EECE401 Senior Design I

Electrical and Computer Engineering
Howard University

Instructor
Dr. Charles Kim
[ckim@howard.edu]

Fall 2014

Senior Design I - Fall 2014

- **EECE 401 (**CRN 83550; 3 credit hours)
  - Class Hours: W 1410 – 1700 (NEW)
  - Classroom: LKD 3121
- **Instructor**
  - Dr. Charles Kim
  - (202)806-4821
  - ckim@howard.edu
  - Office Hours (LKD3014): Open Door Policy
    - TWR 1030 – 1200
- **Highly recommended course to take along (**unless you have some background in hands-on skills of microcontroller)
  - EECE416 Microcomputer whether it is required or not
  - Final implementation usually involves sensors, controllers, and interface
- **Web ---Syllabus, Notes, etc**
  - **Classes and material of previous academic years**
  - www.mwftr.com/SD.html [*Note: case-sensitive]
  - The choose 2014- 2015 academic year

"Senior Design" – brief definition

- Is
  - Culmination of EE/CpE Education, Training, etc
  - Solving a problem (or meeting needs/demands)
  - **Design *experience*** that requires adequate consideration of
    - **Knowledge**
    - **standards,**
    - **Constraints, and**
    - Should be related to the **electrical/computer engineering discipline**.
  - ***Process*** to final product (through Senior Design II)
  - Usually team-based problem solving, inventing, etc.
- Is NOT
  - Further expansion of a class project
  - Final product only

"Design" – Full Definitions

- ABET
  - "The **process** of devising a system, component, or process to meet desired needs," which involves
  - "A **decision-making** process (often iterative), to convert resources optimally to meet the stated needs" by applying basic sciences, mathematics and engineering, adequately considering
  - knowledge, standards, and constraints related to the electrical/computer engineering discipline."
- Industry
  - (1)"Determine that a need exists with a customer for specific goods or services and how much that customer is able and willing to pay for it.
  - (2)Then determine if the product or service is compatible with the competencies of the company and if it can be manufactured at a cost that is less than the customer will pay.
  - (3)If so, proceed by designing to match the company's ability to manufacture, rather than basing the design on state-of-the-art technologies.
  - (4)Finally, prior to full implementation, prepare a pilot demonstration"

Course Objectives and Outcomes

- **Objectives**
  - Learn and use design process to meet needs
  - Becoming to be aware of Technology Impact to Society
  - Becoming an effective team member
  - Becoming an effective communicator
  - Enjoy Design Experiences
- **Topics of the course**
  - Engineering Design Processes
  - Teamwork
  - Communication
  - Professional (or “soft”) Skills
  - Industry Experts and Guest Speakers
- **Course Outcomes (ABET)**
  - (c) Design a system component, process, or system –
    - Throughout the class, we learn the design process and apply it and integrate to a working system which solves customers’ problem
  - (g) Effective communicator –
    - Presentations and report writing will enhance verbal, written, and slide communication
  - (i) a recognition of the need for, and an ability to engage in life-long learning –
    - Awareness of the continued, non-stop learning of new technology
  - (j) a knowledge of contemporary issues –
    - Understand the issues related with the project and their impact to society and the project itself.

"Senior Design" Schedule

- Philosophy:
  - "Variable Time, Fixed Performance"
- Rough/Tentative/Soft Schedule to Follow
  - Understand the Design Processes and Components: Aug-Sep 2014
  - Selection of Design Projects & Team Formation: Sep-Oct 2014
  - Solution Generation: Oct-Nov-Dec 2014
  - Top Design Selection: Oct-Nov-Dec 2014
  - Proposal Presentation (Public event): Nov-Dec2014
  - Design Implementation: Jan-Feb-Mar 2015
  - Design Evaluation: Jan-Feb-Mar-Apr 2015
  - Final Presentation: ECE Day – Apr 2015

