

College of Micronesia – FSM
P.O. Box 159
Kolonia, Pohnpei

Course Outline Cover Page

Fiber Optics Installation

Course Title

VTE 261

Department and Number

Course Description:

This course is designed to teach students how to safely and properly splice, terminate, and test fiber optics cables. Students will be using the latest technology to troubleshoot and repair fiber optics cables. Coursework will include the use of mechanical and fusion splicing, termination techniques on various types of fiber optic end connectors, the use of the Optical Time Domain Reflectometer (OTDR) to troubleshoot fiber optics cables, and the use of light source & power meter.

Prepared by: Gardner Edgar

State: Pohnpei Campus

	Hours per Week	No. Of Weeks	Total Hours	Semester Credits
Lecture	3/6	16/8	48	3
Laboratory	3/6	16/8	48	1
Total Semester Credits:				4

Purpose of Course

Degree Requirement	_____
Degree Elective	_____ X _____
Advanced Certificate	_____ X _____
Certificate	_____
Remedial	_____
Other (Workshop)	_____

Prerequisite Course(s): VEE 103 and VEE 104 or VEM 103 and VEM 104

Signature, Chairman, Curriculum Committee

Date Approved by Committee

Signature, President, COM-FSM

Date Approved by the President

GENERAL OBJECTIVE:

Students in this course will learn how to splice, terminate, and test fiber optics cables using the latest technology in the field of fiber optics.

Learning Outcomes:

Upon successful completion of this course the student will be able to:

1. Describe the fundamentals of a fiber optic communication system.
2. Explain the safety precautions and the proper work practices associated with fiber optics
3. List the applications and advantages of fiber optics.
4. Describe the construction, components, tools, and operating characteristics of a fiber optic cable.
5. Identify and describe the loss factors in a fiber optics cable.
6. Describe the proper procedures of a fiber optics installation in compliance with NEC and TIA/EIA standards.
7. Safely and properly use the OTDR to test and troubleshoot a fiber optic cable or installation.
8. Safely and properly prepare a fiber optic cable.
9. Safely and properly perform fiber preparation procedures.
10. Safely and properly perform fiber optics splicing procedures: Fusion and Mechanical.

NOTE.

**SAFETY GLASSES AND LONG PANTS
MUST BE WORN AT ALL TIMES DURING
PRACTICAL EXERCISES.**

***STUDENTS SHOULD BE MADE AWARE OF OCCUPATIONAL
HEALTH AND SAFETY ISSUES IN ALL SITUATIONS AND BE
EXPECTED TO DEMONSTRATE SAFE WORKING PRACTICES AT
ALL TIMES.***

OUTLINE OF CONTENT:

The course content is as follows:

1. Fundamentals of fiber optics systems
 - a. Block diagram of a fiber optic link
 - b. Roles of fiber optics as a medium
 - c. Milestones in optical system
 - d. Optical communications systems
 - i. Modes of fiber: singlemode and multimode
 - ii. Basic parts of a fiber: coating, cladding, core
 - iii. Power sources: Wavelengths

2. Safety in fiber optics
 - a. Safety rules before handling fiber
 - b. OSHA and NEC regulations
 - c. Working conditions
 - d. Safety hazards
 - e. Classes of lasers
 - f. Disposal of fibers
 - g. Chemical safety

3. Applications and advantages of fiber optics
 - a. Applications of fiber optics
 - i. Telecommunications
 - ii. LAN
 - iii. Factory and military systems

 - b. Advantages of fiber optics
 - i. Wide Bandwidth
 - ii. Low loss
 - iii. EMI
 - iv. Size

4. Fiber Optics System
 - a. Primary and secondary coatings
 - b. Cable construction process
 - c. Cable testing techniques
 - d. Cable components
 - e. Types of cables and connectors
 - f. Types of splices
 - g. Fiber optics color codes

