

**WORCESTER POLYTECHNIC INSTITUTE**  
**MECHANICAL ENGINEERING DEPARTMENT**  
*ME – 593N*

*Laser metrology and NDT*

Fall' 2000

Days: Monday and Wednesday

Time: 5:00 – 6:20 p.m.

Place: Room 104 Salisbury Labs

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**COURSE DESCRIPTION**

Demands for increased performance and efficiency of components in the micro, meso, and macro-scale, impose challenges on their engineering study, design, and optimization. These challenges are compounded by multidisciplinary applications to be developed inexpensively in short time while satisfying stringent design objectives. As a consequence, effective quantitative engineering methodologies, such as optical techniques, should be used in the study and optimization of components. State-of-the-art optical techniques are based on the utilization of coherent light sources, or laser sources. Laser sources are characterized by their optical energy and power, wavelength, phase, polarization state, speed of propagation, and direction of propagation. When laser light is reflected or scattered by the surface of an opaque object, or when it is transmitted through a transparent medium, any or all of its characteristics may be altered. By measuring the changes in these characteristics, it is possible to obtain accurate and precise information about the state of an object or medium of interest, such as its size, shape, temperature, velocity, density, or state of stress. Such measurements are of significant importance in many areas of engineering and science, which include solid mechanics, vibrations, tribology, transport phenomena (heat, mass, and momentum transfer), acoustics, and electromagnetism.

In this course, modern laser metrology techniques are covered and their practical applications to solve problems, with emphasis on nondestructive testing (NDT), are illustrated with laboratory demonstrations. Topics covered include wave and Fourier optics, classic and holographic interferometry, speckle techniques, solid state lasers, fiber optics, CCD cameras, computer vision, camera calibration methods, and image processing and data reduction algorithms as required in quantitative fringe analysis. Detail examples of nondestructive testing and coherent optical metrology in solid mechanics, vibrations, heat transfer, electromagnetics, and reverse engineering will be given.

Students will be required to work on projects depending on their background and interests.

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