ME 4015/4016 Projects for Fall 2011/Spring 2012
(Updated: March 25, 2011)

*****Please check http://www.me.vt.edu/academic_programs/undergraduate/courseselection.html#6 for updates to this list.** More projects are likely to be added, and CRN's and meeting times are subject to change. To verify that you have the correct CRN for your design project, please go to the online timetable and click on the CRN – the project title and any important notes will appear in a pop-up window. For more information about the design projects, please consult the faculty advisors listed. **Note that prerequisite checking will be enforced after course request.** ***

CRN 94364 Vlachos: AEThER biomedical and bioinspired senior design projects
Capacity 15

N/A

CRN 94378 Nelson: Hybrid Electric Vehicle project – EcoCAR
Capacity 24

Hybrid Electric Vehicle project, CRN 94378, 7-8:20 pm M, 9:30-10:45 R, Professor Doug Nelson

The Hybrid Electric Vehicle Team (HEVT) of Virginia Tech is an organization which designs and builds hybrid electric and alternative-fueled vehicles. A 3-year competition sponsored by GM and the US Department of Energy, called EcoCAR; Plugging In to the Future - www.EcoCARchallenge.org, will begin in Fall 2011. Students will model, simulate, and test powertrain components to minimize petroleum energy use, tailpipe emissions and greenhouse gas impact, and meet performance goals. The powertrain design from this project will be integrated into a GM vehicle for testing during following years. Students will also develop controls, powertrain and vehicle tests, and modify and test previous HEVT project vehicles. Students interested in participating in this project are encouraged to also take ME 4554 Advanced Technology Vehicles in Fall 2011 for vehicle modeling background. For more information, see the Hybrid Electric Vehicle Team web site at http://www.me.vt.edu/hevt.

CRN 94372 Kirk: Turbocharger Design
Capacity 8

This project will be a continuation of the turbocharger analysis and experimental testing project that has been offered for the past six years. This year in addition to learning how to operate a 130 HP diesel engine test stand and the details of rebuilding the high speed turbocharger including collecting vibration data, the students will do one or more of the following design content tasks:

Design a new bearing concept for the turbocharger
Design new improved fixtures for checking and rebuilding the turbocharger
Design a variable blockage adaptor for compressor inlet flow distortion studies
Design an improved speed detection system

Prior experience with turbochargers is a plus but not mandatory. Both analysis and experimental testing will be conducted for the current stock bearings and then with the new bearings. It would be helpful to also enroll in ME 5504 Introduction to Rotor Dynamics this coming fall, but it is not mandatory.

CRN 94366 Hong: SAFFiR: Shipboard Autonomous Fire Fighting Robot
Capacity 4

The Shipboard Autonomous Fire Fighting Robot (SAFFiR) is a full size humanoid robot under development in the Robotics and Mechanisms Lab (RoMeLa) with collaboration with the Naval Research Lab, EXTREME Lab, and University of Pennsylvania. The robot is being developed for the US Navy as a first responder to fires on navy ships. It is designed to seek out, navigate towards, and then extinguish the fire autonomously. During this academic year the first prototype will be designed/built and testing/development will be undertaken. Seniors involved in the project will be responsible for designing, building and testing a number of subsystems of the robot (custom linear actuators, structural components, sensor mounts…), developing 2-D balancing and walking algorithms, and assisting graduate researchers on the project. Seniors will have the opportunity to operate and improve upon two existing bipedal robotic platforms. Students involved should have an interest in controls, mechatronics, mechanical design, and CNC fabrication. Selected students will also have the opportunity to travel to Mobile, AL for full scale testing on the navy ship USS Shadwell.

