

LASER WELDING TRAINING CERTIFICATE SYLLABUS



DATE: April 28-30, 2026

LOCATION: Photon Technology Center, Farmington Hills, Michigan

INSTRUCTOR: Dr. Najah George, Senior Director of Research and Development

- 1- Laser Basics
 - 1.1 Introduction to laser and laser properties
 - 1.2 Principle of laser generation
 - 1.3 Laser components/resonator
 - 1.4 Laser materials/pump sources
- 2- Industrial Lasers
 - 2.1 Co2 laser
 - 2.2 Excimer lasers
 - 2.3 Nd:YAG Laser
 - 2.4 Fiber lasers
 - 2.5 Disk lasers
 - 2.6 Direct diode laser
 - 2.7 Blue (GaN) diode laser
- 3- Changing Laser Wavelength
 - 3.1 Second harmonic generation (SHG)
 - 3.2 Third harmonic generation (THG)
- 4- Laser Operation Modes
 - 4.1 Continuous laser
 - 4.2 Pulsed laser, Q Switching and Mode-locking
 - 4.3 The symbols, definition and units of a pulsed laser
- 5- Laser Beam Delivery
 - 5.1 Reflective optics
 - 5.2 Transmissive optics
 - 5.3 Beam expander
 - 5.4 Laser beam scanning systems
 - 5.5 Laser optical fiber
- 6- Laser Beam Modes
 - 6.1 Co2 laser modes
 - 6.2 Fiber laser modes
 - 6.3 Beam Shaping (fixed optics and multi fibers)
- 7- Laser Beam Parameters Calculation
 - 7.1 Co2 laser calculation
 - 7.2 Fiber/Disk laser calculation
- 8- Laser Measurements Devices
 - 8.1 Wavelength
 - 8.2 Power/Energy
 - 8.3 Beam profile
- 9- Laser Welding
 - 9.1 Advantage of laser welding
 - 9.2 Laser welding modes
 - 9.2.1 Conduction welding
 - 9.2.2 Keyhole welding
- 10- Laser Welding Process Parameters
 - 10.1 Laser wavelength
 - 10.2 Alignment positioning, laser focus position, and focus shift
 - 10.3 Laser depth of focus
 - 10.4 Laser power and power density
 - 10.5 Laser mode
 - 10.6 Laser beam quality M2
 - 10.7 Beam shaping
 - 10.8 Laser operating mode (Laser operating mode (continuous/pulsed)
 - 10.9 Laser remote welding without/with power modulation
 - 10.10 Hybrid Laser beam welding
 - 10.11 Hot and Cold wire laser welding
 - 10.12 Laser brazing
- 10.13- Materials Properties
 - 10.13.1 Material composition; Chemical composition
 - 10.13.2 Material composition; Thermal properties
 - 10.13.3 Oxide layers
 - 10.13.4 Surface condition/ Surface roughness
 - 10.13.5 Material thickness
 - 10.13.6 Material contamination
- 11- Joint configurations
- 12- Tooling and Motion
 - 12.1 Welding speed
 - 12.2 Alignments
 - 12.3 Shielding gas
 - 12.4 Fume extraction system
- 13- Laser Welding Defects and Qualification
 - 13.1 Surface defects
 - 13.2 Internal defects
- 14- Testing and Inspection of Laser Welds
- 15- In-Line Laser Welding Control, Monitor and Inspection
- 16- Laser welding project design
- 17- Laser welding examples
 - 17.1 Welding similar materials
 - 17.1.1 Stainless Steel (AISI 304)
 - 17.1.2 Aluminum
 - 17.1.3 Copper
 - 17.2 Welding dissimilar materials
 - 17.2.1 Laser Welding Aluminum/Steel
 - 17.2.2 Laser Welding Aluminum- Copper
- 18- Weld troubleshooting
- 19- Maintenance - Optics Cleaning
- 20- Laser Safety
- Testing