The Proposed Norden ECE MS Program

by

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The following is a proposed program to be offered on-site at Norden by Fairfield University's School of Engineering. This program will lead to a Master of Science in Electrical and Computer Engineering.

1. Characteristics of ECE Graduates

Electrical and Computer engineering embodies the science and technology of design, construction, implementation, and maintenance of software and hardware components of modern electrical, electronics and computing systems. The discipline of has emerged from the traditional fields of electrical engineering and computer science as a separate, although intimately related, discipline.

Our graduates are solidly grounded in the theories and principles of computing, mathematics, science, and engineering and apply these theories and principles to design hardware, software, and processes and to solve technical problems. Continuing advances in computing and electrical systems have created opportunities to apply these developments to a broad range of applications in engineering.

Our graduates work in most industries, including the computer, aerospace, telecommunications, power, manufacturing, defense, and electronics industries. They design high-tech devices ranging from tiny microelectronic integrated-circuit chips, to powerful systems that utilize those chips, to efficient telecommunication systems that interconnect those systems. Applications include consumer electronics (CD players, televisions, VCRs, stereos, microwaves, gaming devices), advanced microprocessors, peripheral equipment, and systems for portable, desktop and client/server computing, communications devices (cellular phones, pagers, personal digital assistants), distributed computing environments (local and wide area networks, wireless networks, Internets, Intranets), embedded computer systems (such as aircraft, spacecraft, and automobile control systems in which computers are embedded to perform various functions), and a wide array of complex technological systems, such as power generation and distribution systems and modern computer-controlled processing and manufacturing plants.

In addition to mathematics and science, our graduates may have a solid foundation in electronics, logic design, computer organization and architecture, and networking, as well as an understanding of software design, data structures, algorithms, and operating systems.

Our students get a strong laboratory experience, using modern laboratory environments,
industry standard hardware and software design tools. The ECE program fosters creativity, developing strong problem solving, design, and analysis skills with the ability to think logically.
Our students have good verbal and written communication skills.
Finally, our graduates realize that technology is rapidly changing,

and therefore, to be successful, they must to continue to learn throughout their careers.

2. Java for Programmers I

School of Engineering Graduate Course Catalog 2000-2001:
A programming course introducing the fundamentals of Java to experienced programmers. Coverage includes the Java elements: objects, classes, variables, methods, syntax, reserved words, data types, operators, control structures, and container data structures. Object-oriented programming is integral to the course and is taught throughout. Accordingly, the concepts of encapsulation, inheritance, polymorphism, packages, interfaces, and inner classes are presented. The course teaches screen design using classes and graphics from Sun's Application Programming Interface (API). Data handling taught includes input from the keyboard, output to the screen, input from files, and output to files. Finally, the concept of multi-threading is introduced in preparation for follow-on studies. Lab included. Prerequisite: Significant programming experience or CS132 or CS134). Note: This course may be substituted for SW403 in order to meet the requirements for core courses.
Note: This course may be substituted for SW 403 in order to meet the requirements for core courses.

Textbook: *Java for Programmers, by D. Lyon.*
Computer Usage: Students **MUST** have access to a computer with a Java compiler. E-mail access is required.
Course Notes: Handouts/diskettes/e-mail
When: Fall Semester, Monday, 6:30- 9:20, Thursday, 6:30-9:20, Saturday 9AM – 12PM
Where: Bannow Science Center, Room 257
Who: Mr. Marquis (Saturday) Dr. D. Lyon (Monday and Thursday)

Phone: (203)641-6293
Fax: (203)877-4187
E- mail: maynard_marquis_99@yahoo.com, lyon@docjava.com
Web Page: http://www.docjava.com
Office Hours:
Monday, Wednesday or Thursday; 6 pm - 6:30 pm in class room (Dr. Lyon)
Monday, Wednesday or Thursday; 5 pm - 6:00 pm in Mc108 (Dr. Lyon)
Or by appointment (Dr. Lyon).
Saturday, 8:30 – 9:00 AM in classroom (Mr. Marquis)

Course Learning Goals: 1 – To teach how to write computer code in Java.
2 – To provide the means to leverage object-oriented programming.
3 - To prepare the student for advanced courses in Java.

Student Activities: Learning a new computer language is very much a hands-on activity, which cannot be learned from lectures or textbook reading alone. It does require those lectures and textbooks, but the real learning results from the laboratory trials and the homework assignments. To achieve the course objectives, the student must have good class attendance and participation, conduct the computer programming tasks during the laboratory periods as well as the assigned homework. Homework assignments and laboratory trials are due at the beginning of the class following the assignments. They are to be placed in an envelope containing the student's name. The contents of the envelope will be a diskette and a paper copy of the requested Java source code.

Course Requirements: The schedule of activities and topics to be covered each week are outlined below. Each week will begin with responses to questions and a brief review on the previous week's topics. The first week will begin with administrative announcements and a review of this syllabus.
Join the List: Every student should join the e-mail list for the course, available on the bottom of the Visual Programming in Java SW408 web page at:
<http://www.docjava.com/java/sw406/syllabus/jointhej.htm>

Week 1- Introduction to Java and Object-Oriented Programming
1 - Java Introduction including the Java & HTML Models, What is Java?
2 - O-O Design including, Objects, Classes, Class Concepts and Class Hierarchy.
3 - Java Syntax and syntax example
4 - Java Packages, Application structure, Class structure, and Method structure.