CRN 94388 Hong: DARwIn-OP: Dynamic Anthropomorphic Robot with Intelligence - Open Platform
Capacity 5

DARwIn-OP is a miniature humanoid robot developed by the Robotics and Mechanisms Lab (RoMeLa) with collaboration with Purdue University, University of Pennsylvania, and Robotis Co. It is used by several universities and robot enthusiasts around the world for education, outreach activities, and advanced research. As an open source hardware and software platform,the seniors will primarily be responsible for facilitating and supporting an interdisciplinary research community for the DARwIn-OP platform. Given the open-platform architecture, many different users are concurrently developing new hardware components and software code for a variety of applications. An online community for these developers enables collaboration and encourages further development. The senior design team's roles are: 1. Designing, fabricating, and integrating new components (gripper, legs/feet, sensors, etc) 2. Advancing DARwIn-OP's current capabilities (faster gait, stand up routine, object manipulation, etc.) 3. Supporting the online community (managing documentation, discussion forum, etc.) Students should be comfortable with designing in CAD software, using shop equipment including a CNC machine, and open to learning new programming languages. Experience with C++ and Lua is highly preferred, and experience with MATLAB and LabVIEW are also valuable. Selected students will also have the opportunity to travel internationally as a member of the DARwin-OP ambassador team.

CRN 94385 Leonessa: Intelligent Robotic Pool Cleaner
Capacity 10

The proposed project entails the design and prototype construction of an innovative Intelligent Robotic Pool Cleaner. Several pool cleaners are available on the market which are mainly based on random walks, with the hope that, sooner or later, the entire pool is covered. Pentair, a leading company in the area of pool supplies, is sponsoring this project for the purpose of creating an innovative autonomous pool cleaner, which can map and navigate through a swimming pool, decide which zones require more frequent cleaning, self charge, and numerous other challenging tasks. The company is interested in novel designs as far as the propulsion system is concerned (not necessarily a crawler kind of design), the cleaning mechanism, the navigation algorithm, and so on. Please do not hesitate to contact Dr. Leonessa (leonessa@vt.edu) should you have any questions about this project.

CRN 94369 Leonessa: RoboBoat Competition
Capacity 10

The RoboBoat Competition is a student robotics challenge in which teams race autonomous surface vehicles (ASVs) of their own design through an aquatic obstacle course. Virginia Tech has already entered this competition in 2009 and 2010, placing 4th both times. We are getting ready to enter the 2011 edition (which we will, of course, win) and we would like to start working towards the 2012 entry. Although this could be seen as a continuation of an existing project, in practice, every year we learn from the previous year's mistakes (if any) and we redesign a brand new vehicle in light of the new competition rules, which change every year. Therefore the 2012 team will be responsible for the design of a brand new vehicle, including the hull, the propulsion system, the navigation system, the onboard computer and any other system necessary for a successful completion of the obstacle course. The team members will then attend the competition (which has routinely been held in Virginia Beach) with travel and lodging expenses taken care of. Do not hesitate to contact Dr. Leonessa (leonessa@vt.edu) should you have any questions.

CRN 94380 Goff: Baja SAE
Capacity 20

Design, document, procure materials, construct, and test a single seat Baja vehicle and compete in international SAE competitions. Do not sign up for this project if you have not already been accepted.

CRN 94398 Taheri: Battery Operated Land Transportation (BOLT)
Capacity 10

The BOLT Mission
Maintaining the reputation and history of innovation at Virginia Tech, the BOLT team is dedicated to evolving electric vehicle technology through design, construction, and demonstration of a high performance electric motorcycle. By challenging the standards of performance, we expect to increase the visibility of clean emissions motorsports while proving the viability of the technology itself.
BOLT 2012
BOLT 2012 is a continuation from the 2011 project with the goal of completing the design and construction of a high-performance, all-electric racing motorcycle to compete in the international TTXGP race series. BOLT is a fun and exciting project open to both mechanical and electrical engineers.

CRN 94403 Terpenny: MedCottage: Adaptive and Universal Design to Maximize Usability and Minimize Costs
Capacity 6

The MedCottage is a charming, modular home that can easily be placed on a homeowner's property. It enables families to remain close and more readily care for aging parents or relatives recovering from an illness. It maintains elements of a comfortable home, using the space efficiently to create sleeping, living and bathing areas, but it is equipped with the latest technical advances in the industry to assist with care-giving duties. With a smart robotic feature, it can monitor vital signs, filter the air for contaminants, and communicate with the outside world via high-tech video. Sensors alert caregivers to an occupant's fall, and medication reminders are provided via computers. Technology can also provide entertainment options including music, literature and movies. The MedCottage has received much media attention due to its potential to revolutionize health care options through increased options and support available for family managed health care at reduced costs. See more about the MedCottage at

