Registration Form

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Office of Continuing Education
The University of Tennessee Space Institute
Becky Stines, MS 15
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Fax: (931) 393-7433
Toll Free: 888 822-8874 ext. 276

CERTIFICATES OF CONTINUING EDUCATION UNITS (CEUs) WILL BE PRESENTED FOR ATTENDING THIS COURSE. UT IS ABET ACCREDITED.

❑ **Perturbation Methods in Science and Engineering**
March 21-24, 2011
Course Fee: $1195.00

METHOD OF PAYMENT

☐ Check or Money Order Payable to:
The University of Tennessee Space Institute

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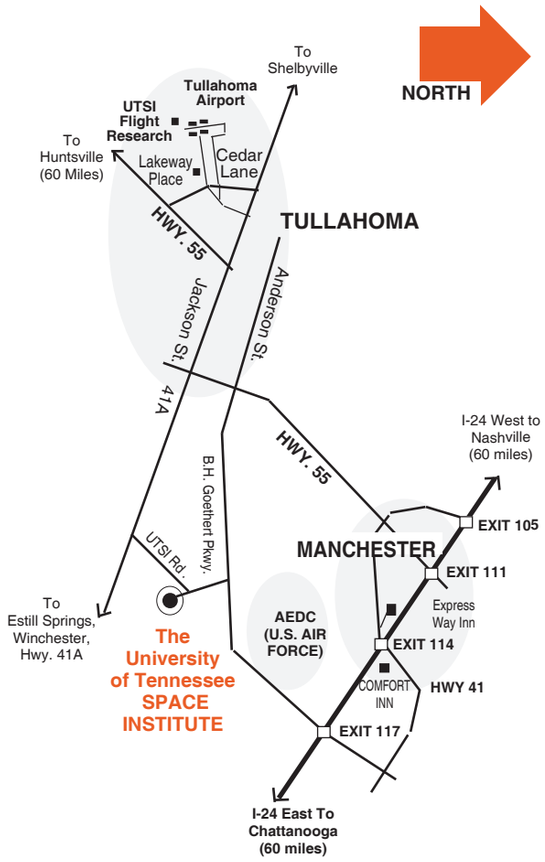

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Short Course:
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March 21-24, 2011
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Space Institute
Tullahoma, Tennessee

Office of Continuing Education offers

Perturbation Methods in Science and Engineering

www.utsi.edu

March 21-24, 2011

Course Director:
Dr. Joe Majdalani

EARLY RESERVATIONS ARE SUGGESTED
- Please Forward To Departments Working In This Field -

Hybrid Rocket Propulsion
March 21-24, 2011

Course Description

The "Perturbation Methods" course is a must for all engineers and scientists aspiring to develop theoretical solutions to accompany their numerical and/or experimental work, irrespective of their research discipline. The majority of problems confronting engineers, physicists, and applied mathematicians encompass nonlinear differential/integral equations, transcendental relations, equations with singularities/variable coefficients, and complex boundary conditions that cannot be solved exactly. For such problems, only approximate solutions may be obtained using either numerical and/or analytical techniques. Foremost amongst analytical approximation techniques are the systematic methods of asymptotic perturbation theory. Unlike numerical solutions that can be acquired using canned packages and/or commercial solvers, the ability to derive closed-form analytical approximations to complex problems is becoming a lost art. Numerical solvers are routinely relied on to the extent that mastery of approximation methods is becoming not only a desirable tool, but rather a must amongst engineers and scientists, especially those aspiring to establish new theories and/or achieve deeper physical insight than may be gained on the basis of numerical modeling alone.

Key Topics

Regular Perturbation Methods

Singular Perturbation Methods: Strained Coordinates, Matched Asymptotic Expansions, and Multiple Scales

Asymptotic Principles: Prandtl, Van Dyke, Least Singularity, and Matching by Supplementary Expansions

Special Topics

WKB, van der Pol's Method of Averaging, Latta's Method of Composite Expansions, and the Generalized Scaling Technique

Parameter-Fee Methods: Adomian Decomposition and Homotopy Analysis Methods

Asymptotic Expansion of Integrals: Laplace's Method and Watson's Lemma

About the Instructors

Dr. Joe Majdalani

Dr. Majdalani is a Professor of Mechanical and Aerospace Engineering at UTSI. He is known for his work on multiple scales theory and singular perturbations, especially in the modeling of internal flows arising in chemical rockets. He has developed new concepts in perturbation theory including the Composite and Generalized Scaling Techniques. He is the Chair of Education for the Hybrid Rocket TC and a Fellow of ASME.

