Test Project # 4

National Competition

Skill- Information Network Cabling

Category: Information and Communication Technology

Prepared by – Telecom Sector Skill Council

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Section - A : Preface

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Skill Explained:

This document contains the Test Project for IndiaSkills – National Level competition in the domain of "Information Network Cabling". The document comprises of "test modules" which are designed to establish the competencies and skill levels of the candidates participating in the domain of "Information Network Cabling".

The document design is in-line with the World-Skills framework and comprises of competency measures in the "Optical Fiber", "Copper", Wi-Fi and "Health & Safety" aspects. The candidates participating at National level are expected to have a clear domain understanding, especially since they have gone through the preliminary levels of Zonal, State and Regional level competitions before qualifying for and competing at the Nationals and also the boot-camp/training sessions conducted from time-to-time.

Focus in on skills & competencies required for handling and working on Fiber Optic and Copper cables, cable components and equipment, including Health & safety aspects. Essential skills for defect identification and trouble-shooting are also covered.

The "test modules" are comprehensively designed to provide a clear understanding of the tasks & activities to be performed by the competitors, equipment they are expected to work upon and outcomes on which they will be judged/graded.

Eligibility Criteria (for IndiaSkills 2018 and WorldSkills 2019):

Competitors born on or after **01 Jan 1994** are only eligible to attend the Competition.

Total Duration: XX5 Hrs

Section – B : Test Project

TOTAL DURATION OF TEST

The "National Level" test project is designed to evaluate the competencies and skills of the candidates in the Information Network Cabling domain comprising of optical fiber and copper cabling installations, commissioning and tests/troubleshooting. The competitors are expected to undertake the specified activities using the correct tools, procedures and processes, meeting the structured cabling norms standards.

The test comprises of four (04) modules. Module 1 is focused on Optical Fiber termination processes & standards, Module 2 focuses on Copper cable layouts and termination whereas Module 3 is designed for Wi-Fi connectivity and Module 4 is on defect identification & troubleshooting for copper, fiber and Wi-Fi systems. The total duration of test (all four modules) is 15 hrs.

MODULE 1 : OPTICAL FIBER CABLING {Duration – 4.5 Hrs, Total Marks – 30}

(a)   Description of Activities
   (i)   Plan cabling system
   (ii)   Install FOE (Fiber Optic Enclosure), TO (Telecommunication Outlet), Cable Termination Box, Fiber patch panels
   (iii) Undertake fiber cabling
   (iv)   Undertake parameter measurements

(b)   The work comprises of the following :
   (i)   Arrange tools & equipment to undertake the work
   (ii)   Installing/pull fiber optic cable through pre-installed conduit
   (iii) Installing fiber optic cable through pre-installed cable trays (vertical & horizontal)
   (iv)   Prepare fiber for splicing
   (v)   Undertake Splicing (Fusion)
   (vi)   Undertake Fiber termination and dressing
   (vii) Undertake Parameter check (to check the quality of splice) {using VFL, Power Meter, OLTS, OTDR}

(c)   Health & Safety. The candidate shall be observed for adherence to health & safety norms whilst working on fiber cables. Jury members may prompt the candidate to adhere to the norms to avoid any untoward incident. The adherence should comply to the following :-

(i)   Use of Eye-Protection gear

(ii)   Use of cut-resistant hand gloves

(iii)   Use of Eye-Wash, if required

(d)   Work Instructions to The Competitor

The competition time is 5 hrs. Plan the cabling work as shown in the Figure1_1. Requirements, as indicated in the figure are to be met by choosing the right cable, cable components, termination components, tools and equipment. Candidate to ensure that the right and compatible mix of components are selected for installation. Competitors must do the following task:-

(i)   Planning and design

• Prepare, read, interpret, and analyse specialist's technical drawings and specifications shown in Fig.1_1.

• Schedule work required to achieve a given outcome and describe in Fig.1_1.

• Select the tools and systems that are most appropriate for the planned task.

• Select the appropriate cabling materials based on usage requirements.

• Assess workstation, design the location and length of cables to minimize damages and risks. FOEs (Fiber Optic Enclosures) should have three meters of slack.