http://www.medcottage.com/ Check out the many news stories about the MedCottage (press, radio, and TV) found under the "Press" selection on the web site. The goal of this project is to work with the company president and manufacturer to investigate and then select a particular area of the current MedCottage design to improve with the objective of improving ease of use, accommodating a wider range of users and needs, or focusing on a particular area where a new design could also reduce costs from the current design. Potential areas of focus could be found in the kitchen, bathroom, overhead lift, floor lighting, transportation to a site, setup at a site, electrical, water and sewer connections, ramp and access, outside lighting, etc.. The MedCottage is conveniently located at the Virginia Tech Corporate Research Center. The team will be supported by Bret Berneche of Cardnal Homes and Ken Dupin of N2Care. The team will be multi-disciplinary with students from Mechanical Engineering and potentially from Industrial Engineering, Building Construction, Construction Engineering Management, Civil Engineering, and Housing.

CRN 94387 Kochersberger: Autonomous aerial vehicle competition
Capacity 12

This project team will participate in one of several possible intercollegiate competitions that require the design and build of a fully autonomous indoor or outdoor aircraft. In the past, the team has participated in the AUVSI International Aerial Robotics Competition (IARC), and the Australian Outback Challenge. The IARC competition is an indoor competition requiring the design of a small vertical take-off and landing aircraft that will fly autonomously inside of a building while searching for a target. The Australian Outback Challenge requires the design of a fully autonomous aircraft that will search an area for a lost hiker, and then drop a water bottle within reach of the hiker. The team will work at the Unmanned Systems Lab (www.me.vt.edu/unmanned) where other research is conducted in autonomous systems including vision sensing, control, and the design of lightweight vehicles and electronics for aircraft.

CRN 94399 Gabler: Autonomous Parking Assist System Design and Testing
Capacity 15

Parking a vehicle, either on the roadside or in a parking lot, can be a complex driving maneuver. Minor collisions during parking, although often not injurious, account for a significant amount of property damage annually. Several automakers are beginning to offer autonomous parking assist systems on their passenger vehicles. These systems often use a combination of range-finding sensors (laser, sonar, lidar) and cameras to assist the driver in various parking tasks. One approach available on some luxury vehicles is an autonomous parallel parking system, where the vehicle autonomously parks between two vehicles. These and other related active system will become a major market in the near future.

This project will design and test an autonomous parking system. Following the process in the auto industry, the project team will develop and test the algorithm using vehicle and sensor simulation software (mainly controlled in Simulink). Modeling has become an important step in the design process, especially in the automotive industry. Prototype vehicle systems can often be expensive and possibly dangerous to test. This project will not involve testing the algorithm on a physical hardware system. Interested students should have strong programming skills, although expertise in Simulink is not required.

CRN 94379 Mueller/Bayandor: A Bioinspired Aerodynamic Sonar Sensor
Capacity 8

Reconciling conflicting sets of specifications is an important problem of engineering design. In the project, we will take clues from nature for designing an active sonar sensor that will also have good aerodynamic properties when mounted on an aerial vehicle.

We will look at the biosonar system of bats for inspiration on how to solve this dual-objective task. Bats have become one of the most successful groups of mammals through a unique combination of exceptional flight and sonar-sensing capabilities.

In the project, we will collaborate with the Smithsonian's National Museum of Natural History in Washington D.C. to obtain digital, three-dimensional models of bat heads from various bat species which feature an interesting integration of their biosonar antennas (i.e., ears, mouths, and other head features). These models will be created using tomographic methods. We will use advanced numerical methods to predict the acoustic and aerodynamic properties of the biological shapes. The insights from this analysis will be used to design a bioinspired sensor head. In the last step, the design will be tested through the construction of a physical prototype that will undergo wind-tunnel and acoustic testing.