Who Should Attend

This course is aimed at bringing together professionals with interest in both conventional and modern analytical modeling approaches. Examples include the Generalized Scaling Technique (GST) and the Homotopy Analysis Method (HAM) that have been developed for the treatment of problems exhibiting multiple scales and nonlinearities. These and other powerful tools can be used to obtain explicit approximations to a whole gambit of transcendental equations and nonlinear problems that arise in aeronautical, astronautical, and aerospace applications. The course is a must-have for all scientists and engineers who wish to augment their investigative capabilities by adding a theoretical component to their research arsenal. In practical applications, analytical solutions are complementary to numerical simulations as they enable us to gain newer physical insight into complex phenomena than is permitted through computations alone. They not only offer an avenue for limiting process verifications but also provide, in most situations, a compelling justification for dissemination in prestigious journals that either favor the advancement of mathematical formulations or require the existence of a theoretical framework to accompany laboratory and/or computer-based measurements.

Course Outline

Introduction, Classification, and Advantages
- -Landau gauge orders and series expansions
- -Systematic solution of transcendental equations

Regular Perturbation Methods
- -Regular expansions and Bürmann's approach
- -Successive expansions and the method of ansatz
- -Dimensional analysis and scaling
- -The von Karman and Laplace equations
- -The Rayleigh-Janzen Expansion Technique

Strained Coordinate Expansion (SCE) Techniques
- -The Lindstedt method of stretched coordinates
- -The PLK method of deformed coordinates
- -The Pritulo method of renormalization

Matched Asymptotic Expansion (MAE) Technique
- -Boundary layers and inner/outer approximations
- -Prandtl's and Van Dyke's matching principles

Multiple Scales Expansion (MSE) Technique
- -Slow and fast scales
- -Stretched and compressed scales

Wentzel-Kramers-Brillouin (WKB) Technique
Van der Pol's Method of Averaging
Latta's Method of Composite Expansions (MCE)

Adomian Decomposition (ADM)
Homotopy Analysis Method (HAM)

Asymptotic Expansion of Integrals
- -Laplace's Method

Office of Continuing Education

Reservations may be made by using the registration form. The registration fee of $1195.00 includes all necessary supplies. Early reservations are recommended. Refund of registration fee can be made if cancellation notice is received ten working days prior to beginning of the course. Cancellation received less than 10 working days prior to the course will be assessed 20% of the registration fee. Registration within the **10 working days prior to the course** is also subject to the same cancellation policy. Substitution may be made at any time.

Please register by mail, fax, or telephone. A telephoned, mailed, or faxed reservation made **by an official training office** is considered a firm registration and cancellation policy will apply. A letter of acknowledgment will be mailed to the individual for whom the reservation is made, or to the training office, as we are instructed. Class size will be limited to ensure optimum interaction among participants. UTSI reserves the right to cancel the course. The liability of The University of Tennessee Space Institute is limited to the registration fee. UTSI will not be responsible for airline ticket cancellation fees or any other expenses incurred because of course cancellation. Enrollees will be notified and a full refund will be made. Late applicants will be considered on a space available basis.

The course is payable in advance and includes the cost of notes, classroom material, refreshments, and lunches. The fee does not include expenses for motel accommodations or other meals. Payment may be made by check, money order, or credit card. Be sure to include attendee name(s) and course title with check. Please make checks payable to The University of Tennessee Space Institute. **VISA, MasterCard, and Discover are accepted**.

UTSI reserves the right to substitute speakers in the event of unusual circumstances. UTSI does not sell the course notes. You must attend the course in order to receive the material. Training taken to maintain or improve professional knowledge and skills is usually tax-deductible. Consult your tax advisor. **Please notify us if you require special meals, wheelchair access, or other accommodations.** Casual dress is appropriate.

Enrollment may be made by individuals or companies. Any number of persons may enroll from a single organization so long as there are vacancies. We suggest that you phone us of your intention to enroll as soon as you initiate your organization procedure so we can hold a place for you and be better able to plan the arrangements. Phone the Continuing Education Director at (931) 393-7276 and then follow with the written application.

A place in the course will be reserved for industry personnel and government employees who require time to obtain authorization. Organizations may enroll for a given number of individuals, supplying the names at a later date, if necessary. For all such enrollments or reservations, the individual names should be received by the Institute as soon as possible to ensure a place in the course. For additional applications, use separate sheet giving all particulars required on the application form.