National Competency Standards level 5, in Telecommunication Technology

`

National Vocational and Technical Training Commission (NAVTTC),
Government of Pakistan

ACKNOWLEDGEMENTS

National Vocational and Technical Training Commission (NAVTTC) extends its gratitude and appreciation to many representatives of business, industry, academia, government agencies, Provincial TEVTAs, Sector Skill Councils and trade associations who speared their time and expertise to the development and validation of these National Vocational Qualifications (Competency Standards, Curricula, Assessments Packs and related material). This work would not have been possible without the financial and technical support of the TVET Sector Support Programme co-funded by European Union, Norwegian and German Governments implemented by GIZ Pakistan. NAVTTC is especially indebted to *Dr. Muqeem ul Islam,* who lead the project from the front. The core team was comprised on:

- *Dr. Muqeem ul Islam,* Director General (Skills,Standards and Curricula) NAVTTC
- *Mr. Muhammad Naeem Akhtar*, Senior Technical Advisor TSSP-GIZ,
- *Mr. Muhammad Yasir*, Deputy Director (SS&C Wing) NAVTTC
- *Mr. Muhammad Ishaq,* Deputy Director (SS&C Wing) NAVTTC
- *Mr. Muhammad Fayaz Soomro,* Deputy Director (SS&C Wing) NAVTTC

NAVTTC team under the leadership of Dr. Muqeem ul Islam initiated development of CBT & A based qualifications of diploma level-5 as a reform project of TVET sector in November 2018 and completed 27 NVQF diplomas of Level-5 in September, 2019. It seems worth highlighting that during this endeavor apart from developing competency standards/curricula in conventional trades new dimensions containing high-tech trades in TVET sector in the context of generation IR 4.0 trades have also been developed which inter alia includes Robotics, Mechatronics, artificial intelligence, industrial automation, instrumentation and process control. Moreover, trades like entrepreneurship, green/environmental skills and variety of soft/digital skill have also been developed to equip the Pakistani youth with skills set as per requirement of the global trends. These skills have been made integral part of all the 27 diplomas.

Nobody has been more important in the pursuit of this project than Dr. Nasir Khan, Executive Director, NAVTTC, whose patronage and support remain there throughout the development process and lastly to thanks specially to Syed Javed Hassan, Chairman NAVTTC and Raja Saad Khan, Deputy Team Lead TSSP-GIZ who made it happened in this challenging time.

Table of Content

Introduction

Purpose of the Qualification

Levelling of Core Competencies of the Qualification along with the occupations

Date of Validation

Valid for 10 years

Date of Review

Shall be reviewed after 3 years

Codes of Qualifications

The International Standard Classification of Education (ISCED) is a framework for assembling, compiling and analyzing cross-nationally comparable statistics on education and training. ISCED codes for these qualifications are assigned as follows**:**

ISCED Classification for Telecommunication Technology level 5	
Code	Description
0713E&E(1)	1st Level D.A. E National Certificate of level-5, in " Telecommunication Technology"
0713E&E(2)	2nd Level D.A. E National Certificate of level-5, in " Telecommunication Technology"
0713E&E(3)	3rd Level D.A. E National Certificate of level-5, in " Telecommunication Technology"
0713E&E(4)	4th Level D.A. E National Certificate of level-5, in " Telecommunication Technology"

0713E&E(5)	5th Level D.A. E National Certificate of level-5, in " Telecommunication Technology"

Members of Qualifications Development Committee

The following members participated in the qualification development of this qualification**:**

Members of Qualification Validation Committee

The following members participated in the qualifications validation of this qualification**:**

Entry Requirements

The entry for D.A. E National Certificate level 5, in Telecommunication Technology are

1. A person having **National Vocational Certificate level 4**, in Telecommunication Technology.
2. A person having **Matric certificate with Science**