5. Loss Factors in fiber optics systems
 - a. Conditions for low loss testing
 - b. Units of power in fiber optics: dBm
 - c. Unit of measure of loss: dB
 - d. Sources of loss: intrinsic and extrinsic

6. Installing Fiber Optic Cable
 - a. Applicable codes: NEC and TIA/EIA standards
 - b. Storage locations and required documentations
 - c. Cable requirements: bend radius, pulling tension, and slack
 - d. Sequential Reports: cable system records

7. The use of OTDR
 - a. Operating principles of OTDR
 - b. Basic operation of OTDR

- c. Wavelengths of OTDR
 - d. Using OTDR to test fiber optic cables
8. Preparing Fiber Optic Cable
- a. Proper procedures in preparation of fiber optic cable
 - b. Proper tools in preparing the fiber optic cable
 - c. Safety precautions
 - d. Grounding and bonding of optical system
9. Fiber Preparation
- a. Process for preparing fiber for splicing
 - i. Stripping fiber
 - ii. Cleaning fiber
 - b. Process for cleaving the fiber
 - i. Cleave using various types of cleavers
 - 1. Thomas & Betts
 - 2. Siecore
 - 3. Fujikura
10. Splicing
- a. Fusion splicing
 - i. Prepare fiber
 - ii. Strip fiber
 - iii. Cleave fiber
 - iv. Splice fiber (0.2dB loss)
 - b. Mechanical splicing
 - i. Prepare fiber
 - ii. Strip fiber
 - iii. Cleave fiber
 - iv. Splice fiber (0.2dB loss)

LEARNING OUTCOMES: On completion of this course the learner will be able to:

Learning Outcome 1 **Describe the fundamentals of a fiber optic communication system.**

- Assessment Criteria
- a. Describe the block diagram of a fiber optic link
 - c. Define the use of electronics to gather, store, manipulate and move information.
 - d. Describe the role of fiber optics as a communications medium
 - e. Discuss the milestone in optical system
 - f. Differentiate copper and fiber in terms of carriers.

- g. Define mode and list two modes of fiber
- h. List applications of single-mode and multimode
- i. Describe three basic parts of a fiber
- j. Identify and describe three wavelengths of lights used in fiber optics systems.

Assessment Method Multiple choice questions
Short answer questions

Assessment Condition Students must pass all assessment criteria with a minimum of 75% of efficiency on written/performance test

Learning Outcome 2 Explain the safety precautions/hazards and the proper work practices associated with fiber optics

- Assessment Criteria
- a. List safety rules before handling fiber
 - b. Follow all safety regulations OSHA and NEC
 - c. Present a proper and safe working environment
 - d. Identify various potential hazards associated with fiber optics (electrical, glass particle, chemical, radiation)
 - e. Describe classes of laser (class 1, class 2, class 3, and class 4)
 - f. Explain the proper procedures of disposing of fiber and cleaning materials
 - g. Identify proper safety equipment used when working with fiber
 - h. Define MSDS form
 - i. Identify the authorized chemicals used in fiber preparations

Assessment Method Multiple choice questions
Short answer questions
Practical performance

Assessment Condition Students must pass all assessment criteria with a minimum of 75% of efficiency on written/performance test

Learning Outcome 3 List the applications and advantages of fiber optics

- Assessment Criteria
- a. List the applications of fiber in telecommunications
 - b. Describe the application in premise wiring
 - c. Describe the applications in LAN, factory automation, and military.
 - d. Describe wide bandwidth

- e. Describe low loss
- f. Define electromagnetic immunity (EMI)
- g. Describe light weight and physical size compared to copper cable.

Assessment Method Multiple choice questions
Short answer questions

Assessment Method Students must pass all assessment criteria with a minimum of 75% of efficiency on written test

Learning Outcome 4 Describe the construction, components, tools, and operating characteristics of a fiber optic cable.

