Integration of Research and Teaching: 

A Two-Way Conduit

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Department of Engineering
College of Technology and Computer Science
Outline

- Research
- Teaching
- Integration of Research and Teaching
- Integration of Research, Teaching, and Service
A University Professor’s Job
• The Biosensors Research Laboratory
Research Projects

- **Tele-audiology**
  - Publications (4 journals, 2 conferences)
  - Funding ($25,000)

- **Orthopedic injection training instrument**
  - Publications (1 journal, 1 conference)
  - Funding ($7,500)

- **Finger plate for balance assessment**
  - Funding (~$3,000)

- **Engineering education**
  - Publications (3 journals, >10 conferences)
  - Funding (~$90,000)
Teaching: Course Developed

- ICEE 1014 – Introduction to Engineering
- ENGR 3014 – Circuits Analysis
- ENGR 3050 – Instrumentation and Controls
- MENG 4350 – Electromechanical Systems

- Currently coordinating the planning of the Electrical Engineering concentration and developing multiple concentration courses
Teaching: Courses Taught

- COAD 1000 – College Orientation
- ICEE 1012 – Engineering Graphics
- ICEE 1014 – Introduction to Engineering
- ENGR 3014 – Circuits Analysis
- ENGR 3050 – Instrumentation and Controls
- MENG 4350 – Electromechanical Systems
- ITEC 6000 – Statistical Application in Industry
- ENGR 4010 – Capstone Projects I
- ENGR 4020 – Capstone Projects II
Teaching: Professional Development

- NSF CCLI/TUES Conference, Washington DC (2 days, January 2011)
- “Conducting Rigorous Research in Engineering Research” Workshop, Golden, CO (4 days, August, 2010)
- NIH SBIR/STTR Workshop, Raleigh, NC (2 days, June 2010)
- ABET Accreditation Assessment Training Workshop, Baltimore, MD (one day, February, 2007)
- MIT Leadership Skill Workshop, Boston, MT (two days, July, 2007)
- VaNTH ERC “How People Learn Engineering” Workshop, Nashville, Tennessee (two days, April, 2006)
Integration of Research and Teaching

- Coherent integration of the research and education is a **two-way conduit**:
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  – From research to teaching
    Research ideas can be migrated into classroom instruction and lead to education innovations
• Coherent integration of the research and education is a **two-way conduit:**
  
  – From research to teaching
    Research ideas can be migrated into classroom instruction and lead to education innovations
  
  – From teaching to research
    Curriculum/course/laboratory development and assessment work provides good research opportunities and best practices and findings might be publishable
The common theme: from anywhere anytime healthcare to anywhere anytime learning
• Philosophical Thinking: from anywhere anytime healthcare to anywhere anytime learning
The common theme: from anywhere anytime healthcare to anywhere anytime learning.
Integration of Research and Teaching

- Ubiquitous Laboratory Learning
  - NSF sponsored project
  - Develop new technology
  - Develop new instruction material
  - Assessment effectiveness
  - Disseminate results
Integration of Research and Teaching

ECU Engineering Core

- Industrial Systems Engineering
- Mechanical Engineering
- Bioprocess Engineering
- Biomedical Engineering

ECU General Engineering
Integration of Research and Teaching

- Ubiquitous Laboratory Learning
  - NSF sponsored project
  - Develop new technology
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Integration of Research and Teaching

Industrial Systems Engineering

Mechanical Engineering

Bioprocess Engineering

Biomedical Engineering

ECU Engineering Core

ECU General Engineering
• Project-driven Instruction Approach

Displacement Sensor Design Project

- Transducer Categories
- Error Analysis
- Signal Amplification
- Signal Conditioning
- Instrumentation Rating

Capacitive Displacement Sensor Design Project
• Project-driven Instruction Approach

Coupled-Tank Level Control Design Project

Transfer Functions
Stability Analysis

Laplace Transforms
Performance Specification

Dynamic System Modeling
Control System Evaluation

Coupled-Tank Level Control Design Project
Project-driven Instruction Approach

- Transducer Categories
- Error Analysis
- Signal Amplification
- Signal Conditioning
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Displacement Sensor Design Project

Capacitive Displacement Sensor Design Project
• Project-driven Instruction Approach

Coupled-Tank Level Control Design Project

- Transfer Functions
- Stability Analysis
- Performance Specification
- Laplace Transforms
- Dynamic System Modeling
- Control System Evaluation
Integration of Research and Teaching

- Project-driven instruction Approach
• **Project-driven instruction Approach**
  
  • ENGR 3014: Four week Thermistor-based Temperature Alarm Design: universal applications of op-amps in electronic circuits.
  
  • ENGR 3050: Four week Capacitive Level Sensor Design: Instrumentation concepts, LabVIEW programming skills
• Project-driven instruction Approach
  • ENGR 3014: Four week Thermistor-based Temperature Alarm Design: universal applications of op-amps in electronic circuits.
  • ENGR 3050: Four week Capacitive Level Sensor Design: Instrumentation concepts, LabVIEW programming skills
  • ENGR 3050: Five week Coupled-tanks Level Control Design: feedback control concepts, integrate mathematical model into real-world dynamic process
  • MENG 4350: Four week DC Motor Modeling Speed Control Design: integrate control theory with dynamics, instrumentation, microcontroller programming, machinery design into the same project.
• **Project-driven instruction Approach**
  
  - **ENGR 3014**: Four week Thermistor-based Temperature Alarm Design: universal applications of op-amps in electronic circuits.
  
  - **ENGR 3050**: Four week Capacitive Level Sensor Design: Instrumentation concepts, LabVIEW programming skills
  
  - **ENGR 3050**: Five week Coupled-tanks Level Control Design: feedback control concepts, integrate mathematical model into real-world dynamic process
  
  - **MENG 4350**: Four week DC Motor Modeling Speed Control Design: integrate control theory with dynamics, instrumentation, microcontroller programming, machinery design into the same project.
• The course is laid out very well. The class is interesting. The labs are fun and educational.
• The Labs compliment the lectures.
• I enjoyed the labs for this class; I like hands-on things because I get a better understanding of the material.
• The labs were great for demonstrating theory put into practice.
• The labs apply the stuff that we learn in class.
• The course material is well laid out. We have homework that is challenging, and the tests material comes from the homework material or the lab material...
• ......
Students’ Successes

- **Yongbo Wan**: 4 journal papers, 5 conference papers
- **Xiaodong Sun**: 2 conference papers
- **Chris Eckert**: 1 journal paper, 1 conference abstract
- **Chris Eckert and Michael Cannon**: best poster presentation, 2010 ECU Research/Creative Activity Week
- **Ellen Crowell**: 1 journal paper accepted, best poster presentation, 2009 ECU Research/Creative Activity Week.
- **Jason Yang**: the Catalyst Award. Presented at the NC State Science Teachers’ State Meeting
Research Revisit

- **Tele-audiology**
  - Work with Communication Sciences and Disorders

- **Orthopedic injection training instrument**
  - Work with Orthopedics East

- **Finger plate for balance assessment**
  - Work with Physical Therapy

- **Engineering education**
  - Work with Kansas State University
Teaching Revisit

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ECU Mission Statement:

To serve as a national model for public service...