(ii)   Installation
   •   Read, understand, and apply standard manufacturer guidelines/instructions for undertaking installation activity.
   •   Select the appropriate procedure for cabling.
   •   Install and optical fiber cabling system as shown in Fig.1_1, such as Closure/Panel/Splice box/TO etc.
   •   Connect and terminate optical fiber cables following Fig.1_1 which you designed. Install at least four (04) installable optical connectors.
   •   Fiber colour code is Competitor's choice.
   •   Proper storage into fiber tray
   •   Organize and label cabling to make future reconfiguring straightforward following "labelling guideline 2017".

(iii)   Work organization and management

• Prioritize work and comply with plans to minimize disruption and to meet agreed time scales.

• Use personal protective equipment correctly.

• Identify and use the appropriate personal protective equipment for ESD.

• Select, use, clean, maintain, and store tools and equipment safely and securely.

• Respect the client's building, keeping it tidy and clean.

    (iv)   Measurement

• Undertake measurements (as specified by the Jury) and save results using Optical loss test set (OTLS) and a visible checker.

MODULE 2 : Copper cable installation {Duration – 3.0 Hrs Total Marks – 20}

(a)   Description of Activities

    (i)   Plan copper cabling

    (ii)   Install copper cable through conduits and cable trays

    (iii)   Undertake copper cable termination

    (iv)   Testing and documentation

(b)   The work comprises of the following

    (i)   Arrange all tools and material to carry-out work as per the Technical Drawing (Figure 1_2)

    (ii)   Install Copper cable through pre-installed conduits, as per the drawing

    (iii)   Terminate cables in accordance with 568-A or 568-B, as indicated in the drawing

    (iv)   End connectorization using RJ-45 connectors (at patch panels/patch cords) as shown in the drawing

    (v)   Dressing of Copper cable at Racks/Enclosures, including tagging and labelling, as per the structured cabling norms

    (vi)   Wiremap testing

    (vii)   Documentation

(c)   Health & Safety
    (i)   Wearing of safety goggles at all times during installation
    (ii)   All competitors should observe safety and tools should be properly and correctly used to prevent any mishap.
    (iii)   In case of an accident, Competitor will have to stop and cancel the competition.
    (iv)   **Identify the problems** that may exist and check with Experts.
    (v)   **Check the material list/tools** and inform Expert for missing items.

(d)   Work Instructions to the Competitors

The competition time is 3 hrs. Plan the cabling work as shown in the Figure1_2. Requirements, as indicated in the figure are to be met by choosing the right cable, cable components, termination components, tools and equipment. Manufacturer's specifications to be read and complied with. Competitors must do the following task:-

   (v)   Planning and design

         • Prepare, read, interpret, and analyse specialist's technical drawings and specifications shown in Fig.1_2.

         • Schedule work required to achieve a given outcome and describe in Fig.1_2.

         • Select the tools and systems that are most appropriate for the planned task.

         • Select the appropriate cabling materials based on usage requirements.

   (vi)   Installation
         •   Read, understand, and apply standard manufacturer guidelines/instructions for undertaking installation activity.
         •   Select the appropriate procedure for cabling.
         •   Install the cabling system as shown in Fig.1_2,
         •   Connect and terminate at the patch panels and TO as shown in the Technical drawing
         •   Organize and label cabling to make future reconfiguring straightforward following "labelling guideline 2017".
   (vii) Work organization and management

         • Prioritize work and comply with plans to minimize disruption and to meet agreed time scales.

         • Use personal protective equipment correctly.

         • Select, use, clean, maintain, and store tools and equipment safely and securely.

         • Respect the client's building, keeping it tidy and clean.

   (viii) Post installation functional & performance checks

         • Undertake checks (as specified by the Jury) and save/document results

MODULE 3 : Setup a Wi-Fi Access (Broadband Router, Access-point and end connectivity to a device/laptop) {Duration – 03.5 Hrs Total Marks – 25}

 (a)   Description of Activities
      (i)   Plan the Wi-Fi installation setup
      (ii)   Install the Wi-Fi devices (broadband router, access point)

(iii)   Configure the Wi-Fi devices
(iv)   Establish connectivity
(v)   Document the installation & configuration settings

(b)   The work comprises of the following :-
(i)   Installation & configuration of the broadband router using the given settings
(ii)   Installation & configuration of Access Point using the given settings
(iii)   Establishing connectivity between access point and router
(iv)   Undertake configuration settings on end device (on user device, i.e. laptop, Wi-Fi Printer)
(v)   Establish connectivity between user device and access point

(c)   Health & safety.
(i)   All Competitors should observe safety and tools should be properly and correctly used to prevent any mishap.
(ii)   In case of an accident, competitor will have to stop and cancel the competition.
(iii)   Identify the problems that may exist and check with experts.
(iv)   Check the material list/tools and inform Expert for missing items.