- Assessment Criteria
- a. Describe primary and secondary coatings
 - b. Explain the cable construction process
 - c. Identify cable testing techniques
 - d. Identify cable components
 - e. Describe hybrid, plenum, and riser cables
 - f. Identify two types of indoor cables
 - g. Describe loose tube gel filled (LTGF)
 - h. Explain the difference between connectors and splices
 - i. Identify the types of connectors being used in optical system
 - j. Identify the two types of splices used in optical system
 - k. List the color code of fiber cable in order.

Assessment Method Multiple choice questions
Short answer questions

Assessment Condition Students must pass all assessment criteria with a minimum of 75% of efficiency on written test

Learning Outcome 5 Identify and describe the loss factors in a fiber optic cable

- Assessment Criteria
- a. Describe the conditions for low loss testing
 - b. Identify sources of loss in fiber systems
 - c. Describe causes of losses in an interconnection
 - d. Explain attenuation
 - e. Define decibel (dB) and decibel milli-watt (dBm)
 - f. Describe fiber termination losses
 - g. Define microbend and macrobend losses
 - h. Describe absorption and light scattering on a optical system

	i.	Explain the effects of bend radius on a optical system
Assessment Method		Multiple choice questions Short answer questions
Assessment Condition		Students must pass all assessment criteria with a minimum of 75% of efficiency on written test
Learning Outcome 6		Describe the proper procedures of a fiber optic installation in compliance with NEC and TIA/EIA standards
Assessment Criteria	a.	Define NEC and TIA/EIA standards
	b.	Outline material and equipment list
	c.	Explain the amount of slack to be placed on ends of the fiber, splice points, manholes, and junction boxes
	d.	Define minimum bend radius and pulling tension of the fiber optic cable
	e.	Prepare cable system records: Outline record sequentials
	f.	List the standards in the TIA/EIA standard
Assessment Method		Multiple choice questions Short answer questions Performance test
Assessment Condition		Students must pass all assessment criteria with a minimum of 75% of efficiency on written/performance test
Learning Outcome 7		Safely and properly use the OTDR to test and troubleshoot a fiber optic cable
Assessment Criteria	a.	Identify various sections of an OTDR
	b.	Explain the basic operation of an OTDR
	c.	Identify testing procedures using the OTDR
	d.	Define OTDR
	e.	Define Rayleigh scattering, Fresnel reflection, and backscatter.
	f.	Define dynamic range and dead zone.
	g.	Determine connector types and external interfaces used in OTDR
	h.	List wavelengths associated with single-mode and multimode fibers.
	i.	Define long pulse & short pulse and usage in optical system

- j. Perform fault locations, distance and loss measurements on fiber optic cables
- k. Perform Reflectance test on fiber optic cables
- l. Perform automatic test on fiber optic cables
- m. Perform non-reflective break test on fiber optic cables
- n. Determine ghost reflection on the OTDR

Assessment Method

Multiple choice questions
Short Answer questions
Performance test

Assessment Condition

Students must pass all assessment criteria with a minimum of 75% of efficiency on written/performance test

Learning Outcome 8

Safely and properly prepare a fiber optic cable

Assessment Criteria

- a. Observe the proper procedures in preparation of fiber optic cable
- b. Identify proper tools in preparing the fiber optic cable
- c. List all safety precautions when preparing fiber optic cable
- d. Remove sheath from non-armored and armored fiber cable using the proper tool
- e. Remove central strength member on fiber optic cable
- f. Remove filled gel with filled cleaner and lint free cloth
- g. Remove buffer tube with the proper tool to expose fiber stands for termination or splicing
- h. List all applicable building codes to follow when preparing fiber optic cable
- i. Prepare the fiber optic cable for grounding and bonding in compliance with all building codes and standards outline in the TIA/EIA

Assessment Methods

Multiple choice questions
Short answer questions
Performance test

Assessment Condition

Students must pass all assessment criteria with a minimum of 75% of efficiency on written/performance test

Learning Outcome 9

Safely and properly perform fiber preparation procedures

Assessment Criteria

- a. Explain the importance of cleanliness and using proper work practices when working with fiber