Team Formation

- **Teams are formed as soon as design projects are determined**
- **All projects are to be originated from:**
  - **Industry**
  - **National/regional student competition**
  - **Research project from faculty**
- **Projects**
  - Niobium Metal Underwater Connector (from Northrop Grumman) : Need 3-4 students, 1 ME student, 1 CHEM student, and 1 GR student as advisor
- **Tentative Projects**
  - Cornell Cup 2015 presented by Intel (?)
  - Other competition
  - Recycling of last year project --- (Ex) Bus boy robot
- **Team Formation Policy**
  - Mix of “Free formation” and “Advice and Encouragement”

Niobium Metal Underwater Connector – Brief p1

- Problem
  - UUVs powered by on-board batteries have limited mission lives dictated by battery capacity and UUV size
  - Reliable underwater remote charging of on-board UUV batteries at depth up to 300 ft
  - Present conductive wet mate underwater connectors are unreliable with complex sealing and wiping mechanism
  - Inductive coupling solutions are complex and occupy significant size and weight as well as substantial efficiency loss

Niobium Metal Underwater Connector – Brief p2

- Objectives
  - Develops a field testable two contact wet mate electrical connector using Niobium (Nb) and/or Tantalum metal contacts which will be self-insulating which requires no seals and can have contacts exposed to water.
  - Connectors carry DC power upto 50V with 48VDC nominal @25A (1.2kW) with very low resistance
  - Connector will demonstrate the performance of the self-passivating nature of Niobium/Tantalum
  - Simultaneous RF link support of the following 2 modes
    - 802.11 Wireless Ethernet Data Support
    - Simulated bi-directional discrete signal

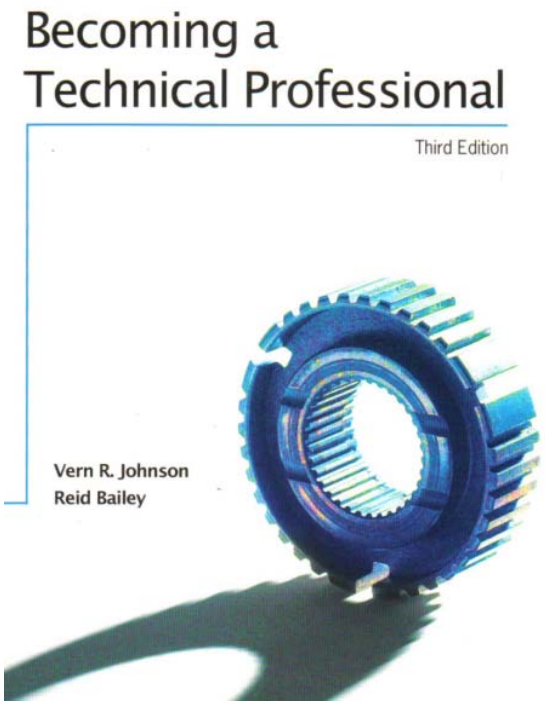
Niobium Metal Underwater Connector – Brief p3

- Design Expectations (Deliverables)
  - Input power 48VDC, 25 Amps
  - Function sea water and fresh water at depths at least 100m
  - Functional temperature: -2 to 50 degrees C
  - Surviving temperature: -40 to 70 degrees C
  - Life expectancy: 25 years in sea water
  - Signal range across the connector: 2.4 or 5 GHz signal
  - Discrete simulator signal across the connector at 900 MHz
- Demonstration
  - Team will visit Northrop Grumman Undersea Systems in Annapolis MD
  - Demonstration of prototype
    - Northrop Grumman Pool
    - Chesapeake Bay
    - Simulated Seawater

Team Formation for Niobium Metal Connector

- Desired Skill Sets and Background and Disciplines
  - Material Science (EE, CHEM)
  - Communication and Wireless Network (EE, CpE)
  - Housing and connector design and manufacturing (ME)
- More importantly,
  - Desire to learn and innovate
- Note: We will come back to this subject again, and the NGC supervisor will be invited to the class soon.