(d)   Instructions to the competitor
(i)   Preparation
•   Identify and arrange the devices/components required for undertaking the task
•   Identify the cable layout and connection modalities
•   Identify and arrange all tools and equipment required to complete the task
(ii)   Installation & configuration
•   Check the materials and equipment. Reset devices to the initial setting.
•   Install the cable between Access Point and backend Router
•   Install & configure backend router
•   Install and configure (IP, Gateway, DHCP, Protocol, Security) Access Point
•   Install Wi-Fi Printer
•   Establish connectivity between customer device (laptop, printer) and from customer device to the accees point and internet connectivity.
(iii)   Test & Documentation
•   Test the connectivity by accessing a popular website
•   Document the settings at Access Point, Router and at Device level

Note : Configuration details for all devices (router, access point and edge devices {printer, laptop}) will be provided at the venue.

MODULE 4 : Defect identification & Troubleshooting {Duration – 4.0 Hrs Marks – 25}

(a)   **Introduction.** Quick and clear defect identification is crucial for continual operations with minimal outage. The candidates are expected to demonstrate basic trouble-shooting steps towards identification and resolve of an injected defect. Defects will be pre-injected by the Jury.

(b)   **Description of the tasks.** Following type of defects will be pre-injected in the setup (three faults will be injected) :-

- (i)   Fiber Optic cabling
  - bends
  - kinks
  - breaks
  - termination faults
  - unmatched components
  - incorrect patching of cables at enclosures
  - cross-talk
  - performance issues
- (ii)   Copper cabling
  - termination faults
  - incorrect pairing
  - incorrect crimping
- (iii)   Wi-Fi Access
  - Incorrect configurations
  - Connectivity faults

(c) Work instructions to the competitors

(i)   Identify the faults using correct test equipment/tools

(ii)   Record the fault parameters

(iii)   Undertake corrective measure.

(iv)   Demonstrate results using VFL, OLTS & LAN, OTDR (as the case may be)

(v)   Record results

Section – C : Marking Scheme

(a) **Marking Scheme for Module – 1**. The total mark of Module 1 is "30". The assessment criteria of Module1 includes the following:

Aspect ID	Aspect type Measure(M)/Judge (J)	Aspect of Criterion - Description	Max Marks for the aspect	Results or Actual Value	Marks Awarded
1-Planning & Design	Total Marks of Aspect - 06				
	J	Understanding of the technical drawing	02		
	J	Selection of correct tools & cabling material	02		
	J	Work plan	02		
2 – Fiber Installation	Total aspect marks - 14				
	J	Cable handling as per specification	02		
	J	Cable installation/pulling/lying procedure (maintaining slack & bend radius)	02		
	J	Installation as per the tech drawing/layout	02		
	M	Fiber Splicing quality	04		
	J	Correct Termination length	02		
	J	Appropriate fiber jacket condition & connector quality	02		
3 – Post installation Activities	Total aspect marks - 06				
	J	Cleaning of workspace	02		
	J	Label on the TO	02		
	J	Label on the cable ends	02		
4 – Fundamental Safety	Total aspect marks - 04				

Aspect ID	Aspect type Measure(M)/Judge (J)	Aspect of Criterion - Description	Max Marks for the aspect	Results or Actual Value	Marks Awarded
		Use of Eye-Protection gear	02		
		Use of cut-resistant hand gloves	02		

(b) **Marking Scheme for Module – 2**. The total mark of Module 2 is "25". The assessment criteria of Module1 includes the following:

