Fiber Optics

CATALOG DESCRIPTION:
In this 60 hour course students will learn basic fiber optics theory and applications. Areas covered include fiber optic transmission, principles of light, optical cables, light sources, detectors, splicing, cable installation, and test equipment.

COURSE OBJECTIVE:
To introduce students to fiber optics principles and applications. Students will be exposed to the theory behind data transmission using light pulses. They will also explore the variety of equipment used to transmit and receive light pulses. Students will be expected to perform hands-on labs utilizing provided tools and material to successfully splice fiber cable and install connectors. They will also be required to use test equipment to determine the success of their efforts. Upon successful completion of this course students should be able to set for and pas the ETA (Electronics Technicians Association) Fiber Optics Installer and Technician examinations.

COURSE LEARNING OUTCOMES:
Upon completion of the course the students should be able to:

- List a chronology of events leading to today's fiber optics technology
- Describe the four basic parts of a fiber optic link
- Describe the basic operation of a fiber optic transmitter
- Describe the basic operation of a fiber optic receiver
- Explain the purpose of decibels (dB's) and convert power levels to and from decibel equivalents
- Explain how optical power is measured (dBm), express optical power levels in dBm
- Explain the health risks when working with LED and laser light sources
- List all of the safety procedures pertaining to fiber optic cable handling and disposal
- Describe hazards pertaining to chemicals as defined by the manufacturer's material safety data sheet (MSDS)
- List different types of environmental work place hazards cable workers may face (ladders, high voltage, confined spaces, underground)
- Describe the electromagnetic spectrum and locate light frequencies within the spectrum in relation to other communications frequencies
- Describe how the index of refraction is used
- Define Fresnel reflection loss
- Explain the effects of refraction and Snell's Law
- Name the two common materials out of which the optical fiber is manufactured
- List common classifications for fiber optics cable
- Describe the purpose of the optical fiber coating
- Describe refractive index profiles and their purpose
- Define mode
- Explain modal dispersion and its importance to fiber optics
- Define material dispersion
- Demonstrate the effects of excessive bending on an optical fiber
- Explain how the cone of acceptance defines the maximum angle of light acceptance in an optical fiber
- Compare twisted pair bandwidth performance with multi mode and single-mode optical fiber
- Describe attenuation in copper and optical fiber
- Explain why electromagnetic immunity is superior in optical fiber
- Describe the weight saving advantages of fiber optic cable over copper cable

- Describe the size advantage of fiber optic cable over copper cable.
- Compare the safety advantages of fiber optic cables over copper cables.
- Compare the security advantages of optical fiber over copper
- Draw a cross section of a fiber optic cable and explain the purposes of each segment
- Explain why and where loose tube fiber optic cable is used
- Describe tight buffered fiber optic cable
- Identify the strength member in a fiber optic cable
- Specify the cable jacket material used in common types of fiber optic cables
- Explain the difference between Installation specifications and environmental specifications
- Explain the differences between cordage and cable
- List applications where cordage is preferred
- Explain why and where distribution fiber optic cable is used.
- Explain why and where breakout fiber optic cable is used
- Explain why and where armored fiber optic cable is used
- Explain what a messenger cable is and how it is used
- Describe ribbon fiber optic cable
- Explain what hybrid/composite cables are and where they are ordinarily used
- Explain how the TIA/EIA 598-B color code is used to identify individual fiber optic cables
- Describe cable markings and how they are used
- Define tensile strength of a fiber optic cable and explain the reasons an installer would need to know the strength of various cables
- Explain the safety classifications and types of light sources used in fiber optic communications
- Explain the differences between light emitting diodes and laser diodes
- List the common wavelengths used in fiber optic communications and the advantages and disadvantages of each
- Describe the basic operation of a photodiode
- Identify TIA/EIA 568-B.3 standard connector types
- Describe ferrule materials used with fiber optics connectors
- Explain intrinsic factors applicable to optical fiber performance
- Explain extrinsic factors applicable to fiber optic connector performance.
- Define physical contact (PC) finish and how it is used to reduce back reflection.
- Define angled physical contact (APC) finish and how it is used to reduce back reflection
- Describe how and where pigtails are used in fiber optic cabling
- Describe the benefits and applications of anaerobic epoxy in fiber optic connector termination
- Describe the benefits and applications of UV epoxy in fiber optic connector termination
- Describe the benefits and applications of oven-cured epoxy in fiber optic connector termination
- Describe the benefits and applications of epoxy-less fiber optic connector termination
- List steps taken in properly performing a visual Inspection of fiber optic connectors.
- List ways to properly clean and care for fiber optic connectors
- Explain the basic operation of optical couplers
- Describe where a T coupler is used
- Describe where a star coupler is used
- Mechanical Splicing:
- Explain the differences between intrinsic factors and extrinsic factors when splicing fiber optic cables
- Describe the use of index matching gel in fiber optic splicing
- Describe a cable tray and splice closure and explain the usage of each Describe the performance advantages of a fusion splice over a mechanical splice.
- Describe the basic operation of a fusion splice machine
- Describe the basic application of a protective sleeve in a fusion splice
- Explain dynamic tensile loading and why it allows for higher loading
- Explain static tensile loading
- Explain dynamic bend radius and the TIA/EIA 568-B.3 guidelines
- Explain static bend radius and the TIA/EIA 568-B.3 guidelines
- Describe the use of pulling tape
- Describe the use of a pulling grip
- Describe plenum and plenum rated fiber optic cable as defined by the National Electric Code (NEC) Article 770
- Describe riser and riser rated fiber optic cable as defined by the NEC
- Describe general purpose and general purpose rated fiber optic cable as defined by the NEC
- Describe conductive fiber optic cable as defined by the NEC

- Describe non-conductive fiber optic cable as defined by the NEC
- Describe composite cable as defined by the NEC
- Explain where conduit should be installed to enclose fiber optic cables
- Describe the requirements for tray and duct installation of fiber optic cabling
- List the considerations for basic fiber optics system design
- Prepare a basic optical link power budget and explain its importance
- Describe the basic theory and operation of a fiber optic light source
- Describe the basic theory and operation of a fiber optic power meter
- Describe the basic theory and operation of an optical time domain reflectometer (OTDR)Describe the basic theory and operation of a visual fault locator
- Describe the basic theory and operation of a fiber identifier
- Describe how to use a fiber identifier to locate a fault.
- Describe how to use a visual fault locator to locate breaks in the optical fiber.
- Describe OTDR signatures
- Explain why the index of refraction is important for accurate testing
- Describe the requirements for documenting link performance during acceptance testing

LAB LEARNING OUTCOMES:

- Measure the loss in a fiber optic cable using a light source and power meter as defined by TIA/EIA 526-14A
- Use an OTDR to measure loss per unit length, evaluate connectors and splices and locate faults.
- Install and test a mechanical splice
- Install and test a fusion splice
- Fabricate and test selected connectors
- Polish and inspect selected connectors