Republic of Rwanda
Ministry of Education

RTB | RWANDA TVET BOARD

FIBER OPTIC NETWORK DEPLOYMENT

NITFO401

Deploy Fiber optic network

Competence

RQF Level: 4

Learning Hours 60

Credits: 6

Sector: ICT and Multimedia

Trade: Networking and Internet Technologies

Module Type: Specific

Curriculum: ICTNIT4001 TVET Certificate IV in Networking and Internet Technologies

1200

Issue Date: September/2023

<table>
<tr><td>Purpose statement</td><td colspan="6">This module describes the skills, knowledge and attitude required to deploy fiber optic network.
This module is intended to prepare students pursuing TVET Level 4 in Networking and Internet Technologies.
At the end of this module, students will be able to Plan fiber optic network, Implement Fiber optic network and Maintain fiber optic network.</td></tr>
<tr><td>Learning assumed to be in place</td><td colspan="6">N/A</td></tr>
<tr><td rowspan="6">Delivery modality</td><td colspan="2">Training delivery</td><td>100%</td><td colspan="2">Assessment</td><td>Total 100%</td></tr>
<tr><td colspan="2">Theoretical content</td><td>30%</td><td rowspan="4">Formative assessment</td><td>30%</td><td rowspan="4">50%</td></tr>
<tr><td colspan="2">Practical work:</td><td rowspan="3">70%</td><td rowspan="3">70%</td></tr>
<tr><td>Group project and presentation</td><td>20%</td></tr>
<tr><td>Individual project /Work</td><td>50 %</td></tr>
<tr><td colspan="2"></td><td colspan="2">Summative Assessment</td><td>50%</td></tr>
</table>

Elements of Competence and Performance Criteria

Elements of competency	Performance criteria
1. **Plan fiber optic network**	1.1 Site survey is properly conducted according to fiber optic site environment
	1.2 Materials are properly selected based on Fiber optic network design
	1.3 Fiber optic network is properly designed according to the site survey findings
2. **Implement fiber optic network**	2.1 Fiber optic deployment route is selected based on network design
	2.2 Fiber optic is properly spliced based on fiber optic network design and standards
	2.3 Fiber optic cable is properly patched according to the network design

	2.4 Fiber optic equipment are properly deployed based on fiber optic network design
	2.5 Link continuity is correctly tested according to Fiber optic network design
	2.6 Technical documentation is properly generated based on the implementation
3. **Maintain fiber optic network**	3.1 Fiber optic network is properly monitored according to the network standards
	3.2 Fiber optic network troubleshooting is properly Performed according to monitoring report
	3.3 Troubleshooting report is correctly generated according to the work done

Intended Knowledge,Skills, and Attitude

Knowledge	**Skills**	**Attitude**
✓ Describe of fiber optic concepts ✓ Identify of materials and equipment ✓ knowledge of fiber optic components ✓ electrical components ✓ Knowledge data rate	✓ Identify fiber requirement ✓ Measure Data rate ✓ Identify fiber optic route ✓ Design fiber optic deployment map ✓ Deploy fiber optics ✓ Document Fiber network ✓ Estimate cost /Prepare bill of	✓ Customer care ✓ Multi-tasking ✓ Teamwork ✓ Flexibility ✓ Self-confidence ✓ Integrity ✓ Honesty ✓ Self-motivation ✓ Punctuality

	quantities ✓ Problem solving skills	✓ Creativity ✓ Patience ✓ Accountability

Course content

Learning outcomes	**At the end of the module the learner will be able to:** 1. Plan fiber optic network 2. Implement Fiber optic network. 3. Maintain fiber optic network
Learning outcome 1: Plan fiber optic network	**Learning hours: 15**
Indicative content	

- **Conducting site survey**
  - ✓ Description of fiber optic
    - Definition of key terms (fiber optic cable, fiber optic network, loop ring)
    - Types of fiber optic cables
    - Parts of Fiber optic cable
    - Fiber Color code
    - Characteristics of Fiber optic cable
    - ✓ Types of fiber optic network connection
      - Dedicated Connection
      - Point-to-Multipoint Connection
    - ✓ Fiber optic network topology

- ✓ Apply Data collection.
  - Terrain details
  - Terrain obstacles
- ✓ Prepare bill of quantities

- **Identification of materials and equipment**
  - ✓ Materials
    - Fiber Optic Cables
    - Fiber Optic Connectors and Adapters
    - Fiber Optic closure
    - Fusion Splice Sleeves
    - Mechanical Splice Connectors
    - Fiber Optic Cable Ducts and Conduits
    - Fiber Optic Cable Trays and Supports
    - Fiber Optic Patch Cords and Pigtails
    - Fiber Optic Distribution Frames (ODF)
  - ✓ Equipment
    - Router
    - switch
    - Media converter
    - Small form factor pluggable (SFP)
    - Fiber optic light source tester
- **Design Fiber optic network**
  - ✓ Selection of transmission equipment

