EE 554 -- REAL-TIME COMPUTER SYSTEMS

This is a project-oriented course. Groups of 4 choose a topic and carry it out. Lectures are devised to support and enhance students' ability to do a real-time (R/T) semester project. There will be a few no-lecture sessions to coincide with critical phases of the projects, to allow students time to proceed. When architecture is covered, only its real-time aspects are emphasized. The same procedure is applied to software discussion. Chronological order of the lectures

1) **Structure of R/T Systems** : R/T Clocks & modes of operation. Interrupt organization & hierarchy. Communication between processes & computers, synchronous & asynchronous modes. Data format and data acquisition. Shared-bus organization. Examples of R/T buses, MIL-STD 1553 (1.5 wks)

2) **Hardware/Software Review** : Example of processor chip made for R/T applications; MIL-STD-1750 & RAD750 ; I/O strategy. Parallel & distributed architecture for R/T usages. All about interrupts. Multiprocessing mode and context switching. (1wk)

3) **Reliability & Availability :** Series/parallel models. Methods for estimating system reliability. Active/standby components. Hybrid models. DMR and TMR (Triple-Modular Redundancy). Software contribution to system survivability. Voter designs. Dynamic reconfiguration for R/T applications. MIL-STD-217. Reliability as practiced on long missions. Database preservation. RAID (3 wks)

4) **Scheduling & Synchronization** : Deadlines, laxities & overruns. Dependent and independent tasks. Non-preemptive & preemptive scheduling in multi-processor environment. Task priority and priority scheduling. Processor sharing algorithms. Guaranteed Response Times. R/T Operating Systems (RTOS) revisited. (2.5 wks)

5) **Queueing Applications in R/T Systems** (no theory): Review of M/M/1 and M/G/1models. Multi-server systems . Task overrun analysis. Time-sharing model. Priority queues, preemptive and non-preemptive scheduling. (2 wks)

6) **Analog Signals & Devices** : Analog/Digital converters (principles of operation, specs, idio-syncrasies, integration into microprocessors). Data sampling & reconstruction. Phase & magnitude errors in ZOH and FOH reconstruction strategies. Compensation methods to minimize errors. (2 wks)

7) **Systems planning**, specs and evaluation of projects.
Benchmarks, uses & pitfalls. Synthetic & Kernnel benchmarks. Benchmark suites.
Slide presentation of an actual Flight Simulator. (1.5 weeks)