Fiber Optics and Optical Calibration

Course No. 138 (former course 174)

APPLICATIONS This course relates to a broad range of fiber optic applications such as telecommunications, automotive, space and military telecommunication systems.

FOR WHOM INTENDED This course provides an excellent foundation in optics and the use of fiber optic cabling for division chiefs and QA/QC personnel as well as technical personnel involved in design, manufacturing and testing and calibration of fiber optic cables and laser applications. It is especially useful for engineers involved in telecommunications design as well as those designing and testing fiber optics replacement systems for traditional wiring, especially on-board systems such as aircraft, military vehicles, space and naval vessels and automotive platforms.

BRIEF COURSE DESCRIPTION This course provides an understanding of the theory of optics and its application in the transmission of data along fiber optic cables. Advantages of using fiber optics are discussed such as: a large amount of data (wide bandwidth) can be transmitted over a single piece of fiber at high speeds; optical transmission is less susceptible to electromagnetic interference (EMI), thus reducing problems due to noise and increasing the security of data transmission.

Disadvantages of fiber optics are discussed along with measures needed to overcome them, such as selecting good quality connectors and preparing procedures and training for fiber optic system assemblers.

The course covers each item in the fiber optic system, such as types of fiber, light source, transmitters, receivers, repeaters, amplifiers, together with test and measurement techniques. Special emphasis is placed on Dense Wavelength-Division Multiplexing (DWDM) applications. Calibration of instruments and systems for the measurement of optical properties is covered in detail, including optical power meters, wavemeters, optical spectrum analyzers and polarization controllers.

DIPLOMA PROGRAMS This course is a recommended optional course for TTi's Instrumentation Test Specialist (ITS) Diploma Program, and may be used as an optional course for any other TTi specialist diploma program.

RELATED COURSES Course 172, Fiber Optic Systems, covers related material but omits calibration and goes into greater depth on optical theory and fiber optic systems.

PREREQUISITES There are no definite prerequisites for this course. However, this course is aimed toward individuals involved in a related technical field.

TEXT Each student will receive 180 days access to the online electronic course workbook. Renewals and printed textbooks are available for an additional fee.

COURSE HOURS, CERTIFICATE AND CEUS Class hours/days for on-site courses can vary from 14–35 hours over 2–5 days as requested by our clients. Upon successful course completion, each participant receives a certificate of completion and one Continuing Education Unit (CEU) for every ten class hours.

Course Outline

Introduction to Light Properties
- Light • Wave Theory • Particle Theory • Light Phenomena
- Light Properties – Wavelength • Electromagnetic Spectrum

Introduction to Light Transmission
- Light Energy • Coherence • Interference • Reflections
- Polarization • Spectrum • Poincaré Sphere

Optical Fiber Basics
- Copper vs. Fiber-Optic Cables: Advantages, Disadvantages
- Glass Optical Fiber • Plastic Optical Fiber
- Light Wave Propagation: Refractive Index • Critical Angle • Snell's Law • Numerical Aperture Number
- Optical Fiber Modes: Single and Multimode Optical Fiber
- Dispersion: Modal, Material, Chromatic
- Attenuation: Attenuation Coefficient • Bending Loss • Cut-off

Light Source: Laser principal, Laser pump, other light sources
- Types of lasers • Laser Safety • Power classifications
- Core size, Fiber size, Light guiding, Energy Loss, Efficiency
- Light collection, LED sources, Semiconductor laser sources

Application of Optics to Data Transmission Systems
- Basic Data Transmission Link • Typical Long Link
- Regenerators • Optical Amplifiers • Speeds • Modulation
- Multiplexing: Time Division Multiplexing (TDM) Dense Wavelength-Division Multiplexing (DWDM)

Chromatic Dispersion Measurements
- Speed of Light vs. Signal Speed • Definitions • Dispersion Compensating Fiber (DCF) • Chirped Fiber Bragg Gratings
- Polarization Mode Dispersion (PMD)

Fiber Optic Cabling, splicing and connectors:
- Cable structure, Cable installation, Cable failure,
- Application and types of fiber splices, Testing, Connectors

Testing DWDM Passive Optical Components: Bandwidth • Capacity
- Wavelengths • Components • Dispersion Compensators
- Fiber Bragg Gratings (FBGs) • Common Tests • Dispersion Measurements • Loss Measurement • Mueller Matrix
- Polarization Test Methods • Return Loss (RL) Tests
- Calibration • Source Monitoring • Insertion Loss
- Dynamic Range • Low-SSE Tunable Laser Cavity
- Wavelength Accuracy, Meters, References
- Swept Insertion Loss

Application of Eye Diagrams

Introduction to Metrology and Calibration
- Measurement Standards and Traceability
- Technical Requirements in Calibration Programs
- ISO Standard 17025

Fiber Optic Calibration: Specifications and Devices
- Optical Power Meter • Traceability • Uncertainty Sources
- Calibrating Linearity • Cleanliness • Cletop Device
- Patch Cords • Connectors • Optical Sources
- Wavelength Standards • Spurious Emissions
- Wavemeter • Filters • Optical Spectrum Analyzers
- OTDR: Back Reflection, Artifacts • Optical Attenuator
- DCA and CSA • Optical Amplifiers • Polarization Controllers
- SONET Generator & Analyzers • SONET Tester

Conclusion, Final Review

Award of certificates for successful completion

Technology Training, Inc.
(a tti group company)
Toll-free tel: 866-884-4338 (866-tti-4edu)
International: 805-845-5050
E-mail: Training@ttiedu.com
www.ttiedu.com