineering Capstone Design Presentation
Faculty Advisors: Dr. Shashi Marikunte and Dr. Sofia Vidalis

Educational Activities Building – Student Perspective

The Penn State Harrisburg Educational Activities Building (EAB) will be home to a new 51,500 sq. ft. addition that will accommodate the laboratory needs of the School of Science, Engineering, and Technology. Students in the Civil Engineering capstone design class were challenged to design this building using the learned skills in their undergraduate studies. Students worked on this project in small groups to create alternate design concepts and compete with other groups. Providing an opportunity for students to work on a real project as teams of experts, similar to a typical design/construction company. Students were encouraged to think "outside-the-box" to come up with innovative solutions to improve building functionality. Seven teams worked diligently, in true competition style, to incorporate changes through value engineering. In today's presentation, teams will disclose for the first time, their approach to make the EAB a "state-of-the-art" construction project.

9:00-9:30 a.m.

Group #1
Group Leader: Aaron McGinty
Members: Seth Lamb, Joshua Gable, Beth Bradbury, Mathew Birney, Joshua Geusic, Robert McKeen, Nana Nyantekyi

9:30-10:00 a.m.

Group #2
Group Leader: Kevin Grim
Members: Clinton Bordner, Shane Brower, Ryan Hartnett, Theresa Olivieri, Djidda Djibrine, Kelby English, Gunnar Rhone

10:00-10:30 a.m.

Group #3
Group Leader: Ercan Akkus
Members: Benjamin Ungurean, Stason Sellers, Daniel Snow, Zachary Romig, Pratikkumar Patel, Parth Bhutwala, Mounir Hadam

10:30-11:00 a.m.

Group #4
Group Leader: Zachary Miller
Members: Eric Burger, Ellen Cao, Kyriakos Karoullas, Taylor Abel, Travis Featherby, Kenneth Seaman, Jameson Wade

11:00-11:30 a.m.

Group # 5
Group Leader: Benjamin Showers
Members: Eric Snyder, Levi Sowers, Ryan Bannon, Cole Nye, Mathew Kearse, Eric Tkacic, Andrew Samy

11:30-Noon

Group # 6
Group Leader: Joel Yambo Torres
Members: Peter Aziz, Joseph Moussa, Marah Haddad, Karlen Jimenez, Mohamed Haddat, Colby Hurley, Adib Zaghtiti

Noon-12:30 p.m.

Group # 7
Group Leader: John Schick
Members: Michael O'Grady, Brandon Hess, Rebecca Smith, Joshua Eddinger, Joshua Ciliberto, Mateusz Cebula, Ommar Eltayeb

ELECTRICAL ENGINEERING AND TECHNOLOGY PROJECTS

E-265 Olmsted Building

Moderator: Cheryl Ebel
Faculty: Dr. Sedig Agili, Dr. Mohammed-Reza Tofighi, and Dr. Seth Wolpert

9:00-9:30 a.m.

Project: Electric Arc Furnace – Roof Temperature Monitor (Funded by Arcelor Mittal)
Group: Anthony DiGiovanni and Mark Kirkauskas
Faculty Advisor: Dr. Sedig Agili

Electric Arc Furnaces (EAF) in the steel industry are primarily utilized to melt scrap metal into liquid form through the use of high powered electrodes to produce arc flashes as the primary source of heat. The process produces excessive flames and soot, and causes the furnace to endure thermal stresses in excess of 3000°F – conditions hazardous to most temperature monitoring systems. The problem is industry-wide and EAF's are typically operated at a "best guess" approach based off of the temperature sensing instrumentation on the furnace side walls that are not subject to the same unique environment as the roof. The benefits of having a temperature monitoring system on the roof would be useful in determining maintenance repair schedules, monitoring manufacturing processes, and providing more real time information to help assure that operations are being performed safely. The final proposed solution of using highly water resistant fiber optics and Fiber Bragg Grating (FBG) temperature sensors run through the water-cooling system of the roof are explained.

9:30-10:00 a.m.

Project: Wireless Guitar
Group: David Duncan and Jonathan Shober
Faculty Advisor: Dr. Mohammed-Reza Tofighi

The Bluetooth Wireless Guitar contains a transmitter inside of the control cavity, eliminating the need for an external wireless belt pack. Traditional wireless instrument systems use the VHF and UHF spectrum, which are prone to interference and the total number of simultaneous systems used is limited. Current Bluetooth modules use spread spectrum transmission and frequency hopping to allow for minimal interference in the ISM band. In addition to this, these modules are capable of high fidelity audio transmission with minimal latency.

