Aerospace Engineering Department
AE 621 - Experimental Fluid Mechanics - Spring 2002

3 credit hours, prerequisite: AE 406, or 602, 611 1st course in fluid mechanics

Prepared by: Dr. Drew Landman  KDH 241H, 683-6008 (ODU),  766-2266 Ext 106 (LFST),  dlandman@odu.edu

Mode: Regular with wind tunnel lab meetings


Schedule: Meets twice weekly for a minimum of 1.25 hours, labs are longer

Grading Policy: Projects 70%, Final Exam 30%

Course Objectives: The objectives of the course are to introduce the experimental techniques, procedures and measurement tools used in fluid mechanics and aerodynamics research and development. The emphasis will be on the measurement techniques, rather than the facility aspects (AE 622). A wide range of flow velocities will be covered with emphasis placed on hands-on laboratory work in the Department’s experimental facilities.

Projects (Labs):

(1) Pressure probe methods – 5 Hole Probe Calibration and Use
(2) Pressure Measurements – Surface Static Pressures on Airfoil for Lift Measurement
(3) Flow Visualization – Low speed surface and stream: Tufts, Smoke, Oil Flow, Liquid Crystals
(4-5) Hot-Wire Anemometry - Calibration and use of X-wire for turbulence measurements
(6) Schlieren and Shadowgraph Flow Visualization
(7) Laser Flow Diagnostics – PIV flow field measurements around vehicle model

Course Contents:

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<td>Introduction to facilities, intro to pressure measurements</td>
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<td>pressure measurements, probes and use, freestream, boundary layer, airspeed, Mach, use of pressure coefficient</td>
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<td>pressure measurements in high and low speed flows, static, total, angularity, surface, interference</td>
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<td>pressure probes - Lab 1: calibration and use of 5 hole probe</td>
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<td>flow visualization - low speed surface and stream flow</td>
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<td>Introduction to uncertainty analysis – bias, precision</td>
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<td>flow visualization - Lab 3: tufts, smoke, oil flow, and liquid crystals</td>
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hot-wire anemometry techniques for measuring velocity, turbulence, and flow direction

hot-wire anemometry techniques for measuring velocity, turbulence, and flow direction

hot-wire anemometry - Lab 4: calibration of an X-wire

hot-wire anemometry techniques for measuring velocity, turbulence, and flow direction

hot-wire anemometry techniques for measuring velocity, turbulence, and flow direction

hot-wire anemometry - Lab 5: use of an X-wire for measurement of turbulence quantities
density sensitive flow visualization

non-intrusive methods for measurement of velocity, turbulence, and flow direction: LDV and PIV

Schlieren and Shadowgraph techniques - Lab 6: measurement of shock waves on supersonic A/C

non-intrusive methods for measurement of velocity, turbulence, and flow direction: LDV and PIV

non-intrusive methods for measurement of velocity, turbulence, and flow direction: LDV and PIV

PIV – Lab 7: Use of PIV to measure velocity flow field in vehicle wake

PIV – Lab 7: Use of PIV to measure velocity flow field in vehicle wake

pressure and temperature sensitive paints (PSP and TSP)

pressure and temperature sensitive paints

PSP demonstration in ODU supersonic tunnel or LFST

surface shear stress measurements

uncertainty analysis

uncertainty analysis

exam