Detail of Competency Standards

CATEGORIZATION AND LEVELING OF COMPETENCES

Sr. No	Competency Standards	NVQF Level	Category	Estimated Contact Hours			Cr Hr
				Th	Pr	Total	
	Electrical Essential & Network						
1	Operate Measuring Instruments.	L2	Tech	16	24	40	4
2	Verify Ohm's Law & Kirchhoff's Law by Implementing Series/Parallel Circuits.	L2	Tech	8	12	20	2
3	Measure Electrical Power, Energy, Power Factor & Determine Phase Sequence	L2	Tech	8	12	20	2
4	Implement Electromagnet to See Various Effects & Verify Faradays Laws.	L2	Tech	8	12	20	2
	Telecom Drawing						
1	Produce Templates, Title Block/ Strip & Draw Lines	L3	Tech	20	30	50	5
2	Develop Symbols of Engineering Drawings	L3	Tech	20	30	50	5
3	Perform Telecom Drawing	L3	Tech	40	60	100	10
	Telecommunication Fundamentals						
1	Generate signals and observe on CRO	L3	Tech	20	30	50	5
2	Install PABX and FAX Machine	L3	Tech	20	30	50	5
3	Identify The Parts of Analog & Digital Telephone Set & Verify Their Function	L3	Tech	20	30	50	5
4	Demonstrate Modulation, Demodulation, Multiplexing & De-Multiplexing	L3	Tech	20	30	50	5
	Computer Application in Telecom						
1	Select Computer Spcification and Work with Windows.	L3	Tech	20	30	50	5
3	Carryout Basic Programming	L3	Tech	20	30	50	5
4	Perform Internet Browsing	L3	Tech	20	30	50	5
5	Perform the Different Engineering Curves Used in Various Mechanism.	L3	Tech	20	30	50	5
	Total Hour						
	Maintenance & Quality of Service						

1	Measure Quality of service for GSM and LAN network	L4	Tech	20	30	50	5
2	Assess Quality of given equipment and works	L4	Tech	20	30	50	5
3	Maintain Occupational Health and Safety	L4	Tech	20	30	50	5
4	Adopt Safety Regulations, Labour Protection Laws, Environmental Protection Laws at Workplace	L4	Tech	10	15	25	2.5
5	Develop Professionalism.	L4	Tech	10	15	25	2.5
	Basic Electrical Work on Telecom site						
1	Maintain Tools & Equipment.	L2	Tech	12	18	30	3
2	Make Cable/Wire Joints	L2	Tech	8	12	20	2
3	Prepare and Install Main Distribution Boards (Single Phase)	L2	Tech	12	18	30	3
4	Carryout Basic Electrical Installation	L2	Tech	12	18	30	3
5	Install Simple Electrical Wiring	L2	Tech	12	18	30	3
6	Perform Testing of Electrical Wiring	L2	Tech	12	18	30	3
7	Repair/ Maintenance of Electrical Installation	L2	Tech	12	18	30	3
	Digital skills in Telecom						
1	Install software	L3	Tech	20	30	50	5
2	Edit graphics	L3	Tech	20	30	50	5
3	Perform computer application skills	L3	Tech	20	30	50	5
4	Perform computer network operations	L3	Tech	20	30	50	5
	Total Hour						
	Mobile Telecommunication						
1	Verify installation equipment and installation plan	L4	Tech	20	30	50	5
2	Install BTS cabinet and accessories	L4	Tech	20	30	50	5
3	Install and Configure BTS	L4	Tech	20	30	50	5
4	Install Telecom Network Equipment	L4	Tech	20	30	50	5
	Telecom Services & Terminal Equipment						
1	Upgrade Transmission System	L4	Tech	20	30	50	5
2	Install Telecom Equipment	L 4	Tech	20	30	50	5
3	Install & Configure CPE	L 4	Tech	20	30	50	5

4	Install Cord Less Telephone	L 4	Tech	20	30	50	5
5	Install and configure ISDN link and ADSL	L4	Tech	20	30	50	5
	Total Hour						
	Power Plant						
1	Construct power supply	L5	Tech	20	30	50	5
2	Install and maintain Batteries	L5	Tech	20	30	50	5
3	Install PDU,SPD,ATS and circuit breakers	L5	Tech	20	30	50	5
4	Install and maintain diesel generator	L5	Tech	10	15	25	2.5
5	Preventive maintenance of telecom power system	L5	Tech	20	30	50	5
6	Maintain Lead Acid Batteries and Implement Their Series Parallel Combination.	L5	Tech	20	30	50	5
	Microcontroller & Programming						
1	Draw microcontroller architecture	L4	Tech	20	30	50	5
2	Programme microcontroller	L4	Tech	20	30	50	5
3	Perform Basic Mathematics Calculations in C++	L4	Tech	20	30	50	5
4	Perform Basic Circuit Analysis Calculations in C++	L4	Tech	10	15	25	2.5
5	Perform Electrical Analysis in C++	L4	Tech	20	30	50	5
	Transmission Systems						
1	Install VSAT for Satellite Communication	L5	Tech	20	30	50	5
2	Install Satellite TV System and Equipment	L5	Tech	20	30	50	5
3	Perform Line of site survey for Microwave Link	L5	Tech	20	30	50	5
4	Install Microwave Link	L5	Tech	20	30	50	5
5	Place, Secure, Splice and Terminate Optical Fiber cable	L5	Tech	10	15	25	2.5
6	Install aerial and underground Fiber cables	L5	Tech	10	15	25	2.5
7	Splice optical fiber cable	L5	Tech	20	30	50	5

	Switching System						
1	Install switch	L5	Tech	30	45	75	7.5
2	Configure Switches	L5	Tech	30	45	75	7.5
3	Maintain/Fault Management in Switching Nodes	L5	Tech	20	30	50	5
	Total Hour						
	Electronic Devices and Circuits						
1	Identify Basic Electronics Components	L4	Tech	10	15	25	2.5
2	Design A Rectifier Using Diode	L4	Tech	20	30	50	5
3	Carry Out Diode Application	L4	Tech	20	30	50	5
4	Implement Bipolar Junction Transistor (BJTs) In Different Applications	L4	Tech	20	30	50	5
5	Implement Field Effect Transistor (FETs) In Different Application	L4	Tech	20	30	50	5
6	Implement (Uni-Junction Transistor, Silicon Control Rectifier, DIAC and TRIAC) In Various Application.	L4	Tech	10	15	25	2.5
7	Design Operation Amplifier.	L4	Tech	10	15	25	2.5
8	Implement Diode and Thyristor in Power Control Application.	L4	Tech	10	15	25	2.5
	Measuring Instruments						
1	Measure Current, Voltage and Make Multiplier for Galvanometer Range Extension	L2	Tech	10	15	25	2.5
2	Measure Temperature, Earth Resistance, Light Intensity	L2	Tech	10	15	25	2.5
3	Measure the Resistance, Measure High Dc Current by Using Shunt.	L2	Tech	10	15	25	2.5
4	Measure Voltage, Frequency, Capacitance & Inductance by CRO	L2	Tech	10	15	25	2.5
5	Operate Oscilloscope	L2	Tech	10	15	25	2.5
6	Identify The Parts and Connection of Energy Meter(Single/3-Phase), Factor(Pf) Meter, MDI Meter, Megger	L2	Tech	10	15	25	2.5
7	Calibrate Electrical Equipment's	L2	Tech	10	15	25	2.5
8	Perform Measurement and Calibration of Instruments	L2	Tech	10	15	25	2.5

	Emerging Telecom Technologies						
1	Install OLT and ONU	L5	Tech	30	45	75	7.5
2	Deploy Cloud Infrastructure	L5	Tech	30	45	75	7.5
3	Install CCTV	L5	Tech	20	30	50	5
	Construction Practice & Project						
1	Install mount of RF antenna and RRU on tower	L5	Tech	20	30	50	5
2	Install GPS antenna and rack	L5	Tech	20	30	50	5
3	Install connector on Optical Fiber cable	L5	Tech	20	30	50	5
4	Manage customer complaints	L5	Tech	10	15	25	2.5
5	Manage store	L5	Tech	20	30	50	5
	Optimize Telecom Networks						
1	Perform 2G Drive/Walk Test	L5	Tech	20	30	50	5
2	Perform 3G Drive/Walk Test	L5	Tech	20	30	50	5
3	Perform 4G/LTE Drive/Walk test	L5	Tech	20	30	50	5
4	Perform Audit of 2G, 3G and LTE Site	L5	Tech	20	30	50	5
	Digital Circuits						
1	Verify Truth Tables of Digital Gates.	L4	Tech	20	30	50	5
2	Construct & Verify Combinational Logic Circuit.	L4	Tech	20	30	50	5
3	Construct and Verify Function of Flip Flops.	L4	Tech	20	30	50	5
4	Use 555 IC as Multi-vibrator.	L4	Tech	10	15	25	2.5
5	Construct Shift Registers and Counters Used Flip Flops	L4	Tech	20	30	50	5
	Total Hour						

0714-E&A-1. Operate Measuring Instruments

Overview: This competency standard covers the skills and knowledge required to Operate Ampere meter, Volt meter& ohm meter.

