

*The University of Western Ontario*  
*Department of Mechanical & Materials Engineering*

**MME 9650 – Selected Topics: “Optical Methods in Flow Measurements”**

**COURSE OUTLINE – 2009-2010**

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- OBJECTIVES:** The course will focus on advanced measurement techniques in fluid mechanics and heat transfer. The course material will include: methodology of experiments, Principles of measurement systems and data acquisition, digital data analysis, Image processing, statistical analysis, validation and error assessments. Measurements of velocity and temperature using optical methods such as: Particle Image/Tracking Velocimetry, Planar Laser Induced Fluorescence, Infra-Red Imaging, three dimensional extensions and Laser Doppler techniques.
- PREREQUISITES:** Graduate standing in MME or permission from the instructor.
- TOPICS:**
- 1 Experiments methodology
  - 2 Physical principles
  - 3 Dynamics of measurement systems
  - 4 Digital sampling, signal conditioning
  - 5 Statistical analysis
  - 6 Error estimation, calibration and validation
  - 7 Basics of image processing
  - 8 Imaging devices
  - 9 Particle Image Velocimetry
  - 10 Particle Tracking velocimetry
  - 11 Concentration estimation using Planar Laser Induced Fluorescence
  - 12 Temperature measurement using Infra-Red imaging
  - 13 Three-dimensional extension using tomography and holography
  - 14 Additional techniques: ultrasound
- CONTACT HOURS:** 2 lecture hours, 2 laboratory/tutorial hours; half course
- TEXT:** Tropea C., Yarin A.L., Foss J.F., Handbook of Experimental Fluid Mechanics, Springer, 2007.  
Tavoularis S., Measurement in Fluid Mechanics, Cambridge University Press, 2005.  
Raffel M., Willert C., Wereley S., Komenhans J., Willard W., Particle Image Velocimetry: A Practical Guide, 2<sup>nd</sup> Edition, Springer, 2007.
- EVALUATION:** Homework 15%  
Final project 85%  
If a minimum of 50% is not obtained on the final project, the student cannot receive a mark greater than 48%.
- INSTRUCTOR:** Roi Gurka, *PhD*  
Room SEB 2057  
Email: [gurka@bgu.ac.il](mailto:gurka@bgu.ac.il)
- ATTENDANCE:** Any student who, in the opinion of the instructor, is absent too frequently from class or laboratory periods in any course, will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular examination in the course.
- PLAGIARISM:** Students must write their essays and assignments in their own words. Whenever students take an idea, or a passage of text from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence (see Scholastic Offence Policy in the Western Academic Calendar).
- NOTE:** The above topics and outline are subject to adjustments and changes as needed.

The course will be taught by dr. Gurka, on leave from the Ben Gurion University in Israel. Dr,Gurka contributed to the development of optical methods.

Taylor Z., Gurka R., Kopp G.A. and Liberzon A., Long duration, time-resolved PIV to study unsteady aerodynamics, submitted to IEEE, 2009.

Gurka R., Liberzon A. and Hetsroni G., Detecting coherent patterns in a flume by using PIV and IR imaging techniques, vol. 37, pp. 230-236, Experiments in Fluids, 2004.

Liberzon A., Gurka R. and Hetsroni G., XPIV - Multi-plane Stereoscopic Particle Image Velocimetry, Experiments in Fluids, vol. 36, pp. 355-362, 2003.

Tentative schedule:

Lec.#	Day & Time	Lecture Topic	L.
1	14/09 16:30-18:30	Introduction	2hr
2	16/09 16:30-18:30	Methodology of experiments	2hr
3	21/09 16:30-18:30	Digital sampling, signal conditioning	2hr
4	23/09 16:30-18:30	Statistical analysis, error estimation and validation	2hr
5	28/09 16:30-18:30	Basics of image processing, imaging devices	2hr
6	30/09 16:30-18:30	Particle Image Velocimetry: intro.	2hr
7	07/10	PIV: extensions: Stereo, Micro, etc	2hr
8	14/10	PIV: High Speed	2hr
9	21/10	PIV: Laboratory	3hr
10	28/10	Concentration estimation by PLIF	2hr
11	18/11 16:30-18:30	Particle Tracking velocimetry	2hr
12	20/11 16:30-18:30	Temperature measurement using Infra-Red imaging	2hr
13	25/11 16:30-18:30	3D extension using tomography and holography	2hr
14	27/11 16:30-18:30	Additional techniques: ultrasound + Projects	2hr