10:00-10:30 a.m.

Project: Solar Tablet Cover
Group: Jonathan Roche
Faculty Advisor: Dr. Seth Wolpert

Everyone has had portable device batteries die at inopportune times. The Bright Idea solar case not only allows a device to charge just by keeping it out in the open, but also offers protection, and allows you to charge any other USB devices through a USB pass through port. Although, not new to the portable world, solar cases have never been created solely to charge devices - most only offer to extend battery life. Also, existing cases do not allow you to charge other devices, as this design does. The design also allows the user to remove the power cord. The need to "plug in" the device to always have power will now be obsolete. At any given time about half of all the world's portable devices are plugged into outlets. This case will allow the device connected to it to get to nighttime with a full battery and last through the night on its own, until it can begin charging in the morning light, relieving a significant load from power grids worldwide.

10:30-11:00 a.m.

Project: Alcohol Content Indicator
Group: Arber Aliu and Paden Weaver
Faculty Advisor: Dr. Mohammed-Reza Tofighi

The alcohol content indicator will be the first ultrasonic and digital monitoring system for home brewing. The device will determine the alcohol content during the entire fermentation process by comparing phase difference between a preset signal and an ultrasonic signal of 40 KHz that passes through the fermentation vessel. As the sugars are converted into alcohol, the alcohol content increases, changing the density of the wort that will change the phase velocity of the signal that passes through it. The change in phase is compared using a phase detector that will produce a voltage. This voltage will be analyzed by Arduino Uno and will output the current alcohol content of the fermentation.

11:00-11:30 a.m.

Project: Snake the Game
Group: Stephan Willis
Faculty Advisor: Dr. Seth Wolpert

Snake the Game brings the flexibility of a Field-Programmable Gate Array (FPGA) to the old game that we love. By setting up a hardware system that can dynamically change to meet user needs, users can benefit from maximum speed and ultimate flexibility. Today's technology is limited by software engineers' abilities to add enough code to over come the boundaries of the logic. The ability to change the hardware as well as the software allows dynamic change to meet any demands that are required. With this technology employed in a video game, entertainment and versatility can be maximized.

11:30-12:00 p.m.

Project: Endoscopic Orientation (Funded by Penn State Milton S. Hershey Medical Center– Surgical Innovations Group)
Group: Peter Rafalko
Faculty Advisor: Dr. Seth Wolpert

The Surgical Innovations Group sought an early detection system for the formation of a torque or loop in the flexible line of a colonoscope. Such deformations are a common complication in routine endoscopies, and can cause potential harm to the patient. After reviewing several viable approaches, the group determined that the optimal solution was to embed multiple Inertial Measurement Units (IMU's) in the endoscopic line. The acceleration and rotational data collected from the IMU's could provide, in real time, a 3-D representation of the endoscopic line. This visual reference would allow the physician to make the necessary procedural adjustments to prevent the aforementioned complications.

E-264 Olmsted Building

Moderator: AB Shafaye
Faculty: Dr. Robert Gray, Dr. Hossein Jula, and Dr. Aldo Morales

9:00-9:30 a.m.

Project: HVAC Home Automation: Smart Glass
Group: Nimish Naik and Niraj Patel
Faculty Advisor: Dr. Robert Gray

Controllable Smart Window Tinting and Home Automation can reduce the energy needed to heat or cool a building, and provide privacy to consumers in their own home or building. A prototype system will block or allow outside light to enter a room through a window depending on the room temperature, lighting and occupancy. In addition to window tint, the system can control heating/ cooling units and interior lighting as needed. Detection of an empty room or office will adjust the heating and cooling system to default seasonal settings, which will lead to energy savings.

9:30-10:00 a.m.

Project: SATCOM Radio Interface (Funded by PA Air National Guard)
Group: Joseph Connolly, Wismith Geffrand, and Joshua Smith
Faculty Advisor: Dr. Robert Gray

Aircraft avionics system upgrades are inevitable today. To keep upgrade costs down and reduce aircraft downtime, systems are often integrated directly with existing aircraft technology. The Portable SATCOM Interface will fully integrate a ground based SATCOM radio with existing aircraft intercom, power, and antenna systems. The Portable SATCOM Interface provides military aircraft SATCOM capability when it otherwise may not be available. This solution will greatly increase military capability and readiness by providing aircraft crewmembers with beyond line of site radio voice and data communication. Typically, installing new systems on aircrafts is a long, arduous process, taking many years and costing millions of dollars. The Portable SATCOM Interface will be a completely removable device that does not alter the aircraft, saving time and money.

10:00-10:30 a.m.

Project: Energy Harvesting: Macro and Micro
Group: Nehwon Kiepea and Jill Hartman
Faculty Advisor: Dr. Aldo Morales

Homeowners want to save money on their energy costs and are integrating technologies such as solar panels and wind turbines to supply power to their homes. Many homeowners do not know how much power these devices can supply. A data logging system, using LabVIEW, will log the power produced by the devices over a period of time and show the user how much power is produced. From this information, homeowners will be able to decide where the device should be located for the best power production and how much power can be supplied for their needs - whether it is small or large-scale production.

10:30-11:00 a.m.

Project: Micro-mouse
Group: Andrew Zern
Faculty Advisor: Dr. Hossein Jula

Micro-mouse, an international robotic competition hosted by the Institute of Electrical and Electronic Engineers (IEEE) since 1979, offers Penn State Harrisburg students a chance to win the annual regional competition. The winning robot needs to autonomously find the center of a maze

the size of two ping-pong tables, in the shortest amount of time. Problems experienced by previous competitors, including direction, tracking distance, and robustness during transport, were analyzed and addressed during the planning phase of the project. A gyroscope and an accelerometer contained on an inertial measurement unit are used to send information to a microcontroller. The front and sides of the robot use infrared sensors to detect walls. A 3-D printed frame offered exact sensor placement and travel robustness.

11:00-11:30 a.m.

Project: Coffee Roaster
Group: Kevin Stauffer
Faculty Advisor: Dr. Hossein Jula

The single pound semi-automatic coffee roaster is a working scale model for small batch coffee roasters. Closed loop control systems are utilized for consistency and safety. Because each single-origin coffee has different attributes of roast, this roaster has the ability to tailor each roast profile according to the flavors desired. Using time/temperature profiles, the desired roasting scheme is designed on the touch screen and automatically produced. The roaster being designed is a working model usable for the home roasting market. However, it could easily be scaled to larger batch sizes for small coffee shops.

MECHANICAL ENGINEERING AND TECHNOLOGY PROJECTS

C-211 Olmsted Building

Moderator: Dr. Gautam Ray

9:00-9:30 a.m.

Project: Rework-Packing Stacking Machine
Group: Syree Berry, Glenn Feaser, David Pritchard IV
Faculty Advisor: Dr. Richard Ciocci

A Carlisle, PA, manufacturing plant had the need for a machine to increase production. A machine was needed to rework powder-containing packets and place them into boxes. This machine was created to efficiently count, stack, and insert a predetermined number of packets into boxes while being moved down a conveyor. The self-contained unit was designed to increase productivity while addressing safety, ease of use, and space constraints in the plant.

9:30-10:00 a.m.

Project: Newton Engine Corporation, Prototype Analysis
Group: Christopher Richards, James Klingerman
Faculty Advisor: Dr. Richard Ciocci

Developed by the Newton Engine Corporation, an induction motor-driven prototype utilizes standard mechanical components in order to store kinetic energy, and cyclically release an impulse to the output shaft of the system. A synopsis and optimization of the prototype machine has evolved as the desired task of the engineer.

Through the utilization of Omega data-logging equipment, a power curve has been derived for the inputs and outputs of the system; via integration an energy balance was derived, and efficiency was calculated. Losses were then attributed primarily to the efficiency of the motor, frictional effects of the systems numerous bearings, as well as the transmissivity of the associated gear boxes in inclusion. Through a full machine design, where fatigue loading was to be sustained for an infinite life

approximation, the system was optimized to maximize the cost and performance system efficiency. Through the reduction of shaft profile at the bearings, as well as overall shaft length, the frictional moment in the bearings can be reduced, helping to maximize the efficiency of the system. Additionally, new, appropriately-sized, gearboxes have been recommended to minimize the power lost in transfer.

10:00-10:30 a.m.

Project: Hydrogen Power Source
Group: Jordan Cuadrado, Jamieson Graham, Brian Snell
Faculty Advisor: Dr. Richard Ciocci

This project showed a way to replace or enhance current energy sources by using hydrogen. The most abundant element in the universe, is simply not used enough. Currently, the world depends on fossil fuels to supply energy. With hydrogen, we could eliminate current and potential conflicts during our life time. The goal was to build a successful device that would produce hydrogen through electrolysis. Other goals were to have the hydrogen produced to perform electrical, thermal, and/or boundary work. The project was divided into three major objectives: to create the base model for the hydrogen, to decide which metal to use for the electrolysis and to decide what kind of work to perform. One of the design criteria was to eliminate the question, "How are you going to store the hydrogen for use?" The thought of storing hydrogen at this stage in time could be thought as "wasteful," given hydrogen's abundance. The criterion for this project was to create hydrogen and use it immediately.

