

Course Number: 28197

**Course Name: Optical Measurement Techniques in Fluid Mechanics and
Their Applications**

Course Type: Lecture/Lab
Prerequisite:
Level: Graduate
Group: Center of Excellence in Energy Conversion

Type & Max Unit: 3
Corequisite:
First Presentation: 2005
Last Edition: 2017

Objectives: To provide knowledge on the fundamentals of the non-invasive measuring of flow parameters including velocity, Temperature, and concentration using optical measurement techniques in fluid mechanics such as PIV, LIF and MTV.

Topics:

Light

What is light?
Wavelength
Filters
Lenses and equations
Mirrors and equations

Lasers

Types of Lasers
Stability

Cameras

Types of Cameras
Resolution
Frame Rate
External Triggering
Exposure Time
Delayed Image
Related Noises
Read noise
Dark Noise
Shot Noise
Background Noise
How to Measure Noises
S/N Ratio

Image Processing

Calibration
Flat Field Frame
Background Subtraction
Processing
Spatial Averaging
Temporal Averaging

Median Filtering

Flow Visualization Techniques

Schlieren

Shadowgraph

PIV Technique (Particle Image Velocimetry)

What is PIV?

Particle Size

Number of Particles

Image Processing and Correlation

Error Analysis

Applications

LIF Technique (Laser Induced Fluorescence)

What is LIF?

One-Color LIF

Two-Color LIF

Materials

Fluorescence

Phosphorescent

Temperature Measurement

Gas Phase

Liquid Phase

Solid Phase

Concentration Measurement

Gas Phase

Liquid Phase

Error Analysis

Applications

MTV Technique (Molecular Tagging Velocimetry)

What is MTV?

MTV Types

Phosphorescent

Photo-Bleaching

Caged Fluorescent

Photochromic

Synchronization

Delayed image

Image Processing and Correlation

Error Analysis

Applications

MTV&T Technique (Molecular Tagging Velocimetry and Thermometry)

Laser and Sound Doppler Velocimetry (LDV and SDV)

Different Applications

Seminar Selected Topics

References: