AUBURN UNIVERSITY
SAMUEL GINN
COLLEGE OF ENGINEERING
AEROSPACE

Special Topics: Advanced Perturbation Methods

AERO 4970/7970 **Course Outline**

Lecturer: Joseph Majdalani, Ph.D., P.E.

Section No.: 001.

Lecture Times: TBD

Lecture Location: TBD

Office Hours: TBD

Contacts: (1) email: maji@auburn.edu; (2) office: 334-844-6800.

Teaching Assistant: None.

Textbook: Class notes.

References:

1. Milton Van Dyke, Perturbation Methods in Fluid Mechanics, Annotated Edition, Parabolic Press, Inc., Stanford, CA, 1975.
2. Bhimsen K. Shivamoggi, Perturbation Methods for Differential Equations, Birkhäuser, Boston, 2002.
3. David C. Wilcox, Perturbation Methods in the Computer Age, DCW Industries, Inc., 1995.
4. Carl M. Bender, and Steven A. Orszag, Advanced Mathematical Methods for Scientists and Engineers, McGraw-Hill, Inc., 1978.
5. Ali Hassan Nayfeh, Introduction to Perturbation Techniques, Wiley Classics Library Edition, John Wiley & Sons, Inc., 1981.
6. Ali Hassan Nayfeh, Perturbation Methods, John Wiley & Sons, Inc., 1973.
7. James A. Murdock, Perturbation Theory and Methods, John Wiley & Sons, Inc., 1991.
8. Jerry Kevorkian, and Julian D. Cole, Multiple Scale and Singular Perturbation Methods, Springer-Verlag, Inc., 1996.
9. A. Aziz, and T. Y. Na, Perturbation Methods in Heat Transfer, Hemisphere Publishing Corp., 1984.

Prerequisites: Differential Equations and Perturbation Methods I.

Objectives: The purpose of this course is to advance students through real life problems requiring the subtle use of asymptotic methods. The goal is to solve problems that arise in propulsion related applications or other fields of science. By the end of the course students will be able to:

- understand the use of several advanced perturbation techniques; these include:
  1) WKB Method (Type I and Type II) with Multiple Distinguished Limits
  2) Latta's Method of Composite Expansions
  3) Method of Averaging (van der Pol's Method/ Krylov-Bogoliubov Method)
  4) Asymptotic Expansion of Integrals (Watson's Lemma)
  5) Laplace's Method
  6) Rayleigh Janzen Expansion
  7) Adomian Decomposition
  8) Homotopy Analysis Method (HAM)
  9) The Expansion of Functions in Infinite Series

- obtain perturbation solutions to complex physical settings involving small or large parameters;
- understand how to model highly oscillatory solutions
- treat partial differential equations;
- treat problems exhibiting a nonlinear scaling structure;
- treat compressible flow problems.

Grading and Exams:

Opportunities to excel:		**Grading scale:**	
Homework	30%	A	93-100%
Two 1-hour exams	40%	AB	86-92
Project	30%	B	80-85
		BC	74-79
		C	69-73
		CD	64-68
		D	59-63