Goals: To define the characteristics of O-O design and show an O-O example the first day. To provide an understanding of class hierarchy. To introduce those portions of Java Basics necessary to show the O-O example.
Outcome: Students can write and run hello world.
Outcome: Students can set up a small class hierarchy, with mammals, humans, students and professors.
Outcome: Students can display a class hierarchy graphically using the code warrior IDE.

Week 2 - Java Data Types and JavaDoc
1 - Reserved Words, Case Sensitivity
2 – Reference vs. Primitive Data Types
a – signed, vs. unsigned
b – fixed, vs, floating
c – 8 primitive data types
3 – Operators & Control Structures
4 – Introduction to JavaDoc
a – Introduction
b – JavaDoc tags
c – JavaDoc in CodeWarrior
d - Summary

Goals: To introduce basic elements of the Java language, which permit the writing and documentation of simple programs.

Outcome: The student will be able to write a Java program that demonstrates a class hierarchy, inheritance, and a simple degree of polymorphism. He or she will also be capable of documenting the program code using JavaDoc.

Weeks 3 – Java Basics

1 – Classes, Overloaded Methods, Constructors
2 – Getter and Setter Methods, Casting
3 – Reserved Words, null and super
4 – Modifier Static (methods & variables)
5 – Modifier Abstract (Classes & methods)

Week 4 - Important Java Concepts

1 – Reserved Word, this
2 – Interfaces (implementing in classes and extending other interfaces, more inheritance & polymorphism).
3 – Summary

Goals: To teach the student the concepts of static and abstract objects, and of interfaces, important tools in Java for Object-Oriented programming.
Outcome: The student will be able to write a program that demonstrates the use of static variables and interfaces in object-oriented programming, using a customer billing problem.

Weeks 5 - Important Java Concepts

1. packages
2. Modifier Visibility, Class Scope
3. Inner Classes (and again class scope)

Goals: To provide the student with the Java concepts that give object-oriented programming its modularity and extendibility benefits.
Outcome: The student will be able to control the scope of a variable or method. He will be able to use the concept of Abstract Methods and Interfaces to amplify and further demonstrate O-O inheritance and polymorphism.

Week 6 - Wrapper Classes Arrays and Vectors

1 – Methods in their Wrapper Classes, pp. 100-104,
2 – Casting, pp. 275
3 – Arrays – their construction, passing variables, pp. 407-67
4 – Vector Class and its methods, pp. 446-447

Goals: To provide the student with the means to manipulate data within his or her program, converting from one data type to another. To also provide the student with a means of grouping the data into the containers, arrays and vectors.
Outcome: The student will be able to write Java programs containing large amounts of data in an efficient manner. He will also be able to increase and demonstrate the efficiency, in terms of lines-of-code, of O-O programming using the containers.

Week 7 - Strings and Processing

1 – String Class
2 – String constructors
3 – String methods
4 – StringBufferClass
5 – StringTokenizerClass

Goals: To provide the student with the means to work with text-type data in Java programs.
Outcome: The student will be able to create, read, and parse text using Java programs.

Week 8 - Review for the midterm

Week 9 – Midterm Exam. An objective test, with multiple choice, fill-in the blank and code sample type questions.

Week 10 - Review Midterm Exam, Exceptions

1 – The try block
2 – throw and throws
3 – The catch block
4 – The finally block

Goals: To expose and explain Java exception handling to the students.
Outcome: The student will be able to create exception handling in Java programs, and he or she will be able to respond to requests for exception handling when using someone else's code.

Week 11-12 – Graphical User Interface Components and Listeners

1 – GUI Components: Frames, Labels, Buttons
2 – Event Listeners: WindowListener, ActionListener

Goals: To give the student the components necessary to create computer screen displays and to respond to events occurring on the screen.
Outcome: The student will be able to place GUI components onto a computer screen and to respond to events such as a mouse click or the push of a button.

Week 12

– Container Layouts: FlowLayout, GridLayout

Goals: To provide the means of arranging and manipulating GUI components in desired patterns on the computer screen.
Outcome: The student will be able to design functional and aesthetic displays on the computer screen using Java classes and using CodeWarrior.

Week 13 - File I\O, input & output streams

1 – Class hierarchy of java.io
2 – Input Stream, OutputStream
3 – Reader, Writer

Goals: To teach the student the techniques used in Java to transfer data to and from computer files.
Outcome: The student will be able to create files and read from computer files using Java. In particular, he or she will be able to create or read from files in the ASCI text format.

Week 14 - review for the final
Week 15 – Final Exam, An objective test, with multiple choice, fill-in the blank and code sample type questions.

Morelli Chapter 12, Recursive Problem Solving and Chapter 16, Data Structures, are not peculiar to Java and will only be covered as time permits. Some of the Data Structures, Arrays and Vectors, are covered in Week 6. Morelli Chapter 4, Applets, is not essential in a fundamental course and will not be covered. Chapter 15, Sockets and Networking, will not be covered in this course, and is relegated to an advanced course.