Aspect ID	Aspect type Measure(M)/Judge (J)	Aspect of Criterion - Description	Max Marks for the aspect	Results or Actual Value	Marks Awarded
1.Installation planning	Total aspect marks - 05				
	J	Understanding of the technical drawing	2		
	J	Selection of appropriate cabling media, cable components and tools	2		
	J	Correct Scheduling/sequencing of activities	1		
2. Cable installation	Total aspect marks - 08				
	J	Appropriate installation as per the Tech drawing	2		
	M	Correct cable length for installation run	1		
	J	Maintaining of correct slack, bend radius	1		
	J	Ensuring correct fixing/securing on conduit ends/cable trays and at entry points	1		
	J	Correct procedure – cable termination and termination slack management	1		

	M	Correct connectorization	2		
3. Functionality/Perfo rmance checks	Total aspect marks - 04				
	M	Continuity check	1		
	M	Wire-map test	2		
	M	Recording & saving of results	1		
4. Post installation/closing activities	Total aspect marks - 03				
	J	Correct cleaning after completing.	1		
	J	Label all cables at both ends	1		
	J	Document the cable installation details and performance parameters	1		

(c) **Marking Scheme for Module – 3**. The total mark of Module 3 is "25". The assessment criteria of Module 3 includes the following:

Aspect ID	Aspect type Measure(M)/Judge (J)	Aspect of Criterion – Description	Max Marks for the aspect	Results or Actual Value	Marks Awarded
1. Preparatory activities	Total aspect marks - 05				
	J	Identify and arrange the devices/components required for undertaking the task	02		

	J	Identify the cable layout and connection modalities as per the drawing	02		
	J	Identify and arrange all tools and equipment required to complete the task	01		
2. Installation & configuration	Total aspect marks - 16				
	J	Install the cable between Access Point and backend Router	02		
	J/M	Install & configure backend router	03		
	J/M	Install and configure (LAN/WAN Settings, IP, Gateway, DHCP, Protocol) Access Point	03		
	M	Apply Wireless Security settings to the AP	02		
	J/M	Install Wi-Fi Printer	02		
	J/M	Establish connectivity between customer device (laptop, printer) and from customer device to the access point and router	04		
3. Test & Documentation	Total aspect marks - 04				
	J/M	Test the connectivity by accessing a popular website	02		
	J	Document the settings at Access Point,	02		

Aspect ID	Aspect type Measure(M)/Judge (J)	Aspect of Criterion - Description	Max Marks for the aspect	Results or Actual Value	Marks Awarded
		Router and at Device level			

(d) **Marking Scheme for Module – 4**. The total mark of Module 4 is "25". The assessment criteria of Module1 includes the following:

Aspect ID	Aspect type Measure(M)/Judge (J)	Aspect of Criterion - Description	Max Marks for the aspect	Results or Actual Value	Marks Awarded
1- FIber Optic - Fault Identification, corrective action and testing	Total Marks of Aspect -10				
1.1	M	Fault identification using the testing tools/equipment - Cable bend/kink - Incorrect termination of Copper pairs - Poor quality of fiber splicing	04		
1.2	M	Undertake corrective action (04 faults to be injected)	03		
1.3	J	Demonstrate results using test equipment	02		
1.4	M	Recording of pre and post action results	01		
2 – Copper Cable - Fault Identification, corrective action and testing	Total Marks of Aspect -08				
		Fault identification	03		

		• Incorrect termination (cross pairs) • Cable break • Mislabelled/interchanged jacks • Interference between cable pairs			
		Fault correction	03		
		Test & Documentation	02		
3.Wi-Fi device /network faults	Total Marks of Aspect -07				
		Fault identification • Misconfiguration (@ router, AP, end device) • blind spots	03		
		Fault correction	04		

Section – D : Equipment List

Equipment, Machinery, Installation & Materials Required

Item	Quantity	Materials	Description
Splicer	2	Fusion Splicer	
VFL	2	Visual Fault Locator	
OLTS	2	Optical Loss Test Set	
OTDR	03	Optical Time Domain Reflectometer	
FOE	2	Fiber Optic Enclosure	Wall Mount – Enclosure Frames only with patch panels fitting arrangement
Fiber Patch Panel	4	Fiber patch panel (snap-in slots)	Patch panel is to be fitted on the FOE
Pigtails	4 x Number of participants (06) = 24	Fiber pigtails	Pig tails with compatible the Fiber cable (SC Connectors for SM Fiber)
FIber Optic Cable	2 (500 mtr each)	FIber Optic Cable (SM) – 6/12 Core {Distribution Cable – Indoor Type}	500 Mtr FO cable (Single Mode) – 6/12 Core
	2	FIber Pulling Grips	Fiber Pulling Grips for pulling the indoor fiber over cable trays or through conduits
	2 sets	Standard Tool Kit	Cleavers, Strippers, Cleaner, Splice protection sleeve,
	6 Sets	Personal Safety Gear	Safety Glasses with Side Shields, Safety hand Gloves
TO (UTP)	6	UTP Terminal Outlet	UTP Terminal Outlet (at customer premise)
UTP Cable	2 boxes (305x2 mtr)	UTP Cable CAT5e/CAT6	

