Syllabus
AE 498 Aerospace Information Technology
Spring 2008

1.0 Course Objectives:
This course is designed to be an introductory level course for information technology in an Aerospace Engineering setting. The learning objectives of the course are threefold in nature. The student, upon successful completion of the course, shall be able to use the C programming language as an engineering tool in designing and implementing aerospace software systems. The student shall develop a programming style that is in accordance with accepted industry practices (i.e. ISO 9000 or DO178B). The student shall develop a basic understanding of computer architecture, real time scheduling and optimization; all of which play relevant roles in the design of embedded aerospace platforms.

2.0 Reference Materials
Recommended Textbooks
Brookshear, J. Glenn. Computer Science: An Overview. 7th ed. Reading, MA: Addison Wesley, 2002. ISBN: 0201781301.

Abelson, H., Sussman, G., Sussman, J., Structure and Interpretation of Computer Programs. 2nd ed. New York, NY, McGraw-Hill, 1996. ISBN: 0070004846.

Cormen, T., Leiserson, C., Rivest, R., Stein, C., Introduction to Algorithms, 2nd ed., Cambridge MA: MIT Press., 2001. ISBN: 0262032937.

Bertsekas, D. Convex Analysis and Optimization. Belmont, MA: Athena Scientific, 2003. ISBN: 1886529450.

3.0 Evaluation
The course shall be evaluated as follows:
Design Challenges: 60%
Midterm Exam: 40%

There will be four design challenge assignments, worth 10% each, which will be carried out based on the Lego™ Mindstorms platform, in the NQC (Not Quite C) programming environment. The students shall design a system that satisfies the requirements of each challenge, while meeting all of the necessary architectural constraints. Students will be divided into groups of four, and each group of four students shall submit the engineered system for evaluation at the due date of each challenge. Platforms will be evaluated on functionality, optimality, robustness and performance metrics unique to each challenge.

4.0 Lecture Material
The four main units of the course shall be roughly divided into the following topics:

I. Data Structures and Implementation (10 Lectures)
   a. Lists, Linked Lists, Arrays, Queues

b. Trees, Graphs, Advanced Structures (BDDs, RRTs etc.)
c. Registers and Implementation
    -Designing register machines, storage, garbage collection, compilation

II. Algorithmic Methods (12 Lectures)
d. Definition and Analysis of Algorithms
    -Conditional, iterative, recursive structures
e. Big O and Omega notation
f. Complexity
g. NP-completeness proofs and Equivalence
    -Graph-Colouring Problem, Travelling Salesman Problem

III. Real Time Computation (10 Classes)
h. Tasks and Processors
    -Von Neumann Architecture and Bottleneck
i. Deadlines, Release Times, Processing Times
j. Real Time Scheduling Algorithms
    -EDF, Pre-emption, Priority etc.
k. Multi-Processor Systems

IV. Optimization and Path Planning (10 Lectures)
l. Optimization Formulation
    -Convexity and Duality
m. Linear Programming (Simplex), MILPs
n. Hamilton-Jacobi-Bellman
o. Path Techniques (TSP Stochastic Solutions, RRTs etc)