Additional References:
1 – Sun's Application Programming Interface, available in CodeWarrior.
2 – *Java How to Program*, Deitel & Deitel, Prentice Hall, Third Edition, 1999.
3 – *The Java Class Libraries*, Chan and Lee, Addison Wesley (c) 1997.
4 – *Java Source Book*, Ed Anuff, The John Wiley and Sons, Inc., First Edition, 1996.
5 – *The Java Programming Language*, K. Arnold & J. Gosling, Addison Wesley, Second Edition.
Grading:
1/3 Homework and Projects
1/3 Midterm
1/3 Final

Computer Usage:
Web and e-mail access are ***REQUIRED.*** You **MUST** have access to a computer with a Java compiler.
References:
The Java Class Libraries by Chan and Lee, Addison Wesley (c) 1997. See http://www.docjava.com for ordering this and other books.
Java Source Book by Ed Anuff, The John Wiley and Sons, Inc., First Edition, (c)1996.
Course Notes, as required, available on-line at http://www.docjava.com or by purchase of copies.
The Java Programming Language, Second Edition, by Ken Arnold and James Gosling, Publisher: Addison-Wesley, ISBN: 0-201-31006-6
Java 1.1 Unleashed, by Morrison, ISBN 1575213613
Core Java 2 Volume 1:Fundamentals by Cay Horstmann,Gary Cornell, ISBN: 0130819336
Java 1.2 Developer's Handbook by Philip Heller Simon Roberts, ISBN: 0782121799
Digital Signal Processing Recipes in Java by D. Lyon and H. Rao, M&T Books, (c) 1998.
Image Processing in Jav *a* by D. Lyon (c) 1999.

Goals:
To learn how to design large-scale software systems using Java. Object orientation and packaging are stressed. Testing and coding of several projects, with a variety of modern techniques.
Coordinator:
Douglas Lyon, Professor of Computer and Software Engineering. *E-mail*: lyon@docjava.com

Assignments will be due at the beginning of class. Assignments handed in after the beginning of class will loose 5 points. Assignments handed in after the end of class will lose 10 points. Late homeworks lose 10 points per day late, weeks ends and holidays included. Missed tests result in a zero unless a written excuse is presented.
More details are available about the class at: http://www.docjava.com

Homework requirements:
Print out a listing of the program. Print out the program input and output. You may need to do this at various levels of detail. Hand in a labeled disk with a printout. Place the disk in a #10 letter envelope and staple the envelope to the printout.
In the event that you *must* miss class, you may hand the homework in via a friend or another student. Should you find that you cannot find anyone in time, you must fax the homework in. Attachments will not be accepted. The fax number for homework is:(203)254-4013 fax. This is the School of Engineering fax machine, so please bring the homework to my attention so that it gets routed to me.

3. Java For Programmers II

Description
A second Java programming course covering more advanced Java programming. Topics include: Using Javadoc, Exceptions, Threads, Packages, nested and inner classes with an emphasis on sound object-oriented design using design patterns, Introspection, I/O, Persistence and advanced API topics, as time permits.

Prereq: SW408, or permission of the instructor.
Textbook: *Java for Programmers, by D. Lyon*. Copies are available from the SOE office**Computer Usage:** Students **MUST** have access to a computer with a Java compiler. E-mail access is required. **E-mail** access is required.
Course Notes: Handouts/diskettes/e-mail, web page
When: Wednesday, 6:30-9:15 pm,
Where: Mc102
Who: Prof. Lyon
Phone (203)641-6293
Fax (203)254-4013 fax
Web: http://www.DocJava.com

Office Hours: **Tuesday, Wed. Thurs; 3:30 pm - 5:30 pm in Mc209 (Dr. Lyon)**
Or by appointment (Dr. Lyon).
Pre-req by Topic

15. Threads
15.1 Concurrency, Multi-tasking, and Multi-Threading,
15.2 Making a new Thread
15.3 Thread States
15.4 Synchronized and Too Much Beer
15.5 Thread Groups
15.6 The Thread Manager
15.7 ThreadUtil
15.8 The Thread Queue
15.9 Running Thousands of threads
15.10 The Poor Mans' Thread
15.11 The Job Thread
15.12 Summary
15.13 Exercises
16. Nested Classes and Interfaces
16.1 The Member Inner Class
16.2 The Local Inner Class
16.3 The Anonymous Inner Class
16.4 The Nested Static Class
16.5 The Nested Interface
16.6 Summary
16.7 Exercises (to be added)
17. Readers and Files
17.1 ReaderUtils
17.2 The Dialog Class
17.2.1. Class Summary
17.2.2. Class Usage
17.3 The FileDialog Class
17.3.1. Class Summary
17.3.2. Class Usage
17.4 Futil Helper Methods
17.4.1. Futil.getReadFile
17.4.2. Futil.getWriteFile
17.4.3. Using Swing to get a File
17.4.4. Futil.getDirFile
17.5 The File Class
17.5.1. Class Summary
17.5.2. Class Usage
17.6 The FilenameFilter interface
17.6.1. Class Summary
17.6.2. Class Usage
17.6.3. DirFilter
17.6.4. The FileFilter Class
17.6.5. The WildFilter Class
17.7 The Ls Class
17.7.1. Ls.getWildNames
17.7.2. Ls.wildToConsole
17.7.3. Ls.getDirName
17.7.4. Ls.deleteWildFile
17.7.5. Ls.WordPrintMerge

25.5 Exercises
26. Graphics
26.1. The Graphics Class
26.1.1. Class Summary
26.1.2. Class Methods
26.1.3. The Radar Class
26.2. The Color Class
26.2.1. Class Summary
26.2.2. Class Usage
26.2.3. Adding Color to the Radar
26.2.4. Building a Color Map
26.2.5. The Color Grid
26.3. The FontMetrics Class
26.3.1. Class Summary
26.3.2. Class Usage
26.3.3. How to Draw a String with a Background
26.3.4. How to Draw a Vertical String, The Target Class
26.4. Charts
26.4.1. The LineGraph class
26.4.2. The BarGraph class
26.4.3. The PieGraph Class
26.5. Images
26.5.1. The ImageUtils class
26.5.2. The ImageFrame class
26.5.3. The WriteGIF class
27. Spiral Components
27.1 The Spiral Class
27.2 Archimedes' Spiral
27.3 Fermats' Spiral Component Class
27.4 Exercises