UTP Racks/Enclosures	2	UTP Racks/Enclosures	
UTP Tool Kit	4 Sets	UTP Tool Kit for preparing cables & termination	Standard tool kit for cable preparation & termination
Cable Pulling tools – Fish Tape	4	Fish Tape for pulling cable through conduits	
UTP Cable Tester	2 Set	UPT Cable Tester	UTP/LAN Tester
UTP Patch Cord	16	UPT Patch cords	UTP path cords (Factory Crimped)
Router	02	Router (for broadband connectivity)	
Access Point/home modem/router	02	Home/office modem/router	
Wi-Fi Printer	02	Wi-Fi Printer	
Laptop	02	Laptop as edge device	

INSTRUCTIONS TO CANDIDADETS

General Rules
- Competitor should carry the id proof and birth date proof should reach venue 15 minute before the entry time.
- No Group work is permitted, it's individual competition.
- Module briefing will be for 15 minutes & will be done before the start of competition
- Open communication / Q&A will be conducted after module briefings.
- Module related queries will not be entertained after the start of competition.

Rules of competition
- Competitor will be disqualifying for any misbehaviour.
- All the rights of the competition are revered with State Skill Competition Committee/SSC/Conducting body
- When you have finished the current module, you can proceed to the requirements for the next module.

Task Rules/Guidelines

The work is to be carried out in accordance with the "technical drawing" provided at appendix "A" & "B" for Module 1 & 2 respectively.

Follow the following guidelines/instructions :-

(i) Read and understand the Technical drawing.
(ii) Plan the work as per the technical drawing and specifications therein.
(iii) Schedule work required to achieve a given outcome and within the specified time
(iv) Read, understand, and apply manufacturers' instructions on handling of FO cables and cords.
(v) Select the optimal cable installation process in the given environment.
(vi) Fiber colour code as per the standards (participants will be informed/code will be displayed)
(vii) Prioritize work and comply with plans to minimize disruption and to meet agreed time lines
(viii) Use personal protective equipment correctly.
(ix) Maintain neat and tidy work environment
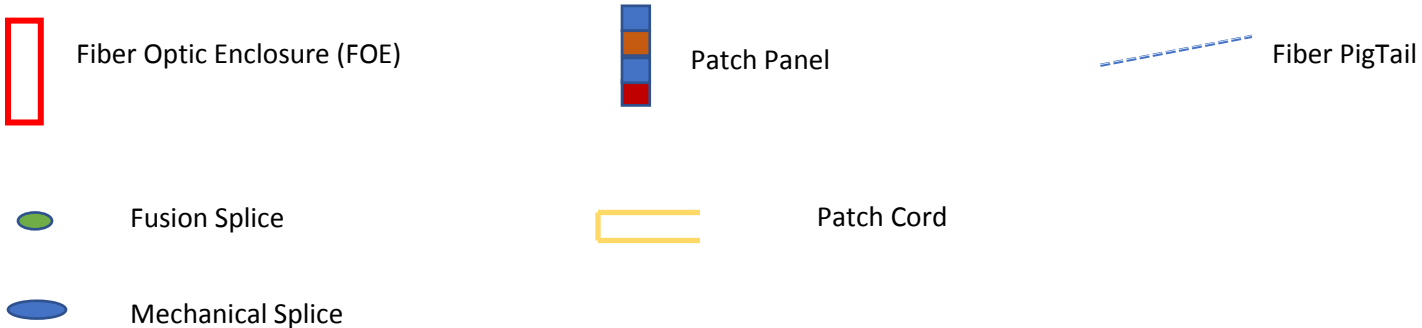
Section – F : Health, Safety and Environment