10:30-11:00 a.m.

Project: Cervical Neck Brace
Group: Zhi Hui Chen, Joseph Felice, Evan Ross
Faculty Advisor: Dr. Richard Ciocci

Sponsored by a physician, a cervical neck brace was designed to provide relief from neck discomfort. Patients who are elderly or those suffering from musculoskeletal degenerative conditions often suffer from neck pain due to disc deterioration. The design of this brace was unique in that the main structure was a mesh pattern produced using 3-D printer technology. A clip crafted to the specifications of an average neck diameter wrapped around the front to comfortably secure the brace in place. The inner part of the main mesh frame was lined with a padded material to provide a cushioned fit.

11:00-11:30 a.m.

Project: The Effect of Roof Color on Ambient Temperature
Group: Adam Carloni
Faculty Advisor: Dr. Richard Ciocci

Due to different factors, urban environments can become hotter than their surroundings, also known as a heat island. The effects of heat islands are undesirable; they can bring about air pollution indirectly and can be expensive on air conditioning utility costs. Cool communities have been incorporated into building standards in many cities. The goal of this project is to conduct an experiment that will monitor surface temperature and heat flow above the surface of dark and white roofs to determine which roof directly contributes more to air temperature and report any findings. The experiment will span a period of one year.

11:30-Noon

Project: ASME UAV Build
Group: Paul Bell, Scott Getsie, Andrew Feminella, Ross Baker
Faculty Advisor: Dr. Ma'Moun Abu-Ayyad

This project is to build an Unmanned Air Vehicle (UAV) that cannot be pre-built in a kit. The UAV must fit through a 28" hoop and navigate through an obstacle course. This project uses a dual rotor setup with a trapezoid-style body. The frame is primarily made of wood with some aluminum rods connecting the rotor housings to the servos. The rotors will be able to rotate forward and backward; both will go forward to move forward, backward to go backwards, and each rotor will be able to rotate in opposite directions in order to turn. The estimated run time for our UAV is 5-6 minutes with recharges in between.

C-212 Olmsted Building

Moderator: Dr. Amit Banerjee

9:00-9:30 a.m.

Project: Shower Mounted Oral Irrigator, The "ShowerPulse"
Group: Ryan MacDonald, Vincent Swisher, Austin Guenst
Faculty Advisor: Daniel Massey

Oral irrigators are already available on the market, but this is a novel redesign since it can be mounted in the shower, releasing a cleaning agent, and pulsating water without a motor. The project required a theoretical redesign of the overall concept, the pulsation method, and the cleaning agent release. The manufacturing was performed on a 3-D printer as a prototype of what the manufactured product will look like when produced with plastic injection molding.

9:30-10:00 a.m.

Project: Alternative Energy Workstation
Group: Todd Beachley, Zachary Bitner, Christopher DeSantis, Scott Fuller, Adam Soares
Faculty Advisor: Daniel Massey

Fossil fuels are limited and may be unavailable one day. This project is an alternative energy work station, with energy being generated by solar panels and a wind turbine. The workstation can be used to power electrical devices such as cell phones, computers, stereos, and other equipment. The workstation is weather-proof and designed to stay outdoors for extended periods with minimal maintenance. The design is similar to that of a picnic table and includes the use of materials such as PVC, steel, aluminum, shingles, and treated lumber. The roof is designed to achieve an optimum angle for the solar panels and to protect the table from sun glare while providing a barrier from rain. The turbine is designed with a vertical axis, which allows us to utilize wind from all directions. Power can be consumed as it is generated and excess power is stored in a battery bank for future use. A meter is used to indicate the charging rate and available battery capacity. The workstation will remain at Penn State Harrisburg to benefit future students.

10:00-10:30 a.m.

Project: Crane Cab Mount Redesign
Group: Andrew Nichols, Bryan Martin, Nate Gillespie, Zach Putt
Faculty Advisor: Daniel Massey

Clients of a local crane manufacturing company have complained that driving their mobile cranes long distances is unpleasant. The goal of this project was to modify the crane's cab mount design to help limit, if not eliminate cab vibration. By changing the cab mounts from rubber biscuits to an air ride style of suspension the cab vibration will be reduced and the overall comfort of the ride will be

improved. The redesign of the cab mounts were performed using Creo 2.0 CAD software and performing general maximum force and vibration calculations to determine the suspension requirements. Costs were analyzed to determine feasibility of the design when implemented into production. The new design could also be implemented into the smaller truck mounted cranes.