Grading:
1/3 Homework and Projects
1/3 Midterm
1/3 Final

Computer Usage:
Web and e-mail access are ***REQUIRED.*** You **MUST** have access to a computer with a Java compiler.
References:
The Java Class Libraries by Chan and Lee, Addison Wesley (c) 1997. See http://www.docjava.com for ordering this and other books.
Java Source Book by Ed Anuff, The John Wiley and Sons, Inc., First Edition, (c)1996.
Course Notes, as required, available on-line at http://www.docjava.com or by purchase of copies.
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Coordinator:
Douglas Lyon, Professor of Computer and Software Engineering. *E-mail*: lyon@docjava.com

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4. Engineering Applications of Numerical Methods

ECE 415 Engineering Applications of Numerical Methods

Instructor: Dr. Jerry Sergent
E-Mail: jsergent@mail.fairfield.edu

Description:

Skills in numerical integration and differentiation, numerical solutions of differential equations, data interpolation, and simulations of processes and systems provide the theoretical basis to proceed to computer graphics, voice and signal processing, and modeling.

Prerequisites: SW 408, Corequisite SW 409

Objectives and Outcomes

No.	Objective	Outcome
1	To understand the constraints, limitations, and potential errors of digital computers used to obtain numerical solutions of mathematical expressions	Students will derive equations and write programs to calculate the errors generated when digital computers are used to obtain numerical solutions of mathematical expressions
2	To develop methods for finding numerical solutions to the roots of equations	Students will derive methods and write programs to determine the roots of equations using the Newton-Raphson and other methods
3	To develop methods for solving sets of simultaneous linear equations	Students will derive methods and write programs to solve sets of simultaneous linear equations using the Gauss-Jordan and other methods
4	To develop mathematical expressions for related data sets	Students will derive methods and write programs to determine mathematical expressions for related data sets
5	To develop methods for numerical differentiation and integration	Students will derive methods and write programs to differentiate and integrate mathematical expressions using Simpson's rules and other methods
6	To develop methods to solve ordinary differential equations	Students will derive methods and write programs to solve ordinary differential equations using the Runge-Kutta and other methods

Textbook: Numerical Methods for Engineers, 4th Edition, Steven Chapra, Raymond P. Canale, McGraw-Hill, 2002,ISBN 0-07-243193-8

Performance Indicators and grading:

The final grade will be based on the homework. The homework will be turned in at the beginning of the class lecture. Students will keep a comprehensive notebook of all problems. All homework will be done in Java.

Homework, Class Participation 100%

Class structure:

Lectures will be the primary source of information. Students are expected to attend every class and to participate in class discussions. Homework assignments will be completed each week and reviewed.

Schedule: Thursday night, 6:30 pm to 9:30 pm

January 22 through May 13, 2004

Schedule

Week	Subjects	Chap.	Problems	Objective
1	**Introduction**	1,2	1.1 – 1.9, 1.15 2.1, 2.5, 2.10, 2.14, 2.15	1
2	**Approximations and Round-off Errors** **Truncation Errors**	3,4	3.6, 3.7, 3.8, 3.10 4.1, 4.2, 4.6, 4.7, 4.8, 4.10, 4.12,	1
3	**Roots of Equations**	5,6	5.1 – 5.12 6.1 – 6.13, 6.22 – 6.24	2
4	**Roots of Equations**	7,8	7.1 – 7.9, 7.12, 7.19 8.18, 8.32, 8.36	2
5	**Solution of Linear algebraic Equations**	9, 10	9.1 – 9.12 10.2 - 10.9	3
6	**Solution of Linear Algebraic Equations**	11, 12	11.1 – 11.10 12.13, 12.14, 12.25, 12.27, 12.28, 12.31	3
7	**Curve Fitting**	17, 18	17.1 – 17-16 18.1 – 18.13	4
8	**Curve Fitting**	19, 20	19.1 – 19-9 20.48, 20.49	4
9	**Numerical Differentiation and Integration**	21	21.1 – 21.20	5
10	**Numerical Differentiation and Integration**	22	22.1 – 22.9	5
11	**Numerical Differentiation and Integration**	23, 24	23.1 – 23.9 24.18, 24.25 – 24.27, 24.41	5
12	**Ordinary Differential Equations**	25	25.1 – 25.11	6
13	**Ordinary Differential Equations**	26	26.1 – 26.8	6
14	**Ordinary Differential Equations**	27, 28	27.1 – 27.12, 27.23 28.21, 28.25, 28.36	6
15	**Final Homework Book Due**			

5. Voice and Signal Processing

Course Name & Number: Voice and Signal Processing
Instructor: Prof. D. Lyon
Home Phone:
Business Phone:
E-mail: lyon@docjava.com
FAX: (203)877-4187
Instructor Assistance: (additional support prior to and/or after class)
Lecture Hours: 3 hours per week starting at 6:30PM
Lab Hours: 0 hours per semester

Course Description:

Overview of Digital Audio and its application Current state of streaming Audio on the Internet Digital Audio Processing Fundamentals. This course applies transform concepts and applied multi-media object-oriented programming.