- ✓ Identification of components
- ✓ Calculation of link loss budget
  - Fiber loss
  - Splicing loss
  - Connector loss
  - Splitter loss
- ✓ Reserve restoration cable
- ✓ Select Fiber optic route.
- ✓ Schedule installation
- ✓ Produce route map

Resources required for the learning outcome	
Equipment	▪ Router ▪ switch ▪ Media converter ▪ Small form factor pluggable (SFP) ▪ Fiber optic light source tester
Materials	▪ Fiber optic cable ▪ Optical Fiber optic closure ▪ Optical Fiber Distribution Frame (ODF) ▪ Optical Fiber jumper cords (OJC) ▪ Optical Connectors
Tools	Pooling machine, Blowing Machine, Splicing machine, Optical Timer Domain Reflectometer, Tubing cutter, Buffer tube cuter, Pliers, read light, Jacket stripper, Kevlar scissor, Tweezers, Fiber Scribe, Cleaver, Fiber Stripper, Fiber optic power meter, Knife, Cleaning tool, Screwdriver.
Facilitation techniques	Demonstration, Group discussion and practical work
Formative assessment	Written assessment and Performance assessment

methods /(CAT)	

Learning outcome 2: Implement Fiber optic network.	**Learning hours: 25**

Indicative content

- **Selection of Fiber optic deployment route.**
  - ✓ Equipment
    - Router
    - switch
    - Media converter
    - Small form factor pluggable (SFP)
    - Fiber optic light source tester
  - ✓ Tools
    - Splicer machine (Mechanical and Fusion)
    - Fiber Optic Testing Equipment
    - Fiber Optic Cable Blowing and Pulling
    - Hand tools
    - Fiber Optic Cable Cutter
    - Visual Fault Locator (VFL)
    - Cable Tracing and Labelling Tools
    - Fiber Optic Cleaning Tools
    - Cable Pulling and Installation Tools
    - Fiber Optic safety tools
  - ✓ Types of Fiber optic route installation

- Underground Fiber installation
- Overhead Fiber installation

✓ Key considerations of choosing Fiber optic route installation

- Location and visibility
- Environment consideration
- Reliability and resilience
- Cost

- **Deployment of Fiber optic equipment.**
  - ✓ Fiber Optic closure
  - ✓ Fiber optic distribution Flame
  - ✓ Cabinet Rack
- **Perform Fiber optic Splicing.**
  - ✓ Description of Splicing process
  - ✓ Types of Fiber splicing.
    - Mechanical splicing
    - Fusion splicing
  - ✓ Core arrangement
    - closure
    - Optical Distribution Flame (ODF)
- **Testing Fiber optic link**
  - ✓ Describe Fiber link testing process
  - ✓ Test continuity
  - ✓ Test power link

- ✓ Test link distance
- ✓ Analyse optical Time Domaine reflectometer report (OTDR)

- **Perform Fiber optic patching.**
  - ✓ identification of Fiber optic connectors
  - ✓ identification of optical Fiber jumper cord
  - ✓ Identification of Fiber optic pigtail
  - ✓ Fiber patching process
  - ✓ Connect IP Equipment

- **Generate Technical documentation.**
  - ✓ OTDR report
  - ✓ Core allocation
  - ✓ Fiber allocation
  - ✓ Equipment location

Resources required for the learning outcome	
Equipment	▪ Router ▪ switch ▪ Media converter ▪ Small form factor pluggable ▪ Fiber optic light source tester
Materials	▪ Fiber optic cable ▪ Optical Fiber optic closure ▪ Optical Fiber Distribution Frame (ODF) ▪ Optical Fiber jumper cords (OJC) ▪ Optical Connectors
Tools	Pooling machine, Blowing Machine, Splicing machine, Optical Timer Domain Reflectometer, Tubing cutter, Buffer tube cuter, Pliers, read light,

	Jacket stripper, Kevlar scissor, Tweezers, Fiber Scribe, Cleaver, Fiber Stripper, Fiber optic power meter, Knife, Cleaning tool, Screwdriver, PPE(Groves, Helmet, Overcoats, Gum boots)
Facilitation techniques	Brainstorming, Demonstration, Group discussion practical work
Formative assessment methods /(CAT)	Written assessment, Oral presentation, Performance assessment, Project based assessment)

Learning outcome 3: Maintain Fiber optic network	**Learning hours: 20**

Indicative content

- **Preform Fiber optic network preventive maintenance.**
  - ✓ Hardware Maintenance
    - Schedule regular cleaning
    - Setting of preventive measures
    - Check physical Equipment condition.
    - Check environment condition.
  - ✓ Software Maintenance
    - Regular change of network credentials
    - Network monitoring software Licencing
    - Updating and Upgrading network monitoring software and device firmware
- **Perform corrective maintenance.**
  - ✓ Hardware
    - Identification of common problem and their causes
    - Repair/Replace damaged equipment.
  - ✓ Software