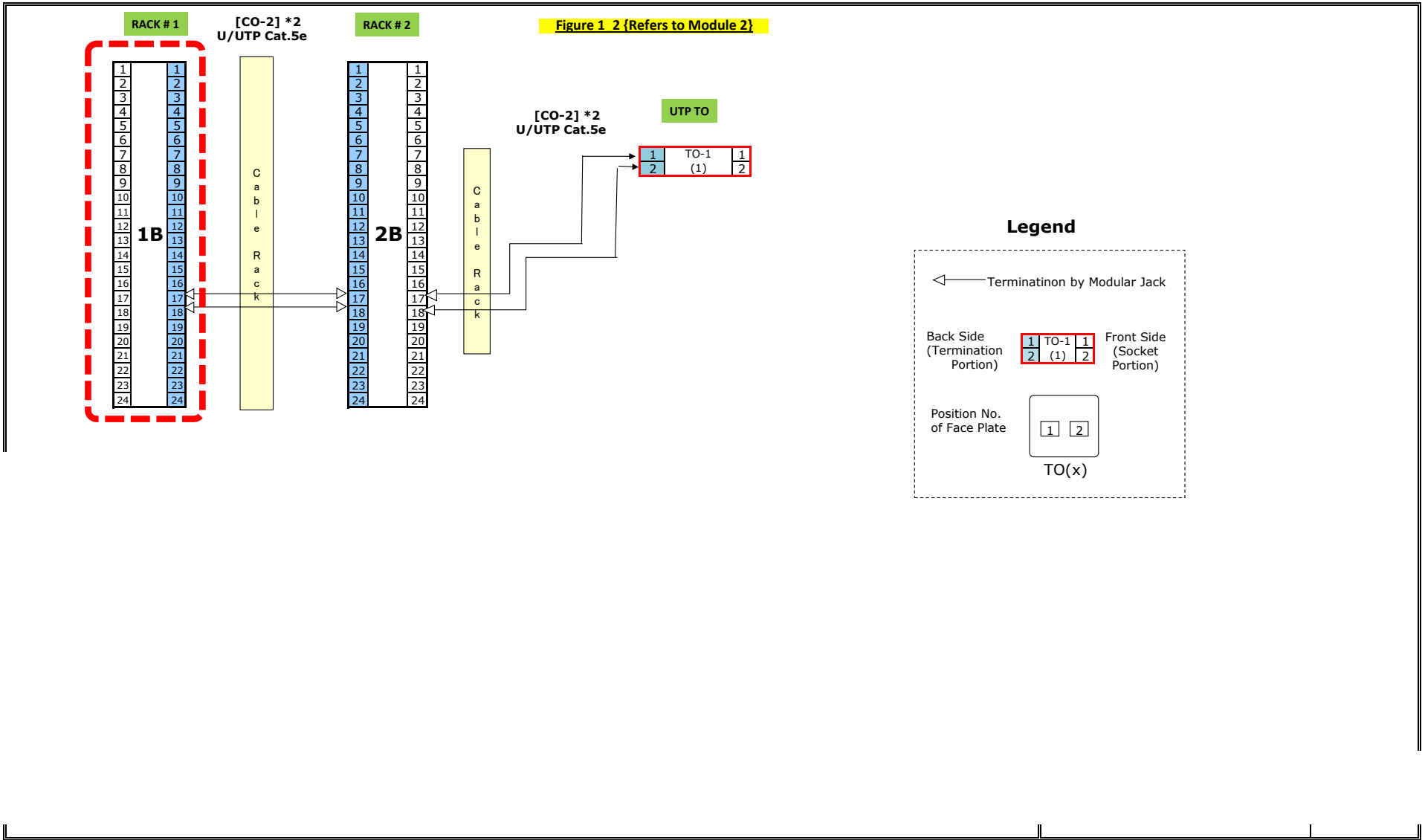Candidates are to adhere to following guidelines

1. Follow all safety norms as covered during the briefing prior to the start of the competition
2. Always wear safety glasses always during fiber installation
3. Always ensure correct disposal of fiber waste
4. All Competitors should observe safety with respect to the use of tools, equipment and material and should properly and correctly use them to prevent any mishap.
5. In case of an accident, Competitor will have to stop and cancel the competition.
6. Identify the problems that may exist and check with experts
7. Check the material list/tools and inform expert for missing items
8. When doing measurement, Competitors need to call Expert(s)
9. When in doubt on any safety issue/matter, call for the attention of the expert