Students will apply the theories of Sampling, Spectra, Fast Fourier Transform Class, convolution and frequency space processing, compression and one-dimensional streaming.

Students will apply the theories by creating programs that read processing and write audio streams. They are exposed to the elements of multi-media network delivery of data. They learn about a wide class of FFT algorithms and elementary sound synthesis.

This course requires substantial programming effort and emphasis is place on good software engineering practices.

Students will learn enough signal processing to take Image Processing, the follow-on course.

Learning Objectives for Voice and Signal Processing

This course designed to support the signal processing and computer systems domain in the CE BS degree.

When the course is done, Students will have deployed Java applications of their own design, on the web. These applications will demonstrate the usage of Java for real-time voice and sound processing.

1. The students will learn the principles of Digital Signal Processing.
   Expected learning outcomes:
   a. Applies transform concepts in programming situations
   b. Recognizes interrelationships among signals and spectra
   2. The student will become proficient with the usage of the Java language.
   Expected learning outcomes:
   a. Demonstrates the ability to utilize Java in practical signal processing problems.
   b. Uses appropriate object-oriented design patters to solve problems.
   After the student take this course, they will know how to write programs that display and manipulate 1D waveforms. They will also have a basic understanding of constructive and destructive synthesis. Finally, the

students will make use of data structures, linear algebra, design patterns and basic software engineering.

This course requires substantial programming effort and emphasis is place on good software engineering practices.

Outcomes:

When the course is done, Students will have deployed Java applications of their own design, on the web.

Performance Indicators:

Aside from the basics assessment procedures based on homeworks and tests, Students must obtain 75% or better on all tests. Additionally, students must perform at least 75% on the homeworks.

Textbook: Java Digital Signal Processing by Douglas Lyon

Reference Material: Digital Audio with Java, by Lindley

Course Requirements:

All homework is to be submitted on time.

The course includes three reporting periods (exam, quiz, project, etc.) and a comprehensive final.

Topics :

1. Overview of Digital Audio and its application

Current state of streaming Audio on the Internet

Problems and solutions

2. Digital Audio Processing Fundamentals

Sampling

Spectra

3. The AudioFrame Class

internal data structures

the AudioStream

the AudioDataStream

doubleData

ulawData

the AudioPlayer

building the menu

intercepting menu event

intercepting keyboard events

4. Audio Files

Audio file formats

u-law companding in the Sun AU files

decoding u-law

encoding u-law

reading

writing

playing

graphing

5. Wave Table Generation

Sine

Triangle
Square
Sawtooth

6. Audio Processing
   Delay, echo vs. reverb
   The Discrete Fourier Transform
   The Inverse DFT
   The Fast Fourier Transform Class
   The Inverse FFT method
   Fast Convolution using the FFT
   Power Spectral Estimation
   Frequency shifting using the FFT
   Filtering using FFT
7. Sound Synthesis
   Additive Synthesis
   Subtractive Synthesis
8. Generalized Modulations
   AM
   FM
9. Object Oriented Design Patterns and signal Processing
   Producer consumer

References

10. Wavelets in Computer Graphics11. Transform compression techniques
12. Multi-media application
13. Telephony
14. Streaming Audio

Attendance Policy: Students are responsible to acquire notes and homework assignment from classmates in case of absence.

Grading:

	Weighted	
Midterm	1/3	
Final Examination	1/3	
Homework	1/3	includes tests, quizzes, projects, etc.

6. Image Processing

Fairfield University

School of Engineering

Course Name & Number:	Image Processing
Instructor:	Prof. D. Lyon
Home Phone:	
Business Phone:	
E-mail:	lyon@DocJava.com
FAX:	(203)877-4187
Instructor Assistance:	(additional support prior to and/or after class)
Lecture Hours:	3 hours per week starting at 6:30PM
Lab Hours:	0 hours per semester

Course Description:

A first course in Image Processing; Image algebra,arithmetic operations,boolean operations, matrix operations

Achromatic and Colored Light

Selecting Intensities, Gamma Correction

Chromatic Color, psychophysics, Color models

Color Space Conversion, low-level pattern recognition.

Students will learn the theory of 2-D Fast Fourier Transform Class, 2D convolution and frequency space processing, compression and 2D streaming.

Students will apply the theory by creating programs that read processing and write image streams. They are exposed to the elements of multi-resolution multi-media network streaming. They learn about a wide class of transforms, including Wavelets, DCT, the PFA FFT and others.

This course requires substantial programming effort and emphasis is place on good software engineering practices.

Students will learn enough signal processing to write their image processing applications.

Prerequisite – PreReq: ECE 304 Voice and Signal Processing

Learning Objectives for Image Processing

This course designed to support the signal processing and computer systems domain in the ECE degree.

When the course is done, Students will have deployed Java applications of their own design, on the web. These applications will demonstrate the usage of Java for image processing.

1. The students will learn the principles of Image Processing.
   Expected learning outcomes:
   a. Applies transform concepts in programming situations
   b. Recognizes interrelationships among signals and spectra
2. The student will become proficient with the usage of the Java language.
   Expected learning outcomes:
   a. Demonstrates the ability to utilize Java in practical image processing problems.
   b. Uses appropriate object-oriented design patters to solve problems.

After the student take this course, they will know how to write programs that display and manipulate 2D images. They will also have a basic understanding of image filtering. Finally, the students will make use of data structures, linear algebra, design patterns, voice and 1D signal processing.

This course requires substantial programming effort and emphasis is place on good software engineering practices.