CRN 94358 Priya: Full-body human-like robots for medical simulation
Capacity 20

The goal of this project is to develop fully functional human-like robots utilizing several different components such as synthetic skin, servo actuators, smart actuators, sensors, composite skull and control system. We have developed an excellent full body platform in last 3 years. In this senior design project we will refine the current platform to reach closer to human being. Current artificial skin not only has physical appearance similar to that human but also has similar hydrophobicity. The hand has similar DOF as human hand and was shown to type 20 words per minute on normal computer keyboard. The tasks of this design team will be to develop new and better waist, legs, shoulders and integration of all the parts with the body. The team will be provided with current robot model. The major components of the project are: (i) mechanical linkage mechanism to combine the actuators and skin for realizing human-like movements, (ii) placement of sensors and their control such that robot responds to external stimuli, (iii) design and fabrication of the lower body parts, and (iv) construction of the full-body system. All the components required to fabricate the robot will be made available.

CRN 94362 Priya: Biomimetic Unmanned Undersea Vehicles (UUVs)
Capacity 15

Our group has made significant progress in the design and characterization of artificial jellyfish. We have shown performance from these artificial vehicles approaching that of natural species. The goal of this project will be to re-design the current generation vehicles using inspiration from large diameter species such that UUV is capable of carrying the payload (sensors and communication systems) and has on-board energy harvesting systems to re-charge the batteries. The main thrust of the program will be to create the propulsion mechanism used by species larger than 0.5 meter in diameter. This project is being sponsored by Office of Naval Research and is part of a large program consisting of five universities and Naval Undersea Warfare Center. It will be unique opportunity for the students to participate in a large and diverse team. (Maximum enrollment = 15).

CRN 94397 Priya: Mid-Scale Windmill
Capacity 15

Last year's senior design team initiated the project with theme of "One windmill per house" that has the goal of creating light and small windmills with output power of ~100W for residential housing. The team was able to develop and verify the concepts for increasing the power without increasing the blade diameter. Also, last years team made significant progress in lowering the start-up speed of the windmill with some innovation in blade design and ducting. Continuing on this development, the goal of the project will be to build and test the full scale windmill in city environments. Improvements for future design will focus on considerations for residential applications such as noise control and factor of safety. All the facilities required to build the turbine, blade, and mounting sections will be provided. This program is being sponsored by "Center for Energy Harvesting Materials and Systems (CEHMS)" which is operating as NSF I/UCRC.

CRN 94405 Gabler: Development of an autonomous microscope for systems biology
Capacity 4

We are looking for an interdisciplinary team of students to develop a control appliance that can be hooked up to commercially available optical components. This appliance will introduce a paradigm shift in microscopy by allowing a closed-loop control of the data acquisition process. Team members are sought who are interested in bioengineering, mechatronics, image processing, computing hardware design, high performance computing, or software development for real time applications.

Time lapse microscopy has emerged as a tool of choice to elucidate the dynamics of gene networks. This technology allows the observation of individual cells over extended periods of time. For instance, time series of single-cell data have been critical to understand the role of molecular noise in the regulation of biological processes at the cellular level. Despite the spectacular success of a few pioneers, this new application of microscopy has remained out of the reach of most biologists. Image processing and data analysis are typically performed in fairly inefficient post-processing steps that often require the development of custom software beyond skills of most molecular and cell biology groups.

This senior design project will design, build, and test a customized hardware and software platform, called Cyto∙IQ, to control an autonomous microscope for time-lapse microscopy. Our goal will be to execute the image processing, data extraction, and data analysis workflow faster than the microscope mechanical latencies. Adapting the rate of image acquisition, exposure time, and sample growth conditions at run time should result in a dramatically increase the amount and quality of data produce during the course of an experiment.

Selection: Resume and interview

CRN 94381 Pierson: VT Fusion
Capacity 10

The team will continue to work on the fusion demonstration reactor. Assuming this year's team is able to consistently demonstrate fusion, next year's team will concentrate on improving the neutron generation capabilities through modified reactor, cathode design, and power supply. The team will focus on neutron activation chamber and radiation counting aspects of samples. Finally, outreach to local high schools and middle schools regarding nuclear engineering and nuclear fusion will be undertaken.

CRN 94392 Bayandor: Bio-Inspired Concepts for Aerospace and Marine Applications
Capacity 8

In the recent decades, general aerospace and marine design concepts have been subjected to rather subtle changes. Today's designs, although more technologically advanced, are mostly based on similar design principles as those from earlier generations. Therefore, through this study, it has been aimed to develop more novel approaches by incorporating bio-inspired mechanisms that can push the conventional aerospace and marine technologies into a new level. The project will particularly focus on creating aerospace or marine structural systems capable of generating propulsive and aero-hydrodynamic forces simultaneously as seen in the nature. It will be intended to mechanically reproduce the kinematics of a select motion in form of a small scale prototype with all its intricacies and as close as possible to the nature. Mechanics of motion in several species will be studies. The team will be able to build upon the relevant work undertaken by the class of 2011.

