



Department of Mechanical & Industrial Engineering

Laser Applications in Engineering

Goal : This course is designed for graduate students who are interested to obtain an insight to application of lasers in science & engineering where by introducing the basic principles, concepts and modern techniques together with their updated applications, the objective is met.

Course Instructor: Mohammad E. Khosroshahi

I: Fundamentals of Light and Matter

1. The nature of light
2. The nature and states of matter

II: Principles of Lasers

3. Basic Laser theory
4. Laser light properties
5. Laser structure and components
6. Types of lasers and their specifications
7. Laser selection criteria for an application
8. Laser safety

III: Laser-Material Interaction Mechanisms

9. Photochemical
10. Photothermal
11. Photoablation
12. Photodisruption

IV: Optical Techniques

13. Laser-based diagnosis systems
Photoacoustics, Photothermal deflection, Laser-induced fluorescence, Laser plasma spectroscopy, Flowmetry, Interferometry/Holography

V: Nanomaterials

14. Definition, Classification, Properties

VI: Applications of Laser in Engineering

15 A. Materials and Surface Engineering:

Laser surface heat treatment, Laser-material processing (drilling, welding, cutting)
Pulse laser deposition, Laser material removal, Laser improved electrochemical and mechanical properties of materials

B. Mechanical & Industrial Engineering:

- i)- Laser-assisted measurements: NDT (Film thickness, Subsurface monitoring)
Laser Doppler velocimetry, Laser particle velocimetry, Non-contact temperature monitoring
- ii)- Optical imaging & Analysis: Combustion, Fluid flow visualization, Pollution
- iii)- Other applications: Laser rapid prototyping, Laser and microfluid mass transfer
Laser process automation basics, Robotic laser machining

VII: Applications of Laser & Nanomaterials in science & Engineering

16. *Industrial*: Water waste management, Solar cells, Minerals detection
Biomedical: Bioimaging and therapy, Automated laser tissue soldering, Drug delivery