Outcomes:

When the course is done, Students will have deployed Java applications of their own design, on the web.

Performance Indicators:
Aside from the basics assessment procedures based on homeworks and tests, Students must obtain 75% or better on all tests. Additionally, students must perform at least 75% on the homeworks.
Textbook: Image Processing, in Java by Douglas Lyon
Reference Material: Java Digital Signal Processing, By Dougas Lyon
Course Requirements:
All homework is to be submitted on time.
The course includes three reporting periods (exam, quiz, project, etc.) and a comprehensive final.
Topics :
Topics: (coverage will be altered to encompass the latest APIs)

- Week 1: Using the AWT - The new Event model
  - The Graphics Class
    - Test Patterns
      - Color Bars
      - resolution chart
      - multi-burst test chart
      - Snell and Wilcox test chart
  - Interaction
    - The mouse
    - The keyboard
    - The Evt class
  - building the menu
    - intercepting menu event
    - intercepting keyboard events
- Week 2: The Model-View Approach
  - observables and the dialogs boxes
    - Int Dialog
    - Float Dialog
    - File dialogs
  - The ImageFrame Class
    - oldPixels
    - newPixels
    - menu construction
- Week 3: Streams
  - File input stream
  - stream tokenizer
  - closing a file
  - token flags
  - writing files
  - summary for writing files
  - Save File Example/ set-up main menu bar
  - Process menu pick - save
- Week 4: Digital Image Processing Fundamentals
  - Overview of Image Processing and its application
    - Image Storage and Display
      - image models
      - cameras video and scanners
  - Current state of streaming video on the Internet
    - Problems and solutions

- Sampling
- Spectra and Spectra
- Preview of Image processing

Week 5: The PixelPlane Class

- range checking
- PixelGrabbers
- internal data structures
  - the ImageStream
  - the ImageDataStream
  - Image doubleData
- Reading and Writing Images
- Reading GIF and JPEG
- Writing GIF
- Reading PPM
- Writing PPM

Week 6: Edge Detection

- Roberts, Prewitt, Frei-Chen,
- Kirsch, Sobel,
- boxcar, pyramid, argyle, Macleod,
- derivative of Gaussian, Robinson,
- Canny
- Laplacian generation, Laplacian of Gaussian
- Hat

Week 7: Boundary Processing

- XY to Vector Conversion
- vector ordering using Dijkstras' algorithm
- Edge following and Martellis' algorithm
- Divide-and-conquer boundary detection
- Range finding via diffraction
- Range map to boundary representation

Week 8: Image Enhancement Techniques

- Blur
  - mean, median, unsharp
- smoothing binary images by association
- local area contrast enhancement
- histogram equalization
- lowpass filtering
- highpass filtering
- averaging multiple images

Week 9: Achromatic and Colored Light

- Selecting Intensities-Gamma Correction in Java
- Chromatic Color
  - psychophysics
  - Color models (CIE, RGB, YUV, CMY, HSV, YIQ)
- Color coordinate systems
  - RGB to L*u*v*, L*u*v* to RGB
  - RGB to L*a*b*, L*a*b* to RGB
  - RGB to XYZ, XYZ to RGB
  - RGB to YIQ, YIQ to RGB
  - RGB to YUV, YUV to RGB
  - RGB to HSV, HSV to RGB
  - RGB to HLS, HLS to RGB

Week 10: Thresholding techniques

Global thresholding
multilevel thresholding
variable thresholding
thresholding using image statistics
using mean and standard deviation
using maximization of between-class variance

Week 11: Morphological filtering
set theory
arithmetic operations
boolean operations
erosion and dilation
medial axis transform
skeletonization

Week 12: Warping
scaling
rotation
shear
cutting and pasting
conformal image mapping
warping

Week 13: The Cosine Transform
The Discrete Cosine Transform
The Inverse Discrete Cosine Transform
The Fast Cosine Transform Class
Reading and Writing JPEG Images

Week 14: The InLine MPEG CODEC
Compressed MPEG movies images
decoding MPEG
encoding MPEG
reading MPEG files
writing MPEG files
displaying MPEG files
measuring loss
Implementing in-line Java Decoders

Week 15: The Wavelet Transform
The Discrete Wavelet Transform
The Inverse Discrete Wavelet Transform
The Fast Wavelet Transform Class
Writing a wavelet encoded file
Decoding the wavelet encoded file
Incorporating the decoder with the data
Distribution of wavelet images on the Net.

Attendance Policy: Students are responsible to acquire notes and homework assignment from classmates in case of absence.

Weighted

Grading:

Midterm	1/3	
Final Examination	1/3	
Homework	1/3	includes tests, quizzes, projects, etc.

7. Microwave Structures

Course Description:

This course considers the generation and transmission of electromagnetic waves. Maxwell's equations and the generation of radiation by currents and charges in free space are covered, followed by the propagation of waves in various media. Structures used in microwave propagation, including transmission lines, waveguides, resonators, and antennas are also considered.

Objectives and Outcomes

No.	Objective	Outcome
1	To understand how electromagnetic signals are generated.	Students will analyze the methods by which electromagnetic signals are generated by both moving and static charges
2	To understand how electromagnetic signals are propagated through various media	Students will analyze and solve Maxwell's equations for propagation in different media
3	To understand how electromagnetic structures such as waveguides, resonators, and antennas operate	Students will analyze and design waveguides, resonators, and antennas for various applications.