CRN 94368 Bayandor: Aerospace Dynamic Damage and Crashworthiness Testing Platform
Capacity 12

This project is dedicated to developing virtual as well as physical damage-testing platforms that can be used to evaluate an aerospace vehicle's damage tolerance and survivability during a range of accident scenarios. A team of selected students will learn about the latest research in the area of aerospace damage analysis, complemented by advanced aerospace structures and design guidelines. Numerical analysis including finite element and micro-mechanics will be discussed and applied to create detailed aerospace crash models. The physical experiments to be designed will include a variety of collision trials built upon the earlier testing platform completed by the class of 2011. The trial results will be used as a benchmark for validation of the numerical models. The validated virtual testing developed can help increase the overall safety of future generation advanced aerospace vehicles through effective and pre-assessed designs, while greatly decreasing the costs associated with full scale structural testing.

CRN 94371 West: Formula SAE
Capacity 25
Do not sign up for this project if you have not already been accepted.

CRN 94393 Fuller: Electronically Steerable Audio Speaker
Capacity 8

This project is a continution of last year's project in which students designed and constructed an audio speaker whose directivity pattern can be electronically steered to chosen directions. In addition last year's students designed and constructed an automatic array for measuring speaker directivity. The applications of the technology is in auditorimus, museums and defence where sound radiation is only required in certain restricted locations. In this year, students will further develop the electronically speaker by improving the speaker array and the DSP system for improved steering and sharpness of the radiation. In addition the students will design, construct and test an electronically steerable speaker with multiple radiation beams in pre-determined directions. Improvements to the testing array will also be considered. The project involves acoustics, electronics, digital signal processing, mechanical design and testing.

CRN 94394 Fuller: Instrumented Surfboard for Dynamic Modeling
Capacity 8

This project is a continuation of last year's project in which students applied strain gages to a surfboard and acquired the data using an on-board data acquisition system(for later analysis) while the surfboard

was being ridden. The data was then used in conjunction with a Finite Element model of the surfboard to estimate the stress/strain distribution of the surfboard while being ridden. This technology will enable understanding of the real stresses in a surfboard for the first time and assist in efficient, new designs of surfboards. In this year of the project the students will improve the sensing by adding more strain gages to the board and implement a wireless system for transmission of data to a land based data acquisition system for real time data analysis. In addition an improved version of the Finite Element model will be developed and calibrated with the improved strain data. Strain sensing and modeling of the fins of the surfboard will also be developed. The project involves transducers, sensing, digital data acquisition, data processing, finite element analysis and mechanical design.

CRN 94404 Kornhauser: Solar Air Conditioner
Capacity 6

A planned solar-powered air conditioning system uses refrigerant vapor from a solar-powered boiler to drive a Rankine-cycle power system. This system, in turn, drives a vapor-compression refrigeration system for air conditioning. Alternate configurations include a gas-fueled heat pump to provide a household furnace with first-law efficiency >100% and a system to provide automotive air conditioning using engine waste heat.

The 2010-2011 student team designed and built a prototype of the engine-compressor-pump which is the key element of the system. For testing, the unit is run on air. The unit was designed to be capable of operation at high pressure and high speed, but is limited to low-pressure, low-speed operation by solenoid valves that control the flow from the boiler into the engine.

Tasks for the 2011-2012 team are:

1. Do additional testing on the 2010-2011 prototype in order to better understand its performance, to refine the performance models already developed, and (if necessary) to modify the design.

2. Design and implement an improved valving system that will allow high-pressure, high-speed operation. This system may consist of improved electrically-driven valves or of mechanically-driven valves with electronic control of opening and closing times.