10:30-11:00 a.m.

Project: Solar-Wind Hybrid Portable Electronic Charging Station
Group: Christine Cesavice, Paul West, Jose Ferraz, Nick Hornung
Faculty Advisor: Daniel Massey

The project goal was to design a system to charge portable electronic devices in public settings. The focus was to utilize renewable energy sources so that after installation the system would be relatively cost free, with maintenance being the only concern. To maximize the best chances of generating power, a hybrid system was designed utilizing both solar and wind sources. A battery is incorporated into the system to store excess power, enabling charging until the battery source is exhausted even at times when wind and solar generation are not occurring. The finished product could be marketed to places such as amusement parks, state Department of Conservative and National Resources (DCNR) officials, and other outdoor recreational facilities. To make this system attractive to these organizations, several objectives must be met: the system must be relatively low in cost for the initial investment, reliable in producing electricity, and also mechanically reliable. Above all, it must be safe for public use.

11:00-11:30 a.m.

Project: High Mix Low Volume Stamping
Group: Chris Whitcomb, Matthew Whitcomb, Caleb Moyer
Faculty Advisor: Daniel Massey

The project demonstrates an alternate method to form round barrels in loose piece terminals. Instead of using the traditional method of a dye in a press, the barrel is formed with a servo motor spinning a roll pin over a mandrel. This allows a one-step process to complete the operation, eliminating transfer between stations. The project will also discuss options through animation for fully automated and semi-automated loading to decrease cycle times and labor costs.

E-253 Olmsted Building

Moderator: Dr. Brian Maicke

9:00-9:30 a.m.

Project: Hirschmann Crane Senior Project
Group: Angela Cornell, Bryan Long, Pierce Osborn, Chris Van Pelt, Justin LiPuma
Faculty Advisor: Dr. Ma'Moun Abu-Ayyad

The purpose of this project is to design and build an interactive display crane for Hirschmann brand wireless sensors to be used by Hirschmann as a marketing tool at various expositions. Hirschmann provided their iSCOUT D2 display console, TRS10 PATB5 wireless receiver, and three wireless sensors to measure load, boom angle, and wind speed. Hirschmann also provided the Stellar EC2000 Crane to ensure that strict time and aesthetics requirements were met. Another objective of this project is to construct an easily transportable base and counterweight system on which to mount the Stellar Crane along with a separate podium. The crane needed to be retrofitted so the boom angle and load can be manipulated through electronic controls. These controls are to be housed on the podium, which will also mount the display console and wireless receiver. Additionally, the students had to ensure that accurate readings from all sensors were displayed. This required student training at the Hirschmann facility on how to program the sensors using CoDeSys programming software.

9:30-10:00 a.m.

Project: Flying Sphere: Spherical Reconnaissance Drone
Group: Ryan Alderfer, Nic Floriani
Faculty Advisor: Dr. Ma'Moun Abu-Ayyad

This project was inspired by Japan's Ministry of Defense which designed and built the world's first remote control spherical flying drone. This project is a simplified version of the design using four control surfaces instead of eight to control and stabilize the aircraft. Similarly, both designs use one overhead propeller like a helicopter giving it Vertical Take Off and Landing (VTOL) capabilities. The control surfaces are located below the propeller to deflect the airflow in a controlled manner to stabilize and maneuver the vehicle. The entire aircraft is controlled by a system that enables semi-autonomous flight control and stable maneuverability. The main application of this project is to be used as a military reconnaissance vehicle to enter hostile environments too dangerous for human exploration. It would be equipped with a live feed camera and controlled from a safe location to obtain information necessary for military advancement into the area.

10:00-10:30 a.m.

Project: Hydraulic Test-Header for Windrower Application
Group: Andrew Hoffman, Todd Hertzler, Joseph Shoemaker
Faculty Advisor: Dr. Ma'Moun Abu-Ayyad

The objective of this project is to redesign a test header that is used to test Self-Propelled Windrowers (SPW's), farming equipment used for cutting hay. The SPW header does the cutting. The test header uses hydraulics to simulate the loading that the head of an SPW will see when it is cutting hay. The design is broken down into three components: the frame (structural), the hydraulics (mechanical power), and the controls (electrical control). The improvements on the frame include drop-down legs that allow the test unit to sit evenly on the ground when detached from the SPW and the weight management system, which allows users to increase the overall weight of the unit by attaching individual hanging weights. The improvements to the hydraulics include larger heat exchangers for increased cooling capacity. A thermal bypass system is being added to allow warming of hydraulic oil in extremely cold conditions. The improvements to the controls include a four-line display where the user can select multiple load cycles or program their own. Also, the header unit will be able to accurately simulate multiple header types. The types of headers in order of increasing complexity include the sickle header disc header and finally the draper header. The test header will be used to test off-the-line production SPW in Grand Island, Nebraska, as well as, for winter time test in the engineering department.

