

## COLLEGE OF ENGINEERING DOCTORAL PROGRAM DESCRIPTION

### A. Mission of the College

The College of Engineering at the University is committed to excellence in undergraduate and graduate education as well as excellence in innovative research. The College of Engineering was founded in 1914 and is the second oldest college at the University. The college embraces the departments of Biomedical Engineering, Chemical Engineering, Civil Engineering, Electrical Engineering and Mechanical Engineering. The current research units include the Institute of Biomedical Engineering Research (IBER), Microscale Physiochemical Engineering Center (MPEC), and the Process Research Center (PRC). During the academic year 1989-90, the College adopted Interdisciplinary Procedures for the doctoral program in the College. This interdisciplinary program has led to two additional collaborative doctoral programs: Engineering Applied Mathematics which is jointly run by the Applied Mathematics Division of the Department of Mathematics and Computer Science in the Buchtel College of Arts and Sciences, and the MD/PHD program with the Northeastern Ohio Universities College of Medicine (NEOUCOM). In addition, another unique coordinated program is the Doctor of Philosophy in Engineering of the University of Akron and Youngstown State University. The doctoral program offered by the College is a truly interdisciplinary in nature.

The interdisciplinary programs are broadly defined as follows:

- *Environmental Engineering* includes the study of water and air pollution, environmental health, chemical disposal, waste management, noise control, resource engineering, and appropriate fields of urban planning.
- *Mechanics* includes the theoretical and experimental study of the stresses, strains, and endurance of structures, machines, and various materials, mechanics of solids, fluids, and composite structures.
- *Systems Engineering* includes the scientific prediction, control, and evaluation of the performance of integrated operational systems, and interaction effects among the components of engineering systems. It includes system analysis and design, operations research, linear and dynamic programming.
- *Materials Science* studies the materials from the physical, chemical, and engineering standpoints. Its purpose is to develop a better understanding of the composition, properties, and performance of various materials, and to develop new materials, manufacturing methods, and applications.
- *Transport Processes* include the theoretical and experimental study of the transfer of mass, energy, and power, as related to engineering systems and processes.

- *Polymer Engineering* combines fundamental engineering principles with the structure and rheological properties of polymers to design and analyze polymer processes and equipment.
- *Biomedical Engineering* studies the theoretical and experimental application of engineering principles to biomedical problems. Some typical areas of interest are signal and image processing, biomechanics, and biomaterials.
- *Engineering Applied Mathematics* draws on the resources of the abstractness, precision, logical rigor, and broad range of application of pure mathematics to develop mathematical methods for the formulation, analysis, and solution of problems in science and engineering.
- *Computer Engineering* is intended for those students wishing to specialize in research in the areas of engineering science in which computing is an essential function. This includes advanced study and research in computer software and computer hardware. Another aspect of the program is research in applications of computers and software in areas of interest to society.

Our graduate programs in general are designed to prepare for careers in industry, governmental laboratories, colleges and universities. The current research emphases for the doctoral program is reflected by the focus areas of each of the engineering departments.

The graduate educational mission of the College are many fold:

- a) Train Engineers and Scientists to solve state of the art technological issues.
- b) Develop theory, methodology and necessary experimental skills to address problems that are of state-wide and national interests.
- c) Provide excellence in presenting their findings via theses, doctoral dissertations and research papers.
- d) Where appropriate train students to be future educators.
- e) Where appropriate train students in industrial research.
- f) Where appropriate train students to work on interdisciplinary teams.

The core of our faculty specialize in selected areas of research. They form the strength of our College. The research strengths are listed below:

### **Biomedical Engineering**

Cardiovascular Dynamics : Investigations of blood flow, Tissue-material-blood interactions

Orthopedics :- Soft tissue characterization, Analysis of bone fracture healing, Gait analysis

Instrumentation: Signals and Imaging

Research programs are funded by NASA, SUMMA Health Systems, Arthritis Foundation, and Akron General Medical Center

## **Chemical Engineering**

The Focus areas are:

Multiphase Transport

Bioengineering program

Catalysis program

Materials research

Nonlinear Dynamics

Surfactant and Sonochemistry and Thermodynamics.

All of these research programs are funded by sources such as NSF, DOE, EPA and by the Ohio Board of Regents.

## **Civil Engineering**

The focus areas are:

Structural Engineering

Water Resources and Hydraulic Engineering

Geotechnical Engineering

Transportation Engineering

Research in these areas are supported by NASA, Alcoa, Orbit Technologies and other industrial organizations.

## **Electrical Engineering**

The major focus of this group is on:

Power Electronics and Motor Drives

Industrial Controls

Computational Electromagnetics

Research supported by NSF, NASA, Goodyear Tire and Rubber Co.

## **Mechanical Engineering**

The focus areas include:

Experimental and numerical investigation of Dynamics of Journal Bearings

Experimental and Numerical Analysis of Solidification Processes

Experimental Studies on Control of Structures using Smart Sensors and Actuators

Experimental Determination of Mechanical Properties of Tire/Wheel/Suspension System

Control of Nonlinear dynamical Systems

Mechanics of Isotropic and Composites Structures

Research supported by NSF, NASA, EPRI and several other industrial sources.

The Interdisciplinary Doctoral Program in Engineering is unique in the sense that for a student originating from one of the five academic departments, the composition of the committee, coursework requirement, and the topic of the dissertation all cross the boundaries of the departments.

#### B. Uniqueness of the Doctoral Program

- The participants in the interdisciplinary doctoral program have access to the academic resources available in the College of Engineering rather than to just those within a department.
- Engineering and science departments outside the College of Engineering have access to an engineering doctoral degree which expands and enhances the student base, stabilizes the critical number of participating faculty, and expands the academic resources available for the doctoral program.
- Faculty with common research interests can be identified and research teams can be organized to take advantage of external research funding.

#### C. Our Program and the Needs of the State

As the state positions itself in the forefront of the technology, appropriately trained scientists and engineers are needed in all fields. Our graduate programs, in particular our Interdisciplinary Doctoral Program, provides training of our students to take leadership roles in technology related to the field of engineering. In addition, our program already attracts a variety of students from the Northeast Ohio region from several industries and NASA Glenn Research Center. The College is a partner of the Ohio Aerospace Institute (OAI) and it is addressing a portion of the state needs.

#### D. Placement Objectives for Graduates

Our graduates are often treated as Colleagues in term of incorporating them in research early in their academic learning. Most of our doctoral graduates often produce high quality publications in professional journals. This leads them to a wide variety of opportunities. Several of our graduates are Professors, Researchers in industries, Scientists at government labs and in several engineering firms etc. The choice of placement of a student depends on the topic of the thesis. Most students who are placed in the Universities are trained to write research papers and in many cases participate in writing proposals. The students seek industrial settings, are often funded by grants from the industry thus enhancing their marketability to these and other industries. The same is true with federal laboratories such as NASA.