Textbook: Electromagnetic Waves, David H. Staelin, Ann Morgenthaler, and Jin Au Kong, Prentice-Hall, 1994, ISBN: 0-13-225871-4

Performance Indicators and grading:

Three written exams will be given at approximately equal intervals during the term as outlined in the syllabus. These will be primarily take-home exams requiring the analysis and/or design of electromagnetic generation and propagation systems and devices.

Exam 1	30%
Exam 2	30%
Exam 3	40%

Class structure:

Lectures will be the primary source of information. There will be several class projects during the term. Students are expected to attend every class and to participate in class discussions.

Wk	Subjects	Chap.	Problems	Objective
1	Review of electromagnetic fields	1	Handouts	1

2	Maxwell's equation and waves	1	Handouts	
3	Maxwell's equation and waves	1	Handouts	1
4	Radiation by currents and charges in free space	2	Handouts	1
5	Waves in media Exam 1 (Chapters 1-2)	3	Handouts	2
6	Waves in media	3	Handouts	2
7	Waves at planar boundaries	4	Handouts	2
8	Transmission lines	5	Handouts	3
9	Transmission lines	5	Handouts	3
10	Transmission line systems Exam 2 (Chapters 2-5)	6	Handouts	3
11	Waveguides	7	Handouts	3
12	Resonators	8	Handouts	3
13	Antennas	9	Handouts	3
14	Antennas	9	Handouts	3
15	Exam 3 (Chapters 1-9)			

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8. Nonlinear Control

Description:

The course considers the fundamentals of the analysis of linear electric circuits. The properties of the components that make up electrical circuits, including resistors, capacitors, inductors, voltage sources, and current sources are presented. Both independent and dependent sources are considered. The Kirchhoff current and voltage laws are applied to electrical networks to determine voltages and currents at all points in the network. Circuit behavior is analyzed for DC, AC, and transient excitation. First and second order differential equations with constant coefficients are applied to the transient case to achieve the solution. The properties of dependent sources are studied by analyzing the operational amplifier, a basic building block of electronic circuits. Concepts of transformers and three-phase circuits are introduced. Computer simulation is used to verify the analytical solutions.

Textbook: Nonlinear Systems, Third Edition, Hassan K. Khalil, Prentice Hall, 2002, ISBN 0-13-067389-7

Objectives and Outcomes

No.	Objective	Outcome
1	To understand the properties of second-order control systems	Students will analyze second order control systems to determine performance for a given set of initial conditions
2	To understand the criteria for the stability of nonlinear control systems	Students will determine if a control system is stable for a given set of initial conditions
3	To analyze the effect of small perturbations on the performance and stability of nonlinear control systems	Students will introduce small perturbations in computer models of control systems to determine performance and stability for a given set of initial conditions
4	To understand how the analysis of nonlinear control systems may be performed using linear methods	Students will analyze nonlinear control systems using piecewise linear methods for a given set of initial conditions

Performance Indicators and grading:

Three written exams will be given at approximately equal intervals during the term as outlined in the syllabus. These will be primarily take-home exams requiring the analysis and/or design of nonlinear control systems

Exam 1, Chapters 1-5	35%
Exam 2, Chapters 6-10	35%
Exam 3, Chapters 1-14, Comprehensive	40%

Class structure:

Lectures will be the primary source of information. Students are expected to attend every class and to participate in class discussions.

Wk	Subjects	Chap.	Problems	Objective
1	Introduction Second-order Systems	1 2	Handouts	1
2	Fundamental properties of nonlinear control systems	3	Handouts	1

3	Lyapunov Stability	4	Handouts	1
4	Input-Output Stability	5	Handouts	2
5	Passivity Exam 1 (Chapters 1-5)	6	Handouts	
6	Frequency domain analysis of feedback systems	7	Handouts	2
7	Frequency domain analysis of feedback systems	7	Handouts	2
8	Advanced stability analysis	8	Handouts	2
9	Stability of perturbed systems	9	Handouts	3
10	Perturbation theory and averaging Exam 2 (Chapters 6-10)	10	Handouts	3
11	Singular perturbations	11	Handouts	3
12	Feedback control	12	Handouts	4
13	Feedback linearization	13	Handouts	4
14	Nonlinear design tools	14	Handouts	4
15	Exam 3 (Chapters 1-14)			

9. Readings in ECE

This course provides an independent research experience. Students ultimately gain confidence in several areas, allowing them to write better and understand technical papers. Students analyze the results of the research, and communicate the conclusions of the work in an open forum. This course designed to help the student formulate a thesis proposal, perform literature surveys and learn the finer points of technical writing at the graduate level. A meta-paper is written about the literature in the field. The basics of technical writing and research are emphasized.

The student, with guidance from the adviser, decides on a topic of interest. The student surveys the available resources, including the library, the internet, and other potential sources for journal articles, conference papers, and books on the topic. The information is analyzed and appropriate conclusions are drawn from the results. The student communicates the results in both a written paper and in an open forum.

The topic is expected to be in the student's domain of primary interest and will, in many cases, be preliminary to the Master's thesis.

The instruction has been organized to emphasize methods of the writing and research process. Emphasis is on the processes the writer must consider. The student learns how to

state a problem, the techniques of analysis, methods of investigation, and functional organization.
Pre-reqs: 15 credit hours at the graduate level
Credit: 3 cr hrs.
Course Overview: In this course, we will examine the elements, methods and format necessary for producing well-organized, clear and concise thesis proposal.
Instructional Methods: We will use the following instructional methods:

1. In-class assignments
2. Class discussions
3. Workshops
4. Group Work
5. Faculty Lecture
6. Exams

The student will address how the research problem focuses on the application of engineering principles to solve one of societies problems. The paper will address the professional, societal, and ethical context of the work. This includes economic tradeoffs between quality and profit.
Course Objectives and Learning Outcomes:
This course designed to support the framing of a problem that has impact on society
1. The students will learn the principles of economic tradeoffs when selecting a thesis problem.