- Troubleshoot network configuration.
- Check network status
- Update network configuration

- **Elaboration of Troubleshooting Process**
  - ✓ Introduction to troubleshoot
  - ✓ Elements of Troubleshoot
    - Client /System information
    - Status before troubleshoots
    - Identification of common problem
    - Implementation of solution
- **Troubleshooting report**
  - ✓ Used Tools, materials, and Equipment.
  - ✓ Status after maintenance
  - ✓ Update us built design.
  - ✓ Recommendation

Resources required for the learning outcome	
Equipment	▪ Computer
Materials	▪ Internet bundles
Tools	Pooling machine, Blowing Machine, Splicing machine, Optical Timer Domain Reflectometer, Tubing cutter, Buffer tube cuter, Pliers, read light, Jacket stripper, Kevlar scissor, Tweezers, Fiber Scribe, Cleaver, Fiber Stripper, Fiber optic power meter, Knife, Cleaning tool, Screwdriver
Facilitation techniques	Brainstorming, Demonstration, Group discussion practical work

Formative assessment methods /(CAT)	Written assessment, Oral presentation, Performance assessment, Project based assessment)

Integrated/Summative assessment (For specific module)

Integrated situation

Ingenzi is the one of village located in Kigali city, Gasabo district, Rusororo sector, Umubano Cell. Due to the slowness of wireless network connectivity in the village, that causes a problem of service delivery. Some buildings of that Village would like to hire a Fiber optic company to help them to deploy a Fiber optic network in order to connect them on Fiber.

You are hired by Kigali Fiber optic company ltd to deliver the Fiber network from connection center (Node) to the labeled buildings as piloting phase as shown in figure. deploy Fiber optic network in those buildings

You have to provide the cost of installation; after installation you are requested to submit a report of

work done.

Duration of the work is 9 hours.

All materials, tools and equipment will be provided by Kigali Fiber Optic company ltd.

Resources

Tools	Pooling machine, Blowing Machine, Splicing machine, Optical Timer Domain Reflectometer, Tubing cutter, Buffer tube cuter, Pliers, read light, Jacket stripper, Kevlar scissor, Tweezers, Fiber Scribe, Cleaver, Fiber Stripper, Fiber optic power meter, Knife, Cleaning tool, Screwdriver
Equipment	Router switch Media converter

	Small form factor pluggable
Materials/ Consumables	Fiber optic cable FibeOptical r closure, Optical Fiber Distribution Frame (ODF) Optical Fiber jumper cords (OJC) Optical Connectors

Assessable outcomes	Assessment criteria (Based on performance criteria)	Indicator	Observation		Marks allocation
			Yes	No	
Plan Fiber optic network (30%)	Site survey is properly conducted according to Fiber optic site environment.	Terrain details was identified			4
		Terrain obstacles are identified.			4
		Fiber optic network is designed			5
		bill of quantities is prepared			4
	Materials, Equipment are properly selected based on Fiber optic network design	Materials are selected			5
		Equipment are selected			5
		Total cost is Estimated			3
Implement Fiber optic network (40%)	Fiber optic is properly spliced based on Fiber optic network design	Fiber splicing method is selected			3
		Core arrangement in closure is performed			3
	Fiber optic cable is properly patched according to the network design	Fiber optic connectors & jumper cord are identified			3
		Patching is applied			5
		IP equipment are connected			5

	Link continuity is correctly tested according to Fiber optic network design	Power link is tested			3
		Continuity is tested			3
		Link distance tested			3
	Technical documentation is properly generated based on the implementation.	Fiber allocation is documented			3
		OTDR report is generated.			3
		Core allocation is documented			3
		Equipment are located and labaled			3
Maintain Fiber optic network (30%)	Fiber optic network is properly Checked according to the network performance	preventive measures are sated			4
		Physical security is set			4
		Logical security is applied			4
		Network Monitoring software are applied			4
		collective maintenance is applied			4
	Fiber optic network troubleshooting is properly Performed according to monitoring report	The issue is identified			3
		The solution is applied			3
	Troubleshooting report is correctly generated according to the work done	The equipment used are documented			3
		The updates are communicated			2
		us built design is updated			2
		Recommendation is written			2

Total marks	100
Percentage Weightage	100%
Minimum Passing line % (Aggregate): 70%	

References

1. **Belden, W. (2020). Optical Fiber Cable Installation Guideline.**
2. **.. (2011). To, Guide, Fiber Optic, and Network Design. *The Fiber Optic Association*, 1–30.**
3. **Union, I. T. (2009). Optical Fibres, Cables and Systems. *International Telecommunications Union*, 144–47.**