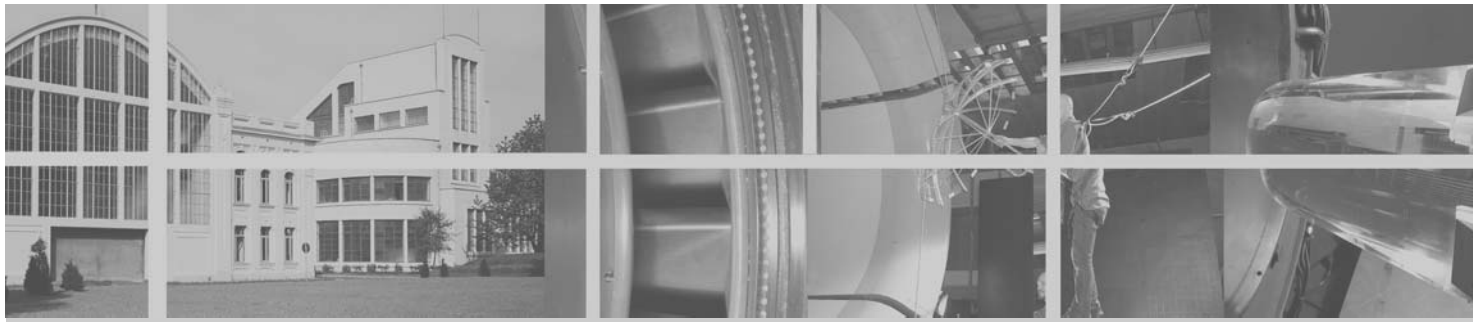

LECTURE SERIES

PROGRAMME

2007 - 2008

VON KARMAN INSTITUTE FOR FLUID DYNAMICS

Lecture Series Secretary
von Karman Institute for Fluid Dynamics
72 chaussée de Waterloo
B - 1640 Rhode-Saint-Genèse

(Please correct your address if necessary)

THE VON KARMAN INSTITUTE FOR FLUID DYNAMICS

offers the following Lecture Series during the 2007-2008 academic year. Lectures will be given by active specialists drawn from universities, research establishments and industries from all over the world.

INTRODUCTION TO MEASUREMENT TECHNIQUES

OCTOBER 8-12, 2007

☐ The objective of this course is to provide young engineers with a broad overview of traditional and advanced measurement techniques applicable to fluid dynamics. Each measurement technique and its field of application will be described. Limitations and advantages will be discussed and special attention will be given to the subject of error estimation. A choice of relevant techniques will be demonstrated to groups of five people maximum during lab sessions on Thursday afternoon and Friday in the VKI facilities. This will provide an opportunity to manipulate the available hardware and will allow for discussion of individual problems. This course, prepared and presented by the VKI teaching staff, is based on a long experience with the different techniques for research applications.(see more details in announcement included).

BASICS OF AEROACOUSTICS AND THERMOACOUSTICS

DECEMBER 3-7, 2007

☐ The accurate modelling of the stability properties of energy conversion processes, such as gas turbines, industrial heaters or domestic heating systems, is facing aero-acoustical and thermo-acoustical issues hindering their economic sustainability. The aim of this EU sponsored course (Marie-Curie Research Training Network AETHER) is to present the state-of-the-art review in this multi-disciplinary engineering field of aero- and thermo-acoustical coupling in energy conversion processes, in a form accessible to both researchers and industrial engineers. After providing the theory of stability analysis, the emphasis will be put on the modelling of combustion and unsteady flow, including the interaction of both of them with acoustics. Biomass combustion, experimental methods in thermo-acoustics, vibro-acoustical coupling and fatigue analysis will also be covered as well as passive and active control of combustion instabilities.

35TH CFD / ADIGMA COURSE ON VERY HIGH ORDER DICRETIZATION METHODS

JANUARY 21-25, 2008

☐ Schemes with order of accuracy higher than two have become a hot topic in CFD, and the perspective of applying them in industrial aeronautical context is realistic within the next decade. In this course the basics and state of the art of the following methods will be discussed in detail: Discontinuous Galerkin Finite Element methods; Spectral Element and Finite Volume methods; ENO-reconstruction and Residual Based Finite Volume Methods; Residual Distribution schemes. Applications are foreseen in the area of compressible aerodynamics and aeroacoustics. The course is organized in collaboration with the European Union targeted research project ADIGMA, and will bring together a balanced mix of European and American top researchers in the field.

INTRODUCTION TO CFD

JANUARY 28, 2007 - FEBRUARY 1, 2008

☐ This course is intended to provide the basic information required to initiate research or applications in most of the important domains of computational fluid dynamics. Participants are expected to have little experience in the field. Topics to be treated will include fundamental mathematical properties of a system of partial differential equations and corresponding boundary conditions, finite difference and finite element techniques, computational methods for different flow regimes: potential, boundary layer, Euler and Navier-Stokes. The course will be similar to the very successful course of the same title offered since 1985 and will employ many of the same. (See more details in announcement included).

POST-PROCESSING OF NUMERICAL & EXPERIMENTAL DATA

FEBRUARY 11-15, 2008

☐ The latest advances of experimental techniques, such as in 3D PIV, yield a considerable amount of detailed data. It is also the case of numerical simulations, as 3D unsteady computations are more and more common. It is therefore necessary to make use of sophisticated post-processing techniques that will allow extracting advanced information from the data set. The Lecture Series will present the needs of such tools and will introduce the participants to techniques such as conditional sampling, Spectrum and Wavelet analysis, POD and many others. Adequate techniques to identify coherent structures will be presented in depth and examples of applications will be analysed.

