Certificate: Intelligent Control

Intelligent Controls deals with the application of artificial intelligence, knowledge base, expert systems fuzzy logic and/ or neural networks for controlling complex physical processes that are difficult to control using conventional methods. Examples of such processes include vehicle control, autonomous vehicles, automatic control, glass furnaces, etc. Participants will be introduced to basic concepts and issues in control systems. This will be followed by a discussion of strategies for conventional controller design. Examples of such controllers include PID control, state variable feedback, etc. Case studies where such controllers are appropriate will be presented. The next phase of the program will deal with the design of non-linear controllers. These will be discussed as alternatives to conventional controllers. Group projects will be assigned to participants.

The final phase of this program will address the application of knowledge base systems and expert systems in controlling very complex processes that are not easily controlled by conventional methods, including neural networks. The emphasis will be on capturing human expertise and translating this expertise into a set of rules for facilitating effective control. Case studies will be utilized to enhance the quality of this subject matter.
(12 credit hours)

ECE 505 Digital Systems and Microprocessors
3 credits
Introduction to modern digital computer logic. Numbers and coding systems; Boolean algebra with applications to logic systems; examples of digital logic circuits; simple machining language programming; microprocessors programming input/output, interrupts and system design.

ECE 532 Automotive Sensors and Actuators
3 credits
Study of automotive sensory requirements; types of sensors; available sensors and future needs. Study of functions, types of actuators, and integrated smart sensors. Term project assigned.

ECE 552 Fuzzy Systems
3 credits
A study of the concept of fuzzy set theory including operations on fuzzy sets, fuzzy relations, fuzzy measures, fuzzy logic, with an emphasis on engineering application. Topics include fuzzy set theory, applications to image processing, pattern recognition, artificial intelligence, computer hardware design and control systems.

ECE 565 Digital Control Systems
3 credits
Mathematical representation of digital control systems; z-transform and difference equations; classical and state space methods of analysis and design; direct digital control of industrial processes.

ECE 583 Neural Networks
3 credits
Computational characteristics of the brain, learning, and self-organization; neural network architectures, e.g., single-layer nets, multi-layer nets, recurrent neural nets, ART, Boltzman. Self-organizing feature maps. Back-propagation, feed-forward, center propagation and other learning techniques; hardware implementation examples and applications.

ECE 576 Information Engineering
3 credits
This course will cover the fundamental concepts of information engineering including computation, storage, communication, and application. Examples of topics are multimedia data such as video, audio, image and text, multimedia transmission through local & wide area networks, multimedia data representations, storage & compression. Information engineering applications will be discussed and students are expected to complete a project in a selected application.

ECE 567 Nonlinear Control Systems
3 credits
A study of nonlinearities in control systems, phase plane analysis, isoclines, equilibrium points, limit cycles, optimum systems; heuristic methods; harmonic balance, describing function, frequency response and jump phenomena. Oscillations in relay systems, state space, optimum relay controls, stability, and Liapunov's method are also covered.

ECE 579 Intelligent Systems
3 credits
This course provides a broad technical introduction and a survey of core concepts of intelligent systems. Topics include: Intelligent system design, training and evaluation, decision trees, rule based systems, Bayesian learning, Support Vector Machines and neural network systems.