Figure 1 1 {Refers to Module 1}
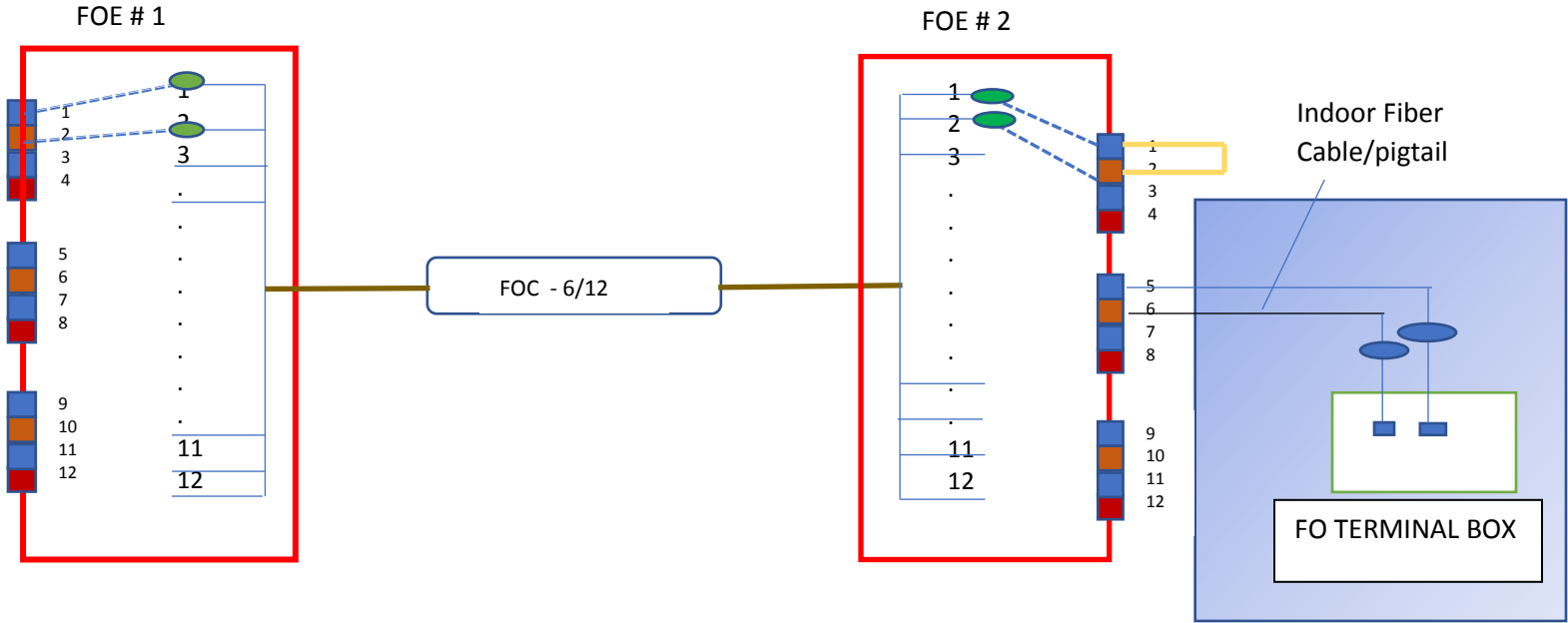
Task – 04 Fusion Splices, 04 Pig Tail connections (with fusion splices), 01 patch cord connection, lying of 6/12 core fiber between FOE#1 and FOE#2

Figure 1 2 {Refers to Module 2}

RACK # 1

[CO-2] *2
U/UTP Cat.5e

RACK # 2

[CO-2] *2
U/UTP Cat.5e

UTP TO

1B

2B

Cable Rack

Cable Rack

| 1 | TO-1 | 1 |
| 2 | (1) | 2 |

Legend

◁——— Terminatinon by Modular Jack

Back Side
(Termination
Portion)

| 1 | TO-1 | 1 |
| 2 | (1) | 2 |

Front Side
(Socket
Portion)

Position No.
of Face Plate

| 1 | 2 |

TO(x)