Fiber Optic Systems

Course No. 172

APPLICATIONS This course covers a broad range of fiber optic applications such as telecommunications, automotive, space and military telecommunication systems. Fiber optics systems were used aboard the space shuttle Endeavor during its February 2000 mission. The Calibration Optical Loop (COL) utilized fiber optics to transmit signals from the shuttle bay to the remote antenna. The system was designed for stable operation despite outside temperatures variations due to the earth's shadow effect on the Shuttle. The temperature changes would have affected the resistance of a conventional electrical cabling system resulting in more complicated systems.

FOR WHOM INTENDED This course provides an excellent foundation in optics and the use of fiber optic cabling for business managers, division chiefs and QA/QC personnel as well as technical personnel involved in design, manufacturing and testing 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 knowledge which will enable evaluation of system upgrades with improved data transfer to overcome present day problems. This course provides an understanding of the theory of optics and its application in the transmission of data along fiber optic cabling. Most courses on fiber optics concentrate on the most common use of fiber optics, in the transmission of telecommunication signals.

The 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 also less susceptible to electromagnetic interference (EMI), reducing problems due to noise and increasing the security of data transmission.

Disadvantages of fiber optics and measures needed to overcome them are discussed, 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. Fiber optic sensors and other applications, both military and commercial, are discussed.

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

RELATED COURSES Course 138 (formerly course 174), Fiber Optics and Optical Calibration, covers related material but adds calibration of 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 on-line 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 and Review
Review of Basic Telecommunications Theory
- POTS, Telephones, Telephone numbers, Central Office
- Telecommunications Protocols: Standards, ITU Study Groups, MIL-STD-188 • Federal Standard 1037C
- Telecommunications Network
- Open Systems Interconnection Reference Model (OSI Model): Layers, Switching, Protocols, Frames, Physical Layer

Introduction to Light Properties: Wave & Particle Theory • Light Phenomena • Wavelength • Electromagnetic Spectrum • Coherence • Interference • Unwanted Transmission Reflections • Polarization • Spectrum
Optical Fibers: Copper wire vs Fiber, Glass vs Plastic Optical Fiber
- Propagation of Light Waves • Refractive Index (n) • Speed of Light • Optical Dielectric Wave Guide • Critical Angle (θ_c)
- Snell's Law • Numerical Aperture (NA)
- Optical Fiber Modes: Single and Multimode • Refractive Index • Mode Properties • High and Low Order Transmission Modes
- Dispersion: Modal, Material, Chromatic • Attenuation
- Bending Loss • Cut-off Wavelength

Light Sources: Light • Spectrum • Other Light Sources
- Laser Principals and Types • Resonators and Oscillators • Safety

Application of Optics to Telecommunications Systems
- Fiber vs. Copper • Basic Fiber Optic Telecommunications Link
- Regenerators • Optical Amplifiers (OAs) • Telecomms Trends
- Advanced Telecommunications Network Standards
- Dense Wavelength-Division Multiplexing (DWDM)
- Asynchronous Transfer Mode (ATM) • Transmission Speeds
- Digital Modulation • Time Division Multiplexing (TDM)
- Monitoring and Restoring Optical Networks

Fiber Optic Cabling: Cable structure, Splices, Physical Medium
- Connectors: Types, Installation, Care

Erbium Doped Fiber Optical Amplifiers (EDFA): Design, Properties
- Gain, Categories, Commercial EDFA, Other amplifier types

Chromatic Dispersion Measurements: Definitions, Speed of light
- Chirped Fiber Bragg Gratings • Reference Wavelength
- Modulation • Wavelength Resolution • Interference Filter

Testing DWDM Passive Optical Components
- Increasing Bandwidth, Capacity • Wavelengths •
- Passive Components • Fiber Bragg Gratings (FBGs) • Tests
- Polarization Dependent Loss (PDL) • Return Loss (RL)
- Dispersion and Loss Measurement • Swept Loss Measurement
- Polarization Dependent Loss (PDL) Tests • Mueller Matrix
- Instrumentation, Wavelength Meters • Calibration

Application of Eye Diagrams:
- Dispersion, Chromatic, Polarization Mode
- NRZ and RZ signals • Jitter • Bit Error Rate (BER)

Fiber Optic Sensors: Accelerometers, Downhole Applications
Applications: Medical, Automotive, Civil Aviation, Defense, Space
Optical Devices being Developed at Naval Research Laboratory
Modern Communication Systems for US Air Force Aircraft Fleet
Conclusion, Final Review
Award of certificates for successful completion

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