3. Demonstrate operation of the engine-compressor-pump with improved valving at high pressures and high speeds.

CRN 94389 Kennedy: Design of a Fortified Wood Pellet Plant
Capacity 5

Due to a number of resource, environmental and political issues, it is imperative that we diversify our sources of energy. Wood pellets have been used for years as a fuel source to heat homes. They are in particular demand in Europe. Based on previous research, it has been demonstrated that wood pellets can be produced much easier if a small percentage of a clean burning polymer is blended with the wood chips or saw dust. It has also been demonstrated that with a 50/50 blend of wood to polymer, the pellets produce 11,000 BTU/pound, which compares favorably with high quality coal.

The addition of polymer expands the design window for pellet production process. The key issue is that current production requires that the chips or saw dust must be dried to a very low moisture content before they can be made into pellets. Addition of polymer eliminates the need for the wood to be dried so pellets can be made with wet wood and then dried. One of the likely sources of polymer is from the post

consumer waste stream, which will reduce the volume of material going into land fills.

The design project will be to develop a detailed process for fortified wood pellets that takes advantage of the expanded design window.

CRN 94390 Kennedy: Planter for Biomass Crops
Capacity 6

The U.S. has aggressive goals for utilization of renewable fuels for transportation. It is projected that biomass will come from both annual and perennial crops. For the foreseeable future, annual crops such as corn and other grains, sweet sorghum, sugar cane, and tubers will be the primary feedstock. A group of entrepreneurs have worked with a breeder to develop a variety of sweet potato, called the eTuber, that can weigh as much as 20 pounds. Data suggests that eTubers could be the crop of choice in the southeastern U.S. For a small refinery that produces 50 million gallons of ethanol annually, 33,000 acres of eTubers will be required and at least 10,000 plants will be required per acre. eTubers, like all sweet potatoes, are started by planting small plants in rows. Plantersm such as a tobacco planter, have been developed for this purposes but the current design cannot effectively plant the large number of acres required for an ethanol refinery. This goal of this project is to develop a planter that can quickly plant large acreage in small plants.

CRN 94370 Bohn: PACE Automotive Projects
Capacity 16

The objective of this project is to design future vehicles in collaboration with General Motors engineers and designers. The theme is sustainable urban transportation systems for the year 2030. This is a multi-university team competition: We will team with engineering and industrial design students at 3-4 other universities around the world, and our team will compete against 7-10 other global multi-university teams. We will present our work to General Motors managers and executives.

CRN 94359 Bohn: Online Design Tools
Capacity 8

Design teams need tools to more effectively archive and share information during the engineering design process. This is particularly an issue for geographically dispersed design teams. For instance, the common approach of using MS Excel spreadsheets to manage Quality Function Deployment (QFD) charts or Failure Mode and Effect Analysis (FMEA) charts is inadequate and ineffective for even short-term use because of the lack of information that can effectively be stored in the spreadsheet cells. This project will apply the engineering design process to develop online engineering design tools for local and geographically dispersed design teams alike.

CRN 94357 Ball: CFD - Modeling of Particulate Flows
Capacity 6

This project will involve using the industry-leading computational fluid dynamics (CFD) code, FLUENT, to model air flow with a dispersed phase (particulate matter) through a variety of geometries. Phenomena such as settling, agglomeration, entrainment and re-entrainment, etc. will be the focus of the studies. The main application of interest is the transport of biological agents such as anthrax, with the intent of improving homeland security and counter-terrorism. Naturally occurring pandemics such as H1N1 influenza could also be a focus of this research, or even broader applications such as soil erosion. The senior design team will work closely with a small team of graduate students, who are also conducting bench-top scale experiments for use in code validation and verification of results. The design team will

evaluate the existing experimental setup and look for new designs or modifications that will improve its usefulness and/or broaden the range of parameters and applications for which it can be used.

CRN 94396 Williams/Kochersberger: 3D Printed Autonomous Aerial Vehicle
Capacity 6

Currently, deployed military operations must endure significant downtime while waiting for replacement parts for specialized equipment, such as unmanned aerial vehicles. Supply chains must be organized, inventory must be managed and part delivery can be dangerous.

With its digital approach to part design and fabrication, 3D Printing offers an opportunity to solve this problem. A deployed 3D Printer could eliminate the need for inventory management and negate the need for a supply chain as parts could quickly be fabricated on-site as needed.

