



# Fault Diagnosis in Dynamic Systems

## MECHENG 7372

### Credit Hours:

3.00 - 3.00

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### Course Components:

Lecture

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### Course Description:

Covers the theory and application of fault diagnosis in multi-domain dynamic systems. Theory and case studies drawn from industrial applications.

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### Prerequisites and Co-requisites:

Prereq: 7380, ECE 4551, 5551, AeroEng 4521, or permission of instructor.

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### Course Goals / Objectives:

- Introduce the concepts of fault diagnosis and prognosis. Develop methodologies for system hazard analysis including fault trees and failure modes and effects analysis
- Review of linear system theory with focus on multivariable systems and observability concepts
- Present analytical redundancy concepts and develop the notion of fault modeling and residuals
- Develop the parity equation method for diagnosing systems using linear input-output models. Develop design methods for the synthesis of parity equation algorithms
- Develop observer-based methods for diagnosis systems using state estimation methods. Luenberger observers, reduced-order and unknown-input observers; Kalman filters, extended Kalman filters
- Introduce the concept of passive robustness in fault detection, including threshold adaptation
- Develop methods for the statistical analysis and testing of residuals. Binary hypothesis testing, sequential probability ratio test, other statistical methods
- Introduce frequency-domain methods for signal analysis. Diagnosis by spectral estimation. Parameter identification methods. Use of non-stationary (time-frequency) analysis methods
- Develop methods for fault diagnosis in nonlinear systems; nonlinear parity equation residual generation methods; nonlinear observers
- Introduce the concept of prognosis, and develop analysis and synthesis methods for model-based prognosis