Competency Units	Performance Criteria
CU1. Operate Ampere meter.	**P1.** Identify ampere meter. **P2.** Make a parallel circuit with three different resistors on breadboard **P3.** Adjust proper range of ampere meter as per load. **P4.** Connect ampere meter in series to each resistor to measure the current. **P5.** Turn on the supply and note the reading of current against each resistor.
CU2. Operate Volt meter.	**P1.** Identify volt meter. **P2.** Make a series circuit with three different resistors on bread board. **P3.** Adjust proper range of Volt meter as per load. **P4.** Connect volt meter in circuit **P5.** Take the reading.
CU3. Operate ohm meter.	**P1.** Identify Ohm meter. **P2.** Adjust proper range of ohm meter as per resistance value. **P3.** Connect ohm meter with resistor **P4.** Take the reading.

Knowledge & Understanding

- Define current and its unit.
- Describe series circuit.
- Enlist the name of various meters
- Describe purpose of ampere meter
- Describe how ampere meter is connected in the circuit.

- Define voltage and its unit.
- Describe parallel circuit.
- Describe purpose of volt meter
- Describe how voltmeter is connected in the circuit.
- Define resistance and its unit
- Describe purpose of ohm meter

Tool and Equipment

SN	Tools
1	Voltmeters
2	Ammeter
3	Ohmmeters
4	Multi meters.
5	Resistors of different values.
6	Small pieces of copper wire.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Turn on the supply and note the reading of current against each resistor

0714-E&A-2. Verify Ohm's Law & Kirchhoff's Law by Implementing Series/Parallel Circuits.

Overview:

This competency standard covers the skills and knowledge required to Make series circuit and measure voltage and verify KVL, make parallel circuit and measure current and verify KCL, verify resistance of a resistor, Find unknown value of ohms law

Competency Units	Performance Criteria
CU1. Make series circuit and measure voltage and verify KVL	**P1.** Construct series circuit with different resistors on bread board and give supply voltage. **P2.** Measure the voltage across each resistor. **P3.** Note the value of voltage against each resistor. **P4.** Sum the voltage of each resistor and verify is it equal to applied voltage.
CU2. Make parallel circuit and measure current and verify KCL	**P1.** Construct parallel circuit with different resistors on bread board. **P2.** Measure the current of each resistor as well as total current. **P3.** Note the value of current against each resistor. **P4.** Sum the reading of ampere meters and verify, is it equal to the total current of circuit.
CU3. Verify resistance of a resistor	**P1.** Select the 4 color band resistor. **P2.** Determine the value of resistor using color code. **P3.** Connect ohm meter across the resistor. **P4.** Note reading form ohm meter. **P5.** Compare both reading.
CU4. Find unknown value of ohms law	**P1.** Construct the complex circuit using different resistors. **P2.** Find I, V with proper meter and determine R using ohms law **P3.** Find I, R with proper meter and determine V using ohm law **P4.** Find R, V with proper meter and determine I using ohm law
CU5. Measure resistance of	**P1.** Take sliding Rheostat of 17 Ω and Ohmmeter. (0 to 20 or more than 17 Ω) which is available.

	Rheostat	**P2.** Adjust zero with shortning the ohmmeter leads. **P3.** Take reading of rheostat when slide is full placed at end,(whole resistance of rheostat)with the ohmmeter like digram shown above. **P4.** Note this result 17 Ω in your note book. **P5.** Repeat these reading when sliding exact in half of rheostat, and note this reading.
CU6.	**Measure resistance of voltmeter**	**P1.** Take Voltmeter of 15, 30 V (D.C) or any range of voltmeter, which is available at your ab store. **P2.** Adjust zero with shortning the ohmmeter leads. **P3.** Take the reading of ohmmeter like shown above, and note it on your note book.
CU7.	**Measure resistance of incandescent lamp.**	**P1.** Take 40 W, lamp and 1 digital or analog ohmmeter. **P2.** Adjust zero with shortning the ohmmeter leads. **P3.** Connect the ohmmeter with its terminal and note its resistance, **P4.** Repeat this method for 60 & 100 W lamp

Knowledge & Understanding

- Describe characteristics of series circuit
- Describe the use of volt meter
- Describe characteristics of parallel circuit
- Describe the use of ampere meter
- Describe color code and its use.
- Describe the purpose of ohm meter
- Describe how current, voltage and resistor interact with one another
- Describe the purpose of ohm meter
- State Kirchhoff's first law.
- State Kirchhoff's second law
- What is reheostat?
- Why we used rheostat?
- State law of resistance?
- State law of resistance?

- What is internal resistance of voltmeter

Tool and Equipment

SN	Tools
1	Voltmeters
2	Ammeter
3	Ohmmeters
4	Multi meters.
5	Resistors of different values.
6	DC battery
7	Small pieces of copper wire.
8	Rheostat
9	Voltmeters
10	Ohmmeters
11	Incandescent lamp of different watts.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Adjust zero with shortning the ohmmeter leads.

