College of Engineering
Master's Degree Program
Spring 2006

Rowan University Offers Engineering Courses at the William J. Hughes FAA Technical Center
A Pilot Program Supported by the US Department of Education and NASA

FAA employees and members of the New Jersey Aviation Research Technology Consortium will have the opportunity to attend professional and master's level engineering courses which began September 2005. And you'll be able to do so without traveling to another location at the end of your work day.

Dedicated to economic development and academic enrichment in southern New Jersey, Rowan University is offering Engineering Courses at the William J. Hughes FAA Technical Center with funds from the US Dept. of Education and NASA. The five engineering courses that will be offered this spring are described below.

Initiating New R&D Projects: From Conceptual Idea to Organizational Reality

Date: January 17–May 2 **Time:** 6:00 – 8:30 p.m. Tuesdays
Instructor: Peter Joyce
Credits: 3 **Course Code:** 0901-501-06 **Registration Number:** 13469

Course Description: New research ideas and concepts often die because of a variety of reasons characteristic of the new, the unproven and the upsetting to conventional wisdom. When introducing truly new projects and programs, the initiator often runs into a myriad of problems and issues related to technical feasibility, economics, culture, completeness, benefits and political positioning. Management often creates broad expectations for nurturing new initiatives for value creation but cannot or will not address all of the complexities and idiosyncratic issues related to a specific small project that might not "fit" the existing paradigm. In addition, the researcher may be up against opposing forces that are difficult to quantify and overcome, not the least of which are resources and budgeting issues because new initiatives, by their very nature, are born out of the need to take existing projects and programs to a new level that was not anticipated.

This course will result in several student-generated projects being supported through unorthodox means and resources to hopefully reach the level of serious consideration and development by management. There will be three main components of the course: a.) Entrepreneurship in general in terms of how to identify and prove a concept, evaluate risks, sell ideas, obtain support and create relationships that generate value without consuming cash, b.) Preparing a summarized research proposal for an idea or concept that could introduce a discontinuous step change in either technology or other organizational improvement of great benefit to either society or the FAA and c.) Actually implementing the best 3 to 5 proposals in a competition voted on by the class as a whole. The implementation effort described in item c.) will result in the class being broken down into "teams" that will have as its leader the proposal voted on by the class as the best ones to put forward and develop and the other students will become support members of the team.

A requirement of this course is that students should have an idea that they would like to see implemented and be able to put that idea or concept into a pre-determined format that will be taught as part of this course.

Prerequisite: Permission of the instructor.

DATA FUSION II – Radar Trackers

Date: January 19 – February 16 (5 Thursdays) **Time:** 5:00 – 7:30 p.m. Thursdays
Instructor: James K. Beard
Credits: 1 **Course Code:** 0901-501-04 **Registration Number:** 13459

Course Description: Radar trackers are the data processing blocks between raw detections and data for synthetic displays. The tracker is where the radar detection information is combined with the transponder data to provide information for the display graphics such as target identification. The base tracker function is to provide and maintain a data base of radar contact information as a set of track files. These track files provide the data for alerting functions such as collision alerts and altitude warnings as well as for synthetic displays. Radar tracker technologies vary from traditional coast-and-update methods to state-of-the-art track-before-detect methods. The methods used by FAA radars in the past and present are used as a basis for describing the advantages and disadvantages of the technologies for FAA and other radars for present and future radars. The high traffic density seen in many FAA and other radar installations builds on this basis to describe the concept and design of a multiple hypothesis tracker (MHT) for ground based radars, and the practical considerations in the design and implementation of these trackers and in the function of sharing data between radars or merging data from multiple radars at a central facility such as an air traffic control center. Other topics will be presented, including a review of probability and statistics as applied in relevant radar tracker technologies, interactive multiple models (IMM) in radar trackers, radar tracking from moving and airborne platforms, and basic considerations in data sharing between radars.

Prerequisites: Knowledge of probability and statistics; basic understanding of elementary vectors and matrices, to include matrix multiplication of vectors, and determinants and inverses of matrices. Readings will be assigned to those who need an introduction to vectors and matrices. The student should be capable of using Matlab or another general purpose software environment for simple problems.

College of Engineering
Master's Degree Program
Spring 2006

DATA FUSION III – Estimation Theory
Date: February 23 – March 23 (5 Thursdays) **Time:** 5:00 – 7:30 p.m. Thursdays
Instructor: James K. Beard
Credits: 1 **Course Code:** 0901-501-05 **Registration Number:** 13460

Course Description: Estimation is the principal enabling technology applied to tracking and data fusion. Simple examples are used to illustrate basic methods and show how probability and statistics underlie simple algebraic descriptions of well-known estimation techniques, which we use as a basis for showing the estimation theory basis of the Kalman filter. The method of maximum likelihood is a basic approach for designing estimators that use the Maximum Likelihood Estimators (MLEs), which are known to provide estimates which have the smallest mean square errors that can be provided from a given set of data. The classical basis for maximum likelihood is presented and extended to the vector case, such as estimating aircraft position in two or three dimensions from radar data. We show how the Kalman filter is related to MLEs. The classical estimation methods of maximum likelihood, maximum *a priori* (MAP), and Bayesian estimates are presented and compared. We discuss the practical issues with application and use of these estimators, such as biased estimates and how to remove biases.

Prerequisite: Permission of the instructor.

Smart Sensors
Date: February 24-25, 2005 **Time:** 1:00–5:00 p.m. Friday 8:00 a.m.–5:00 p.m. Saturday
Instructor: John Schmalzel
Credits: 1 **Course Code:** 0909-504-05 **Registration Number:** 13470

Course Description: Smart Sensors are an important emerging class of transducers with intelligence. Largely defined by the family of IEEE 1451.X standards, smart sensors offer structured methods for embedding sensor objects into distributed system architectures. Key components include the incorporation of the transducer electronic data sheets (TEDS), which provides the means to assign important sensor attributes that are available for automatic system configuration. In addition, the TEDS structure is generic enough to allow extensions to embed other information; this provides further usefulness in other applications. Distributed smart sensor architectures also introduce new challenges such as timing. These and other related topics are considered in this course.

Prerequisites: Sufficient background in digital system, networking, and software systems.

Intro to the Engineering and Science of Nanotechnology
Date: January 23-March 27 **Time:** 5:00 – 7:30 Mondays
Instructor: Robert Krchnavek
Credits: 2 **Course Code:** 0909-504-06 **Registration Number:** 13468

Course Description: By many estimates, nanotechnology has to potential to affect everything we do in life. From the clothes we wear, to the technology we use, to the health care we receive, nanotechnology will have an impact. Why is nanotechnology such a big thing? This class will introduce the fundamental science behind nanotechnology, why the nano realm is more important than any other size regime, and how this nanoscience manifests itself in technology.

Prerequisites: Undergraduate college chemistry and physics. A BS degree in science or engineering.

To Learn More About This Program:	
Rowan Contact: Dr. Steven Chin Associate Dean College of Engineering chin@rowan.edu (856) 256-5301	**Tech Center Contact:** Aundre Byrd Office of Organizational Excellence Aundre.byrd@faa.gov (609) 485-7774