10:30-11:00 a.m.

Project: Industrial Swing Arm
Group: Chris Sabol, Will Hasse, Taylor Stefansic, Ryan Royer
Faculty Advisor: Dr. Ma'Moun Abu-Ayyad

This project was proposed by Daisy Data Displays Inc., as a redesign of their 917X series industrial swing arm design. Their current model utilizes square tubing, nylon based rotational joints and a locking gas spring. The swing arm is used primarily in pharmaceutical, food, and military industries. Because of its structure, the design must be kept sealed to keep internal components free of outside contaminants, and cleaned to meet NEMA 4X requirements. The company requests that the swing arm be used interchangeably between a post and wall mount as well as changing the current square tubed design to a round tubular post. They have also requested that the current pneumatic spring locking mechanism be replaced with a counter-weight system that can support a load between the range of 85-115 lbs. The swing arm is required to be able to rotate 340o on a post mount with a 20" vertical range. The springs will be designed to act as the counter-weight system and hold the monitor mounted to the arm at any user-friendly position with minimal force needed to change positions.

11:00-11:30 a.m.

Project: Lobar Geothermal project
Group: James Anderson, Angeline Widjaja, Guadalupe Chalas, Jordan Winey
Faculty Advisor: Dr. Ma'Moun Abu-Ayyad

This project was sponsored by a local building and construction firm Lobar Associates to analyze a malfunctioning geothermal system in the HVAC system of one the sponsor's facilities. In mid-2011 the client's geothermal system stopped performing properly. Numerous inconclusive tests performed by hired HVAC companies left the client unsure what caused the system failure. This particular system is unique because it is used to cool the servers and computers that occupy the building by providing air conditioning all year round. It was determined that the malfunction was related to the thermal-fluids sciences aspect of the system. It was determined from the collected data and evaluation of the systems design that the malfunction is related to a combination of poor design choices and the special case nature of the systems application. The ground loop portion of the system has become heat saturated and steadily increased in temperature over the life of the system to the point at which the loop field could no longer provide the cooling needs of the facility. The data revealed elevated ground temperatures beyond what is desired to provide cooling for a facility of this nature. The results provided experimental proof for the theory of the systems failure.

11:30-Noon

Project: Modification of a 1978 Yamaha Chappy Scooter
Group: Tyler Scaglione, Coleman Graf, Joe Heisey, Jerry Hake
Faculty Advisor: Dr. Ma'Moun Abu-Ayyad

This project is the modification of a 1978 Yamaha Chappy Scooter. After riding the scooter for a few weeks, some areas of improvement were identified. When the scooter was marketed in the mid-seventies, there was a considerable emphasis on fuel economy which affected the design. One modification was to repower the scooter with a larger, powerful engine and also to lengthen it to ensure there was not a safety problem. The four primary goals were: modification, repower the scooter with a 4 stroke 125 cc engine, lengthen the swingarm to move the center of gravity downward, lengthen the frame for the same reason, and to fabricate a new exhaust for the 4 stroke engine. This creates the need to manufacture new parts and to modify the original frame.

E-254 Olmsted Building

Moderator: Dr. Esfakur Rahman

9:00-9:30 a.m.

Project: Hay Wheel Rake
Group: Bryan Miller, Kent Weibley, Chris Freeman
Faculty Advisor: Dr. Ma'Moun Abu-Ayyad

The project accomplished the design and construction of a new versatile hay wheel rake. The wheel rake's main function is to have the ability to move a 20 foot width of hay into a single row or to make two rows that contain a 10 foot width of hay into each row. The sign was finished using Solidworks CAD software. Throughout the design phase, hand calculations and finite element analysis were performed in parts where stress was considered to be high. The fabrication process comes in three phases: parts fabrication and part orders, welding, and assembly. The group ordered all parts and raw materials for the parts fabrication. The group is currently finishing the fabrication of parts and has accomplished about 25 percent of the welding.

9:30-10:00 a.m.