EXPERIMENTAL DETERMINATION OF DYNAMIC STABILITY PARAMETERS

FEBRUARY 18-22, 2008

☐ The stability of aerial vehicles has always been one of the most important topics studied for a safe and smooth flight.
Dynamic stability is usually thought as the aerial vehicle's response over time when disturbed from a given angle of attack, slip or bank. One of the biggest problems in studying dynamic stability is the accurate determination of dynamic stability parameters, in other words, the damping coefficients.
The objective of this lecture series is to provide a review of the experimental dynamic stability tools and to present a state-of-the-art survey of the analytical, wind-tunnel and flight-test techniques used for dynamic stability investigation. Experts will present the fundamentals of dynamic stability testing, the detailed post processing methodologies, advances in experimental tools, etc… Demonstrations on experimental facilities and examples from flight tests are also to be presented.

AEROENGINE DESIGN

March 3-7, 2008

☐ This course proposes an excursion across an aeroengine, from the fan to the exhaust nozzle, mainly focused on aerodynamics aspects. First, the preliminary design will show how in an early phase a number of parameters are selected. Then will follow the detailed design of the entire compressor section: fan (addressing noise issues), the booster, the HP compressor.
The lectures on the combustor will also cover emissions. The design of high pressure and low pressure turbine will then be described before focusing on the exhaust nozzle and the engine integration on the aircraft. Finally, the last lectures will review a number of ongoing investigations that are exploring new engine architectures (e.g. contrafan, geared turbofan, etc.).

LARGE EDDY SIMULATION AND RELATED TECHNIQUES. THEORY AND APPLICATIONS

March 10-14, 2008

☐ Large Eddy Simulation (LES) has reached a level of development and width of application to justify a full course dedicated to this specific topic. The first part of the course will introduce and discuss the fundamental principles, present state-of-the-art applications and possible developments of LES and LES-related techniques for high Reynolds-number flows. The second part will present applications of these approaches to various engineering fields of wide interest. The course will be delivered by internationally recognized experts. Its content is addressed both to researchers interested in the fundamental simulation of turbulence and engineers wanting to apply the LES technique or LES solvers to the accurate simulations of turbulent flows.

STRUCTURAL DESIGN OF AIRCRAFT ENGINES - KEY OBJECTIVES AND TECHNIQUES

May 13-16, 2008

☐ Aeroengines are complex assemblies with highly solicited components. The continuous trend in weight reduction and novel engine architectures result in large structural loads. Today security margins are very small regarding, static stresses, temperatures, cyclic loads and vibration. The objective of this lecture series is to explain the main challenges of structural design from integration problems to details of component design. The lectures will present the various fields of structural engineering, the current practices and the main research areas: architecture, certification, dynamics, fatigue, material, creep,… The main constraints related to the structural problems will be explained, and how to deal with them in the multidisciplinary design of aircraft engines.

ATMOSPHERIC BOUNDARY LAYER FLOWS IN AIR POLLUTION MODELING

May 19-23, 2008

☐ The purpose of the course is to provide the state-of-the-art information on atmospheric boundary layer flows required for air pollution modeling. Lectures will include fundamentals of atmospheric boundary layer phenomena, of urban aerodynamics and contaminant transport. Recent advances relevant to the development of the multi-scale pollution transport models from micro-, meso- to global scales will be addressed, as well as the variability and uncertainty related to urban dispersion models. The course aims at Ph.D candidates and researchers in the field, but also to policy makers involved in regulations for environmental/air quality issues and emergency assessment.

OPTIMIZATION AND MULTI-DISCIPLINARY DESIGN

June 2-6, 2008

☐ This course intends to provide the basic concepts and tools for single-discipline (single-point and multi-point) and multidisciplinary (interaction of fluid-structure, fluid-acoustics, conjugated heat transfer) optimization. Topics which will be treated in detail include: gradient based and steepest descent methods, methods based on adjoint equation, evolutionary/genetic algorithms, concept of pareto front, game strategy, fast approximation methods (Radial Basis functions, Artificial Neural Networks, Kriging), robust design.

NON-EQUILIBRIUM GAS DYNAMICS, FROM PHYSICAL MODELS TO HYPERSONIC FLIGHTS (RTO-AVT-VKI)

September 8-12, 2008

☐ Development of hypersonic flights for defense program or aerospace transport industry require more and more to consider non-equilibrium gas dynamics for accurate design of space operation. These high temperature effects, associated with chemistry and internal energy mode of molecules from the flow affect many aspects of the flight and represent a large impact for design engineers. The investigations of such features of hypersonic regime involving kinetic processes at microscopic level appear as a challenge in itself. It relies on set-up of fine experimental apparatus and the development of physical modeling to integrate in CFD code which have been built and elaborated along with the demand of aerospace activities. Objectives of the special course are to review the up to date experimental techniques with numerical simulation strategies involved in the treatment of reacting flows specific to hypersonic conditions. The purpose is also to initiate a synthetic presentation of theoretical models that contribute to better predict the thermal loads on re-entry bodies.

ADVANCES IN LAMINAR-TURBULENT TRANSITION MODELING (RTO-AVT-VKI)

Not yet defined

☐ After the AGARD/FDP Lecture Series held at the VKI on this subject in 1984 and 1993, the purpose is now to revisit the subject in view of the latest advances made, specially taking into account the increased capabilities in numerical simulations and in non-intrusive optical measurement techniques, allowing detailed use of DNS data or of experimental data to understand more deeply the turbulent transition mechanisms, as a necessary prerequisite for a more accurate modeling. The topics to be covered include the different transition phenomena and scenarios, treating subjects like receptivity of boundary layer to disturbances, by-pass mechanisms which anticipate transition, growth of 3D instabilities and their breakdown mechanisms, or progresses in parabolized Navier Stokes methods.