0714-E&A-3. Measure Electrical Power, Energy, Power Factor & Determine Phase Sequence

Overview:

This competency standard covers the skills and knowledge required to Measure single phase power using Volt-Ampere meter method, watt meter & Measure consumed energy with Energy meter

Competency Units	Performance Criteria
CU1. Measure single phase power using Volt-Ampere meter method	**P1.** Select a proper load to calculate the power and give supply to it. **P2.** Measure the voltage and current by using voltmeter and ampere meter. **P3.** Find power using power formula.
CU2. Measure single power using watt meter	**P1.** Select a proper load to calculate the power and connect watt meter with it. **P2.** Give supply and measure the reading of power.
CU3. Measure 3 phase power with watt meter	**P1.** Connect current coil of watt meter in series to any phase and one terminal of balance load. **P2.** Connect voltage coil of watt meter to that phase and neutral **P3.** Give 3-phase supply to load and take reading. **P4.** Multiply the reading of watt meter with 3 to get the total power of load.
CU4. Measure power with two-watt meters	**P1.** Connect current coil of 1st watt meter in series to 1st phase and load. **P2.** Connect voltage coil of 1st watt meter to 1st phase and 3rd phase. **P3.** Connect current coil of 2nd watt meter in series to 2nd phase and load. **P4.** Connect voltage coil of 2nd watt meter to 2nd phase and 3rd phase. **P5.** Give supply and take the readings of both watt meter **P6.** Calculate the total power of load by adding the reading of both watt meter.
CU5. Measure power with three-watt	**P1.** Connect current coil of 1st watt meter in series to 1st phase and load.

	meters	**P2.** Connect voltage coil of 1st watt meter to 1st phase and neutral. **P3.** Connect current coil of 2nd watt meter in series to 2nd phase and load. **P4.** Connect voltage coil of 2nd watt meter to 2nd phase and 3rd phase. **P5.** Give the supply and take the readings of both watt meter **P6.** Calculate the total power of load by adding the reading of both watt meter.
CU6.	**Measure consumed energy with Energy meter**	**P1.** Connect phase line of AC supply to the left side terminal of energy meter. **P2.** Connect neutral line of AC supply to the next input terminal of energy meter. **P3.** Connect any AC load to the output terminals of energy meter. **P4.** Give supply and take reading of energy in terms of unit after few minutes form display.
CU7.	**Measure power factor with voltmeter, ampere meter and watt meter**	**P1.** Connect voltmeter & ampere meter with inductive load (Motor) **P2.** Connect watt meter with the load also. **P3.** Give AC supply and take the readings of volt, ampere and watt meter. **P4.** Utilize the above readings and calculate power factor using power formula P=VI $\cos\phi$
CU8.	**Measure power factor with power factor meter**	**P1.** Connect current coil of power factor meter in series to the load. **P2.** Voltage coil of power factor meter in parallel to the load. **P3.** Give supply and note the value of power factor form power factor meter.
CU9.	**Improve power factor & measure it with power factor meter**	**P1.** Connect ampere meter as well as current coil of power factor meter in series with load **P2.** Connect voltage coil of power factor meter in parallel to the load. **P3.** Connect a capacitor bank parallel to load. **P4.** Select the small value capacitor with the help of selector switch and give supply and note the value of power factor

	form power factor meter and current reading form ampere meter. **P5.** Now select the higher value of capacitor form capacitor bank with the help of selector switch and note its effect on power factor and load current.
CU10. Determine phase sequence with phase sequence meter.	**P1.** Connect three phase supply with safety switch. **P2.** Connect all three leads of phase sequence meter with safety switch. **P3.** Push the button, and observe the direction of small induction motor, which is built-in in equipment. **P4.** If motor disc is rotating toward red mark clock wise, then phase sequence is correct. **P5.** Opposite direction will indicate the wrong phase sequence.

Knowledge & Understanding

- What is the formula of D.C power?
- How can we measure power of any circuit directly with any meter?
- What is difference between electrical and mechanical power?
- What is C.C (current coil)?
- What is P.C (potential coil)?
- What is three phase system?
- What is wattmeter?
- What is balanced load?
- What is the relationship between the individual wattmeter readings and the total three phase power?
- Why we used three wattmeter methods to measure three phase load?
- What are advantages of three wattmeter method?
- How can we connect three-watt meter for measurement of power in delta connection?
- What is diffrence between power & Energy?
- What is B.O.T?
- What is Revolutions of Disk of energymeter?
- What is CC & PC?
- What is loading Rheostat?