Project: DMLS Thermal Camera Analysis with FLIR Thermal Software
Group: Andrew S. Griesemer, Andrew D. Kaufman, Michael R. Del Moore
Faculty Advisor: Dr. Issam Abu-Mahfouz

The objective of this project is to design a system that will capture the process in which a high powered laser melts metals such as aluminum, titanium, bronze and steel, layer by layer, to create a desired product. This process is achieved by a Direct Metal Laser Sintering (DMLS) machine. As the laser melts the metal powder it causes a melt pool. A FLIR A325sc thermal camera will capture each step of the laser sintering process, which will then be converted to thermal images via pro thermal software. To achieve these goals, a custom mounting system is needed to support the camera. Making sure that the camera does not overheat or leak air into the DLMS is top priority. The support system consists of an internal mounting system. This system is made of multiple parts: a bulkhead plate, rod, adjuster plate, and camera case. The adjuster plate will be used between the case and the rod to ensure that the case does not come in contact with any parts of the DMLS. The rod is designed to hold the adjuster plate and case and the bulkhead plate will fit at the top of the DMLS.

10:00-10:30 a.m.

Project: Temperature Control Chamber and Fixture Design for CT Scanner
Group: John A. Pressley, Andrew Martin, Joshua Bitler, Joshua Derr
Faculty Advisor: Dr. Issam Abu-Mahfouz

Inspection of connectors can be performed through the use of computed tomography scanners. In this process, an X-ray machine scans an object and generates a 3-D model which can be compared to the original CAD model or other scans that have been generated. The scanning process can be enhanced by developing a fixture in which to position a connector, and by developing a temperature control chamber which can be placed inside the X-ray machine. Using the temperature control chamber, connectors can be scanned under a thermal load and any deformation can be seen in the 3-D model. This is important because too much thermal deformation could cause the connector to fail. To regulate the thermal load inside the chamber, a heater is run through a temperature controller which receives inputs from a thermocouple and infrared sensor.

10:30-11:00 a.m.

Project: Instrumentation Pod for Electroplating Solution Baths
Group: Dan Roach, Matt Jones, Luke Westfall, Joe Brendlinger
Faculty Advisor: Dr. Issam Abu-Mahfouz

The purpose of this project is to design and build a device to continuously monitor the plating line. The instrumentation pod will be created from multiple sensors and combined into one replaceable part in the chemistry lab beakers. This device will be capable of reading temperature, pH, and resistivity (I-V curve of solution). LabView will be used to read and capture the data recorded from the sensors. The challenge to this is corrosion from the variety of chemicals in these baths. The future sensors need to monitor the level of the bath consistently, while avoiding the corrosiveness of the fluid. The data from LabView will then be sent to the lab technicians' iPad for monitoring purposes.

11:00-11:30 a.m.

Project: 3-D Inspection System
Group: Tyler Plesko, Aakash Patel, Danny Luong
Faculty Advisor: Dr. Issam Abu-Mahfouz

Electronic applications typically have challenging surfaces, angles, steps, and structures that must be measured during the inspection phase. Understanding surface roughness, planarity, flatness and other qualities allows manufacturers to adapt the most effective processing and control measures. Ensuring the quality control of such parameters requires quantifiable, reproducible, and reliable inspection of the electronic applications. TE Connectivity designs and manufactures highly engineered solutions that connect and protect data and power. The goal for the project is to create a 3-D Inspection System that is able to locate the true position of connector pins deep inside the housing of the connector. There were different objectives for this project, including choosing an optimal sensor that meets the need for the project. Depending on the vision system, the group had to design a protective shield to house the inspection system and fixture that holds the connector in place during inspection. Finally, incorporate the appropriate safety features and create a PLC code to run the vision and pneumatic systems.

11:30-Noon

Project: Buell Test Cyclone
Group: Matt Ensor, Amir Ibrahim, Brianna Hershey, Sang Kim, Younes El Abdouni
Faculty Advisor: Dr. Issam Abu-Mahfouz

The Buell Cyclone separation testing system was designed to study and visualize the flow inside of a separation cyclone. A separation cyclone uses fluid flow and strong vortices to filter a particulate from a gas. The cyclone testing system was designed with the intention of verifying computational fluid dynamics models for Buell, Division of Fisher-Kolsterman Inc. Buell designs and produces separation cyclones for refinement of fluids in industry. The cyclone system will be used to observe the actual flow separation. Most dimensions were kept to the company's standard, while other parameters were designed to change dynamically for testing and analysis purpose. The cyclone uses air as the fluid, and is made of acrylic, which allows the flow to be viewed and analyzed. An industrial blower is used to generate the air flow through the testing rig. The flow inside of the cyclone is monitored through multiple sensors to determine velocities and pressure differentials. The data is then collected using lab view interface. The data can be studied to obtain other important design parameters, such as erosion and efficiency.