- b. Explain the importance of stripping and cleaving when working with fiber
- c. Strip fiber to the approximate length
- d. Clean fiber using recommended field cleaner
- e. Cleave fiber using Thomas & Betts cleaver
- f. Cleave fiber using Sicores cleaver
- g. Cleave fiber using Fujikura cleaver

Assessment Method	Multiple choice questions Short answer questions Performance test
Assessment Condition	Students must pass all assessment criteria with a minimum of 75% of efficiency on written/performance test
Learning Outcome 10	Safely and properly perform fiber optics splicing procedures
Assessment Criteria	<ul style="list-style-type: none"> a. Perform a 0.2dB loss on fusion splicing b. Prepare fiber for fusion splicing c. Strip fiber to proper length for fusion splicing d. Cleave fiber for fusion splicing e. Clean and splice fiber using fusion splicer f. Test fiber for total attenuation loss g. Perform a 0.2dB loss on mechanical splicing h. Prepare fiber for mechanical splicing i. Strip fiber to proper length for mechanical splicing j. Cleave fiber for mechanical splicing k. Clean and splice fiber using mechanical method l. Test fiber for total attenuation loss
Assessment Method	Multiple choice questions Short answer questions Performance test
Assessment Condition	Students must pass all assessment criteria with a minimum of 75% of efficiency on written/performance test

REQUIRED COURSE MATERIALS:

1. Instructor
 - a. Facility – classroom and laboratory
 - b. Equipment:
 - i. Light source and Power meter
 - ii. Optical Time Domain Reflectometer (OTDR)
 - iii. Fusion Splicer
 - iv. Talk set

- c. Hand tools
 - i. Miller strippers
 - ii. Jacket remover
 - iii. Cable slither
 - iv. Snips (scissors)
 - v. View Scope
 - vi. Visible Laser
 - vii. Mechanical Splicer
 - viii. Cleavers
 - 1. Thomas & Betts
 - 2. Siecore
 - 3. Fujikura
 - ix. Polishing Pad Kit
 - x. Oven and Cooling stand
 - d. Materials:
 - i. Fiber Optic Cables
 - 1. multimode and single-mode (non armored)
 - 2. multimode and single-mode patch cords
 - ii. Connectors – ST and SC
 - iii. Mechanical Splice Connectors
 - iv. Splice Sleeves
 - v. Fan out kit
 - vi. Lint free cloth
 - vii. Gel Filled Cleaner
 - viii. Enclosure Boxes
 - ix. Wall and Rack Mount Patch Panels
2. Student:
- a. **Required Textbook:** Technician's Guide to Fiber Optics, Donald J. Sterling, Jr., 3rd edition, 2000
 - b. Ring binder
 - c. College ruled note sheet, pencil or pen
 - d. Scientific calculator
 - e. Lab/shop fee – course materials [expendable items] *see attachment*

REFERENCE MATERIALS:

Technician's Guide to Fiber Optics, Donald J. Sterling, Jr., 3rd edition, 2000
Fiber Optic Cable System Installation, Eric Pearson, 1997

METHOD OF INSTRUCTION:

- 1. Lecture/Discussion/Demonstration
- 2. Practical Performance

3. Video Presentation

EVALUATION:

Final Grade for this course will be based on meeting the course requirements at the following percentage rates:

90% - 100%	A – Superior
80% - 89%	B – Above Average
70% - 79%	C – Average
60% - 69%	D – Below Average
0 % - 59%	F – Failure

ATTENDANCE:

The COM-FSM Attendance Policy will apply

HONESTY:

The COM-FSM Honesty Policy will apply

A student is required to pay a \$50 fee to cover course materials [expendable items] used in the course.

Materials:

- Fiber optics cables
- Connectors
- Splice sleeves
- Fan out kits
- Polishing kit
- Gel filled cleaner
- Lint free cloth
- Splice organizer tray
- Paper towels
- Electrical tape