



## Certificate Course Outline

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Gain knowledge needed to build the foundation for sound laser welding and process implementation from setup to final weld inspection. Laser Welding Technology Certificate Course is a comprehensive 3-day course that covers the concepts, fundamentals, and applications of laser welding technology. You'll be able to confidently engineer, design, and weld like and unlike materials together, and troubleshoot common problems.

Topic placement subject to change based on attendee needs.

### Day 1

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#### 1- Laser Basics

- Introduction to Laser and Laser Properties
- Principle of Laser Generation
- Laser Components/Resonator
- Laser Materials/Pump Sources

#### 2- Industrial Lasers

- CO2 Laser
- Excimer Lasers
- Fiber Lasers
- Disk Lasers
- Direct Diode Laser
- Blue (GaN) Diode Laser

#### 3- Changing Laser Wavelength

- Second-Harmonic Generation (SHG)
- Third-Harmonic Generation (THG)

#### 4- Laser Operation Modes

- Continuous
- Pulsed Laser, Q-Switching and Mode-Locking
- The symbols, Definitions and Units of Pulse Laser

#### 5- Laser Beam Delivery

- Reflective Optics
- Transmissive Optics
- Beam Expander
- Laser Beam Scanning Systems

#### 6- Laser Beam Modes

- CO2 Laser Modes
- Fiber Laser Modes
- Beam Shaping

#### 7- Laser Beam Calculation

- CO2 Laser Calculation
- Fiber/Disk Laser Calculation

#### 8- Laser Measurements Devices

- Wavelength
- Power/Energy
- Beam Profile



#### Your Instructor:

Dr. Najah George has more than 35 years of experience working with laser technology in the education, research, and industrial Energy Commission (IAEC)/Laser Department. He is the Sr. Director of Research and Development at Photon Automation, Inc. where he oversees an ever-increasing variety of laser material processing projects and provides comprehensive training to customers. Dr. George holds a B.S. in Physics, M.S. in Laser Technology, and a Ph.D. in Solid State Physics.

## Day 2

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### 9- Laser Welding

- Advantage of Laser Welding
- Laser Welding Modes:
  - Conduction Welding
  - Keyhole Welding

### 10- Laser Welding Process Parameters

- Laser Wavelength
- Laser Focus Position and Focus Shift
- Laser Depth of Focus
- Laser Power and Power Density
- Laser Mode
- Beam Shaping
- Laser Operating Mode (Continuous/Pulses)
- Laser Remote Welding
- Hybrid Laser Beam Welding

- Hot and Cold Wire Laser Welding
- Laser Brazing
- Materials Properties:
  - Material Composition; Chemical Composition
  - Material Composition; Thermal Properties
  - Oxide Layers
  - Surface Condition/Surface Roughness
  - Material Thickness

### 11- Joint Configurations

### 12- Tolling and Motion

- Welding Speed
- Alignments
- Shielding Gas
- Fume Extraction System

## Day 3

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### 13- Laser Welding Defects and Qualifications

- Surface Defects
- Internal Defects

### 14- Testing and Inspection of Laser Welds

### 15- In-Line Laser Welding Control, Monitor and Inspection

### 16- Laser Welding Examples:

- Welding Similar Materials
- Stainless steel
- Pulsed Nd/YAG Laser Welding Dual-Phase (DP) 1000 Steel Butt Joint
- Welding Galvanized Steel
- Aluminum
- Welding Dissimilar Materials
- Laser Welding Aluminum/Steel
- Laser Welding Aluminum/Copper

### 17- Weld Troubleshooting

### 18- Maintenance – Optics Cleaning

### 19- Laser Safety