SAMPLE SYLLABUS

This syllabus is to be used as a guideline only. The information provided is a summary of topics to be covered in the class. Information contained in this document such as assignments, grading scales, due dates, office hours, required books and materials may be from a previous semester and are subject to change. Please refer to your instructor for the most recent version of the syllabus.

ABET Course Syllabus EEE480

1. **Course: EEE 480 Feedback Systems**
2. **Credits and Contact Hours:** 4 Credit Hours (lecture, lab), Topics: Engineering
3. **Course Coordinator:** Dr. K. Tsakalis, Professor
4. **Textbook:** Rodriguez, *Analysis and Design of Feedback Control Systems*, 1st Edition 2003, Control3D, LLC ISBN: 0131849956.
   Supplemental materials: Class notes, simulation codes distributed by the instructor.
5. **Specific course information**
   a. **Catalog description:** Analysis and design of linear feedback systems. Frequency response and root locus techniques. Series compensation.
   b. **Prerequisites or co-requisites:** EEE 203 or MAE 318.
   c. **Required/elective/selected elective:** Elective
6. **Specific goals for the course**
   Students can analyze and design simple feedback control systems
   a. **Outcomes of instruction:**
      1. Students can use Laplace transforms to analyze feedback systems
      2. Students understand the concepts of stability
      3. Students understand use of internal model principle for analyzing and designing feedback systems
      4. Students can use root locus ideas for feedback system stabilization and performance enhancement
      5. Students can use Bode plot and Nyquist plot ideas to analyze and design feedback control systems
      6. Students can use computer aided design software packages (e.g. MATLAB) to analyze and design feedback systems
   b. **Outcomes of Criterion 3 addressed by the course:**
      (1) The course promotes critical thinking through the assignment of problems that are infeasible or possess multiple solutions and require a sense of context for their resolution. A modeling section in the course discusses examples of model derivation from first principles, for use in feedback control systems design. Control system theory is applicable to an extremely wide range of problems (EE as well as other disciplines). This is achieved by translating the physical problem into an abstract but rigorous and quantitative mathematical problem.
      (2) This course enhances the understanding of the physical phenomena behind each process and their quantitative study through mathematical analysis. Extensive use of modern CAD software in homework, Lab, and project(s) to design, analyze, and evaluate designs.
      (4,6) Many modern practical problems require the use of simple feedback (power supplies, car cruise control) for which the classical compensator design techniques are applicable. Feedback is also present implicitly and in different forms in physical systems, e.g., biology, economy.
7. **Brief list of topics to be covered**
   1. Mathematical Modeling of Dynamic Systems: Differential equations, Laplace transforms, transfer functions, block diagrams, state equations, basic system time response, specifications

2. Feedback: Effects of feedback, stability, Routh's criterion, steady-state error analysis
3. Root Locus analysis: Designing for closed loop-damping
4. Frequency-Response analysis: Bode, plots, Nyquist criterion, relative stability, designing for phase margin, gain margin, and bandwidth
5. Design and Compensation Techniques: Lead, lad and lag-lead compensators, PID controllers

Computer Usage:
MATLAB (or other equivalent CAD software) in homework problems, labs and projects.

Laboratory Experiments:
Students meet weekly for a three-hour laboratory under the guidance of a TA.
1. Use of MATLAB and Simulink
2. System Responses
3. Modeling, approximations and uncertainty estimation
4. Simple Root-Locus compensator design
5. Simple Nyquist-Bode compensator design
6. Case studies (e.g., torque pendulum, cart-and-pendulum, temperature, aircraft control)

Course Contribution to Engineering Science and Design:
Use of open-ended exercises and ambiguously stated or partially defined problems. For example, a controller should be designed to achieve a primary objective without "objectionable behavior." In some problems the solution may yield infinite-bandwidth controllers and in others multiple solutions may exist. The students should be able to overcome such issues using insight from the problem physics and applying analytical tools (e.g., time/frequency responses, simulations with disturbances/noise, etc.).

Person preparing this description and date of preparation: K. Tsakalis, June, 2021.