Miami Dade College

**<u>Course Description</u>**

**EET4730C | Feedback Control Systems | 4.00 credits**

This upper division course for students majoring in electronics and computer engineering technology, is designed to introduce students to the analysis of circuit networks and control systems. Students learn about stability and compensation considerations, using root locus, the Nichols chart, and Bode plots; simulation techniques; and how to apply these principles to build and test control systems. Prerequisite: EET 3716C.

**<u>Course Competencies</u>**

**Competency 1:** The student will demonstrate an understanding of the building blocks of basic and modern control systems by:

1. Describing and identifying common control systems including feedback components
2. Describing basic features and configurations of control systems
3. Designing and analyzing a control system based on specific control requirements

**Competency 2:** The student will demonstrate an understanding of the complex mathematical operations associated with building blocks of various control systems by:

1. Applying the Laplace transform to solve common modern control problems
2. Applying the concept of Partial Fraction Expansion in relation to control systems
3. Applying mathematical models, such as transfer function, for linear, time -invariant electrical and mechanical systems
4. Converting non-linear systems using Laplace transform to find transfer function for basic and complex systems
5. Modeling a basic control system in the frequency domain

**Competency 3:** The student will demonstrate an understanding of how to build basic principles from classical to modern by:

1. Differentiating between the frequency domain and time domain
2. Defining fundamental notions of controllability and the ability to observe state variable feedback
3. Discussing advances in robust control theory
4. Applying pole placement techniques (e.g. Ackermann's formula) in the design process

**Competency 4:** The student will demonstrate an understanding of how to design for typical control applications by:

1. Identifying appropriate applications for designs (i.e., insulin delivery control, low pass filter, printer belt driver, Mars rover vehicle, Hubble Space Telescope pointing control, etc.)
2. Analyzing and modifying design documents to satisfy design requirements
3. Applying compensating controller to improve varying factors in control systems

**Competency 5:** The student will demonstrate an understanding of system models by:

1. Creating mathematical models of physical systems in input -output or transfer function form
2. Comparing the transfer function of variable dynamic concepts
3. Designing and developing dynamic systems that comprise automatic control systems
4. Calculating and positioning mass systems such as hydraulic actuators

**Competency 6**: The student will demonstrate an understanding of the characteristics of feedback control systems and how to apply them by:

1. Describing sequential design (e.g., Disk Drive Read system), including how and where it is used in feedback control systems
2. Discussing techniques to improve the efficiency of energy use in feedback control systems
3. Applying parameter variations to open and closed loop control systems
4. Analyzing and interpreting steady state system errors
5. Modifying control system parameters to reduce the effect of unwanted input signals or disturbances on the output

signal

**Competency 7:** The student will demonstrate an understanding of how feedback control systems perform by:

1. Testing performance of second order systems response due to various inputs
2. Identifying the poles and zero's locations and transient response
3. Calculating various control system's steady-state errors
4. Testing various response systems' performance using simulation tools such as MATLAB or Simulink.

**Competency 8:** The student will demonstrate an understanding of stability of linear feedback systems by:

1. Defining the concept of stability and criteria of stability in control systems
2. Defining the Routh- Hurwitz Stability Criterion
3. Applying the Routh-Hurwitz method to build sequential logic into control systems (e.g., a tracked vehicle turning control)

**Competency 9:** The student will demonstrate the ability to use the Root Locus method by:

1. Defining the root locus method and discussing how it is applied to parameter design of control systems
2. Applying the root locus method to balance sensitivity in three- term PID controllers
3. Calculating and predicting system parameters to achieve the desired
4. performance
5. Calculating and analyzing root locus parameters to derive steady state response

**Competency 10:** The student will demonstrate ability to use Bode plots in the design and analysis of feedback control systems by:

1. Defining frequency response plots and their use in feedback control systems design
2. Applying Bode plots technique to draw the frequency response of several types of feedback control systems
3. Synthesizing magnitude and phase plots for various transfer functions
4. Analyzing a case study of a control system using Bode plot techniques
5. Synthesizing and analyzing several feedback control systems using Nichols chart for generating magnitude and phase plots

**Competency 11:** The student will demonstrate the ability to design a control system to perform an engineering application by:

1. Developing a control project proposal
2. Analyzing, designing, building and testing a control project that performs an engineering application that has been reviewed and accepted by the instructor
3. Demonstrating the project function to the original specifications
4. Writing a project document including the following sections: introduction, background/theory, design explanation, schematics and code, testing, discussion and conclusion

**<u>Learning Outcomes:</u>**

- Use quantitative analytical skills to evaluate and process numerical data
- Solve problems using critical and creative thinking and scientific reasoning
- Formulate strategies to locate, evaluate, and apply information