Expected learning outcomes:

a. Apply project schedules
b. Examine ethical ramifications of the problem
c. Be able to perform an ethical study
d. Learn how to review a paper

2. The student will become proficient in a domain related to some combination of hardware and software.

Expected learning outcomes:

a. Demonstrates the ability to utilize research tools to identify relevant literature in the field.
b. Uses appropriate citations to frame a problem.
c. Learn how to select relevant papers

This course requires substantial research effort and emphasis is placed on good engineering practices.
Outcomes:

1. After the student take this course, they will have thesis proposal, with literature survey. A good problem statement will be a part of the thesis proposal. The proposal will appear on the web for general comment.
2. At least one case study in professional ethics
3. Students will select papers from conferences and journals. Each week, every student will submit a review of a paper, totalling 11 reviews. Reviews are in the style of a review submission to an IEEE transactions. Students are not required to check any mathematical proofs, but they much make a judgement on whether the proofs are clear, convincing and elegant. They are to identify topics of future work.

Rationale: Students learn to write reviews to ensure they have read the papers thoroughly. They are initiated to the process of review writing. Student will learn to eliminate grammatical errors and rhetorical problems. An English instructor (skilled in technical writing) would be helpful here. A technical instructor is needed to make sure that the reviews are technically sound. Each review will contribute to a thesis literature search and help to contribute to a problem proposal. Students must read to find what is most relevant to their particular research agenda and must be critical. Reviews are more than summaries, they contain a list of suggestions for improvement.

Non-native speakers of English must be prepared to seek help from instructors who specialize in teaching English as a second-language.

An SOE masters degree requires a thesis proposal. If the thesis proposal is not available at the end of the Readings in ECE course, the student will take an Incomplete and be blocked from registering for a thesis or a project.

10. Master's Thesis

The Master's thesis is intended to be a test of the student's ability to formulate a problem, solve it, and communicate the results. The thesis is carefully supervised by a faculty member on an individual basis. A thesis involves the ability to gather information, examine it critically, think creatively, organize effectively, and write convincingly, it is a project that permits you to demonstrate a great many skills that are basic to both academic and work in industry. The student must also submit a paper for possible inclusion in a refereed journal appropriate to the topic.
Credits: 6-9
Prerequisite – Readings in ECE
Registration for this course requires an approved problem statement by an advisor. Once this is obtained, a thesis schedule is established.
The thesis schedule:
A thesis schedule will be established by the thesis advisor, in collaboration with the student. The student and thesis advisor are required to meet regularly and these meetings are documented. The student submits progress reports, as required by the schedule. These progress reports are submitted to the thesis advisor and if, unsatisfactory, may be forwarded to a standards committee for advise or action.
Advisee (or advisor) transference is possible, but generally not advantagous.
Outcomes:

1. A thesis
2. A submitted paper

Format
The recommended structural sequence for a thesis is:

1. Title Page
2. Certificate
3. Acknowledgments (if any)

4. Preface (if any)
5. Table of contents
6. List of illustrations and tables (if any)
7. Abstract
8. Introduction (if separate from Chapter 1)
9. Chapters in sequence
10. Appendix or appendices (if any)
11. Bibliography

The title page should contain the thesis title, your name, your degree and the year of submission. The table of contents should be fairly comprehensive, since an index is not included.

Beginning with the first page of the Introduction (or Chapter 1, if there is no separate introduction), the pages should be numbered consecutively using Arabic numerals. Preceding pages, except for the title page, should normally be given lower-case Roman numerals.

You must bind an abstract of no more than 400 words within the thesis. You must also submit an additional three copies of the abstract. No single style of bibliography or referencing is required, but you must be consistent.

Printing guidelines:

1. One-and-a-half (1.5) line spacing is preferred, but double-spacing is acceptable. Single-spacing may be used for appendices and footnotes
2. The thesis must be printed on one side of the paper only
3. The margins on each sheet must be at least 40mm on the left-hand side, 20mm on the right hand side, 30mm at the top and 20mm at the bottom

Presentation and binding

You must prepare three copies of your thesis. Each copy should be in a loose leaf form, in a temporary binder.

After your thesis has been examined, and after you have made any recommended corrections or amendments, the copies of your final thesis must be bound in boards, covered with University press boards and the spine must be embossed with gold lettering in the following way:

1. At the bottom and across - the letters SOE
2. 90mm from the bottom and across - the degree and year of submission, for example:

   MS
   2001
3. Evenly spaced between the statement in 2. and the top of the spine - your initials and surname
4. If the spine of the thesis is too thin to support lettering across, the wording can be embossed along the spine, reading from top to bottom
5. A version of the thesis will be mounted on a web server for public view as both PDF and HTML.

Submission

You must submit three hard copies of your thesis for examination.

With your thesis, you must also submit the following three forms:

1. A certificate of Authorship / Originality signed by you stating that the work is yours and that you haven't submitted it for any other degree
2. A Supervisors Certificate signed by your supervisor(s) stating that your work is ready for examination

You can submit your thesis at any time during the year, however you need to allow about 2 months between the time you submit your thesis and when you can graduate.