In order to work towards this goal, students in this project will be tasked with creating an autonomous aerial vehicle that can be completely fabricated with 3D Printing technologies. Students will work in the Dr. Williams's DREAMS Lab and Dr. Kochersberger's Unmanned Systems Laboratory to design, analyze, fabricate and test a 3D Printed autonomous helicopter. To tackle this challenge, students will have to completely redesign existing UAVs, as current models are not designed for fabrication via 3D Printing. Students will be challenged by the material limitations of 3D Printing while also taking advantage of the technologies' ability to fabricate complex geometries and integrated assemblies.

CRN 94400 Vandsburger: Field Solar Powered Machines and Devices
Capacity 4

The projects will be mostly in the field of Photovoltaic systems. The participating student will design several photovoltaic based systems. These systems will include very practical and mostly existing devices, e.g., LCD announcement boards in the VTB stations. Info will include the bus schedule for the specific station, news of the moment, from NPR, BBC etc., and activities screen.
Other projects will involve integration with biological systems, e.g. power system for heart beat controller, power for Deep Brain Stimulation electrode, and others.
The students will choose the project, i.e., will propose a project, and I with other experts will approve a project for each group.
I would like to see groups of 4 students.
If you have questions drop me a line and we'll schedule a meeting.

CRN 94360 Nain: Design of Fibrous Environments Accurately Mimicking the Extra-Cellular Matrix
Capacity 4

We are looking for a team of enthusiastic mechanical engineering students who will develop a design strategy-philosophy for developing fibrous scaffolds mimicking the native extra-cellular matrix (ECM). Engineered fibrous biomaterial scaffold possessing the hierarchal spatial properties of a fibrous ECM can serve as a building block upon which living cells are seeded for repair or regeneration. Numerous studies have indicated the importance of key engineered parameters: fiber diameter, fiber alignment, geometrical fiber spacing, scaffold mechanical strength, fiber roughness and topological constraints of scaffolds. These spatial parameters constituting a vast design space with limited available information on their engineering limits along with their interdependency rules lead to a currently loose framework for designing fibrous biomaterial scaffolds. Team members are sought who are interested in bioengineering,

computational modeling, structural design, polymeric materials and nanoscale experimental techniques.

STEP lab has pioneered a novel polymeric fiber manufacturing platform, which can deposit aligned fibers with tight control on dimensions in single and multiple layers (diameter: sub 100nm-micron, Length: mm-cm, Spacing: sub-micron to tens of microns). Using this platform and in conjunction with time-lapse+immunostaining microscopy, students will design scaffolds for controlled cellular migration. Through careful selection of material and geometrical parameters (polymer material, fiber diameter and spacing), fine-tuned environments of varying stiffness's will be developed and characterized for mechanical properties. Rat mesenchymal stem cells and mouse C2C12 pluripotent cells will be seeded on the scaffolds and migration rates will be determined. In parallel a computational predictive tool will be developed using finite-element techniques corresponding to the fiber networks with migratory cells. Our goal is to be able to use this computational tool to predict cellular behavior, which will lead to the design of accurate scaffolds for tissue engineering.

CRN 94383 O'Brien: Design of Green, Renewable Autonomous Energy Systems
Capacity 16

Most renewable, green energy systems are designed to be operated as supplemental power to a grid, or as intermittent auxiliary power. However, there are many applications where the local energy supply system needs to provide power continuously and reliably, and operate as an autonomous system. remote or temporary settlements.

Supplying energy continuously and reliably under these conditions is a challenge. A typical solution is to ship in oil or gas supplies and use diesel or gas turbine engines. However, these solutions are dependent on a continuous resupply of fuel from the outside. The "logistics chain" is subject to interruption, and the fuel required is fossil fuel with its limitations.

This design project will begin with the study and identification of the best locations for autonomous, green energy supply systems. Then, a system meeting the requirements of the application will be designed and simulated in operation using SIMULINK or similar software. It may be possible to build and operate a sub-scale model of the system. In any case, the goal is to design an innovative, practical system, and to show that it will work.

Cost, reliability, and emission-free operation will all be considerations. Examples of possible energy sources include wind, solar, geothermal, and tidal energy. The goal is to design a system that can be shown to be technically and economically feasible.