E-258 Olmsted Building

Moderator: Mike Dideban

9:00-9:30 a.m.

Project: 3-D Printer: Open-Source 3-D Printer
Group: Stephen Keele, Rob McKnight
Faculty Advisor: Dr. Kamyar Pashayi

The objective of this project is to design and build a 3-D printer. This project allows us to demonstrate our understanding of the Mechanical Engineering course work. The printer will be controlled by an Arduino microcontroller. The group will be using five stepper motors connected to a control board to move the printer's extruder and print bed which will have six degrees of freedom. This printer will be running open source software Repetier. The software creates thin cross-sectional layers of the 3-D model. These layers are then transformed into G-code. G-code contains the coordinates that the printer must travel in order to create the solid model. The printer will have the capabilities to extrude ABS or PLA. The goal is to have a printer resolution of 125 micron inches or less. The smaller the printer's resolution, the higher the print quality.

9:30-10:00 a.m.

Project: Design and Fabrication of an All-Season Snowmobile
Group: Darren Stauffer, Doug Taylor, Chris Connors, Greg Altrichter
Faculty Advisor: Dr. Kamyar Pashayi

Snowmobiles are used off road or in all terrain conditions during the winter months. However, they have a limited window of use that requires many people to have two recreational vehicles in order to use them all year round. The group will be building a multi-use vehicle based on a snowmobile, that can be used all year round without damaging it or losing performance. A snowmobile can damage the track in the summer or overheat, and an all terrain vechicle (ATV) is not nearly as capable as a snowmobile in the winter. The vehicle will put two wheels on the front of the snowmobile and a swing arm to swap out the track in the back for two more wheels. This will allow it to be changed in a relatively short manner and be continuously used all year. The goals are to achieve a speed of 70 mph in both configurations and be able to change configurations in about three hours. The cooling system has to be improvised because the snowmobile uses snow as a cooling substance and is designed for cooler air.

10:00-10:30 a.m.

Project: Pallet Runner Repair
Group: Tyler Flickinger, Joshua Stahl
Faculty Advisor: Dr. Kamyar Pashayi

The purpose of this project is to design a machine that can assist in the process of preparing pallet runners for reuse. These runners are 2x4's that allow for the pallet to be lifted via a forklift. The machine will be designed to compress the nails in the runners so the surface is flush. This is essential to make sure that when used in a new pallet, the wood is perfectly flush and secure.

SPONSOR A PROJECT

The purpose of the Capstone Design Engineering Project is to help bring the real-world into the classroom by providing engineering students with practical, hands-on experience.

PARTNERSHIPS WITH INDUSTRY: WIN-WIN

This program was instituted following recommendations from our industry partners, who recognized the need for graduates who are well-trained in the engineering fundamentals and professional skills necessary to effectively compete in today's marketplace, such as teamwork, project management, cross-functional networking, communications, and design.

For small companies, Capstone Design Engineering Project teams can be a boost to an engineering workforce. For larger companies, these teams help develop new ideas or improve current practices, both of which can positively impact a company's bottom line.

Cooperative projects are a great way for companies to get to know students when looking for new employees, and they are also helpful in training junior-level engineers and managers by providing project management experience in a low-cost, low-risk, potentially high-payoff setting.

SPONSOR BENEFITS

Some of the benefits of sponsoring a Capstone Design Engineering Project are:

1. Low-risk, low-cost investment with high potential Return On Investment (ROI)
2. Work on "back burner" projects and help refine ideas
3. Help start-up and small companies with prototyping and development work (while flushing out a business plan through collaboration with a team of business students)
4. Direct access to some of the best Penn State students (15-week interview)
5. Newly hired employees (i.e. Penn State students) are better trained as a result
6. Company liaison overseeing the project gains valuable project management experience
7. Increase company brand awareness among Penn State students and faculty
8. Entry point (and guide) into the Penn State network
9. Network with other companies through events and cross-promotions
10. Opportunity to give back to the college and influence the education and careers of many students

SPONSOR RESPONSIBILITIES

Sponsors are expected to make a tax deductible contribution of $2,500, submit a proposal explaining the scope of the project, identify an industry liaison to serve as the team's point of contact for the project, interact regularly with the student team, review reports and provide feedback, and evaluate the students' performance at the Capstone Design Conference.

ADDITIONAL DETAILS

For additional information and details on how sponsoring projects can work for your company, please contact the Penn State Harrisburg Development Office at 717-948-6316.