Main Text and Resources



- Becoming a Technical Professional
  - by Vern Johnson and Reid Bailey
  - published by Kendal/Hunt Publishing Co.
  - 3rd Edition
  - ISBN 13:978-0-7575-2765-4
  - Written for first-year engineering students
  - Process/Idea is same for seniors with actual application & implementation of the process & idea.
- Resources
  - Niku, Creative Design of Products and Systems, Wiley

Engineering Design – Topics and Objectives

- Topics
  - Engineering Design Overview
  - **Problem Formulation**
  - **Problem Solving**
  - **Solution Implementation**
  - The Art and Science of Creativity
  - Project Management
  - Technical Presentation
  - Technical Writing

- Objectives
  - Understanding an engineering design process
  - Understanding the 3 phases of design and how design is an adaptive, systematic process
  - Applying a design process to meet a set of needs
  - Design under constraints
    - Budget
    - Time
    - Regulation/Standards

Course Grading and Expectation

- Expectation
  - Attendance
  - Active Participation
  - Weekly Activities
  - Assignments
  - Active interaction with instructor and advisor
  - Everything counts
  - Professional manner
  - Teamwork
  - Project Note – describe activities, works, findings, etc. → submit at the end of semester

- Grading
  - **Individual Score (X):40%**
    - Attendance (10%): only on-time arrival counts
    - Homework +Others (10%)
    - **Project Note (sturdy lab note) (10%)**
    - Final Exam (10%)
  - **Group Score (Y): 60%**
    - Class activities + Assignments (30%)
    - Proposal + Presentation (30%)
  - **Peer Evaluation Score (P): 0 – 1.0**
  - **FINAL SCORE (F)**
    - **F = X + Y*[0.6+ 0.4*P]**
- **Grades**
  - **A: 90 – 100**
  - **B: 80 – 89**
  - **C: 70 – 79**
  - **D: 60 – 69**
  - **F: 0 - 59**

Competitions - Last Year

- 3 team applied for Cornell Cup 2014
  - 1 team was selected as a finalist
  - 2 teams were eligible to continue as Wild Card teams – but gave up later
- 1 team participated in the DOE's Better Building Case 2013
  - Team:, Monica Burnett, Alexis Wells, Lakeasha Williams, and Venessa Woodson

Cornell Cup 2014 - Report

- Cornell Cup presented by Intel
  - 3rd USA national contest for embedded systems
    - Howard teams success
  - College-level embedded design competition created to empower student teams to become the inventors of the newest innovative applications of embedded technology.
  - Teams of 3-5 students will create detailed design plans, a working prototype, and a final presentation that effectively demonstrates the capabilities and robustness of their ideas.
  - Applications and final report entries will be “blind” reviewed by a team of experts and all judging criteria is made openly available to all contestants
  - Intel Atom board based Design and Implementation
- Howard University
  - 1 team as a finalist: Eye-view Navigation System
  - Competed in May 2014 in Orlando, FL

Eye-View Navigation Team [2014]

- Team members: Emmanuel Ademuwagun (Microsoft), Yusuf Siyanbola, Zachary Spence (Tuskegee grad school), Patrick Buah (Intel), and Jordan Wren.

Howard's Success in Cornell/Intel Cup 2013

- 2013:
  - 2 proposals were submitted
  - Both teams were selected each as a finalist
  - **Water Purification:** Eric Turner, Henok Mazegia, and Ade Akinsiku
  - **Smart Backpack:** Paul Alade, Ellwood Lane, Jennifer Okafor, Samuel Omosuyi, and Kalonji Bankole
  - Team Sigma ("**Smart Backpack**") earned the Honorable Mention award

Charles Kim – Howard University

Howard's Success in Cornell/Intel Cup 2012

- 2012:
  - 2 team proposals were submitted
  - 1 ("Green lighting") was selected as the finalist
    - Chidi Ekeocha, Shamir Saddler, Ameer Baker, Isaac Collins, Ravi Jaglal
  - 1 ("Blind Assistant") was selected as a wild card
    - Gerard Spivey, Joshua Durodola, Antonio McMichael, Keir Morris, Christopher Urquhart
  - The "Blind Assistant" won the Wild Card Winner in the Final Competition in May 2012