ECE 3710
Spring 2008
Severance

Course Syllabus
Linear Systems

Professor: Dr. Frank L. Severance
office: A-239, Parkview Campus
office phone: 269-276-3161
home phone: 269-372-2237
e-mail: *frank.severance@wmich.edu*

Office Hours:

Monday:	10:00 to 11:00 am
Wednesday:	10:00 to 11:00 am
Thursday:	10:00 to 11:00 am
Friday:	10:00 to 11:00 am

Prerequisites:

Electrical Engineering:	ECE 210 (Electrical Circuits) ECE 310 is a must
Mathematics:	MTH 272, MTH 374 (Calculus, Differential Equations and Matrices).
Computer Science:	CS 111 or ECE 2510 is helpful.

Text: [required]: Electric Circuits (sixth edition) by J. W. Nilsson and S. A. Riedel; published by Prentice Hall, 2000.

Course Objectives: As a student you should be able to...

1. Solve a linear initial value problem using Laplace transforms
2. Pose a linear circuit as a Laplace system
3. Find the transfer function of a linear system
4. Solve a linear system with a well posed deterministic input signal
5. Create the Bode plots of a linear system
6. Design and analyze low pass, high pass and band pass filters
7. Describe an arbitrary signal in terms of its Fourier coefficients
8. Find both the trigonometric and complex form of Fourier series
9. Compute the Fourier transform of an arbitrary signal
10. Solve linear circuit problems using Fourier transforms

Grading: There will be seven assignments due each Monday throughout the course. Each of these will be graded and returned at the next class period. Also there will be several " opportunities" to demonstrate your facility in class material, two quizzes (30 minutes each) and two tests (50 minutes each) and one comprehensive final examination (two hours). The relative weight of each will be as follows:

10 assignments:	**10**%
3 tests (20% each):	**60**%
1 final examination:	**30**%

The final grading scale will be based on overall class performance. Historically, the class GPA has been approximately 2.20. Your interim grades and class standing will be published after each " opportunity" (test). If there are any questions or concerns, do not hesitate to discuss them with me.

Academic Integrity:

This is a mathematically oriented engineering science course. As such, it will be conducted in a lecture/discussion format. In class we will do a number of examples (all of which are fair game for tests) and you are expected to study primarily by doing a number of analogous exercises. Even-so, please note that all graded work, including homework assignments, is expected to be your own. Failure to observe this rule will result in action by the office of *Student Judicial Affairs* and may result in a failing grade for the course.

Course Description:

ECE 3710 is a course in the principles of mathematical modeling of physical systems. The principles will be taught in the traditional lecture/test format while the practice will require several computer assignments using MatLab. This course satisfies all ABET design requirements Roughly speaking we will cover chapters 1 through 9. Specific topics include…

Course Topics

Introduction
- Control systems
- Open loop
- Closed loop
- Mechatroninc Systems

Mathematical Modeling of Physical Systems
- Linear systems
- Transfer functions
- Block diagrams
- System flow graphs
- Physical systems Mechanical systems
  - rectilinear
  - rotational
- Fluid systems hydraulic
  - pneumatic
- Thermal systems

State Variable Models
- State variables
- State differential equations

Feedback Control Systems
- Error signal analysis
- System sensitivity
- Disturbance signals
- Steady-state error

Performance of Feedback Systems
- Second order systems
- Adding poles and zeros
- S-plane analysis
- Transient response
- System design

Stability of Linear Feedback Systems
- BIBO stability
- Routh-Hurwitz stability criterion
- Relative Stability

Root Locus Techniques
- Mathematical foundations
- Graphical root locus algorithms
- Sensitivity
- Software implementation
- Examples

Frequency Response Methods
- Bode Plots
  - Theoretical
  - Linear Approximation
  - Experimental
- Empirical derivation of transfer functions

Stability in the Frequency Domain
- Contour maps in the s-plane
- Nyquist criterion
- Relative stability
- Time-domain vs. Frequency domain analogies
- System bandwidth
- Transport delays
- Examples

Class Procedure:

i. The magic formula to succeeding in this course has two parts: attend each class and do all the assigned homework. Simply put, as in any mathematics class, you will need lots and lots of practice.

ii. There will be seven homework assignments from the Dorf text. Each of these should be done on your own and with care. In particular, each submission should have an appropriate cover page and each problem should be clearly stated and labeled. Use a separate page for each problem. Presentation quality is the order of the day.

iii. Answers to all assignments will be published when the problem set is returned to you. Therefore, late assignments will not be graded.

iv. If you don' t wish to take homework seriously, please do not submit anything. It simply wastes both your time and mine. The purpose of homework is primarily for your feedback; I do not need it to give you a grade.

vi. Tests and quizzes will be announced well in advance and there is no provision made for make-up exams.