- What is power factor?
- What are the reasons of power factor lagging?
- How can we improve power factor of an A.C inductive circuit?
- Wattmeter is used for measurement of…….?
- What is C.C & P.C of Wattmeter?
- What is leading power factor?
- How can we improve power factor of an A.C inductive circuit with capacitor?
- What is inductive load?
- What will be the effect of improved power factor on load
- Current?
- What is phase sequence?
- Why we indicate each phase by red yellow blue?
- If the phase sequence of three phase motor is not correct, then what will happen with motor?
- Logically explain why on wrong sequence motor will not work?
- Why we use lamps as phase indicator?

Tool and Equipment

SN	Tools
1	Voltmeter.
2	Ammeter
3	Wattmeter.
4	Connecting Leads.
5	Power Supply.
6	Screw Driver& Plier.
7	Single Phase Load or 100 watt lamp**.**
8	Single phase Energy Meter with connecting leads.
9	Rheostat load 2 Kw. 220/230 volts A.C.
10	Ammeter & Voltmeter
11	Single phase inductive load. Any available

	load at your lab (up to 100 watt)
12	Power Supply with switch & fuse protection (0 - 220 V.ac). Single phase.
13	Voltmeter. 0-300 volts.
14	Capacitor bank
15	Single phase power factor meter
16	Connecting leads. As required.
17	Wattmeter. 0-10 A / 600 V
18	Three phase supply source.
19	Safety switch
20	Phase sequence meter
21	Ammeter. 0 to 5 A.
22	Wattmeter. 0-500 watt
23	Change over switch
24	Three phase supply

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Give supply and take reading of energy in terms of unit after few minutes form display

0714-E&A-4. Implement Electromagnet to See Various Effects & Verify Faradays Law.

Overview:

This competency standard covers the skills and knowledge required to Implement Electromagnet, Implement circuit to determine the effect on current carrying conductor in magnetic field, Determine the effect on conductor by varying the current with the help of rheostat, plot magnetic lines of forces of bar magnet, Verify Faradays law by moving magnet in side coil, Verify Faradays law by moving coil near the magnet field, Verify EMF through induction**.**

Competency Units	Performance Criteria
CU1. Implement Electromagnet	**P1.** Take iron nail (approximately 3 inches in length) as iron core and make 30 to 40 turns of thin coated copper wire to form a coil. **P2.** Connect dry cell battery with coil wound on the iron nail. **P3.** Bring iron nail near the iron pieces and tell the observation
CU2. Implement circuit to determine the effect on current carrying conductor in magnetic field.	**P1.** Take copper rod (5cm in length) and connect wires across it. **P2.** Give DC supply to copper rod through rheostat. **P3.** Place current carrying copper rod inside the horse shoe magnet.
CU3. Determine the effect on conductor by varying the current with the help of rheostat.	**P1.** Reduce the rheostat resistance **P2.** Record the effect on copper rod. **P3.** Increase the rheostat resistance **P4.** Record the effect on copper rod.
CU4. Plot magnetic lines of forces of bar magnet.	**P1.** Place a bar magnet on paper and outline its boundary with the help of lead pencil. **P2.** Place a compass needle at one side the magnet. **P3.** Mark points on paper where the compass needle stop. **P4.** Repeat the same procedure till compass reach at the other

	end of magnet. **P5.** Change the position of compass needle near the magnetic pole and repeat the procedure for P3 to P4.
CU5. Verify Faradays law by moving magnet in side coil.	**P1.** Construct a coil with hollow iron cylinder (approximately 3 inches in length 1.5 inch in diameter.) and make 150 to 200 turns on it. **P2.** Connect Galvanometer with coil. **P3.** Move permanent magnet inside the coil fast and slow and record the effect on reading of Galvanometer. **P4.** Hold the magnet inside the coil and do not move, now record the effect on reading of Galvanometer.
CU6. Verify Faradays law by moving coil near the magnet field.	**P1.** Construct a coil with hollow iron cylinder (approximately 3 inches in length 1.5 inch in diameter.) and make 150 to 200 turns on it. **P2.** Connect Galvanometer with coil. **P3.** Fix permanent magnet and move the coil fast and slow on it and record the effect on reading of Galvanometer. **P4.** Hold the coil near the magnetic field do not move, now record the effect on reading of Galvanometer.
CU7. Verify EMF through induction.	**P1.** Take step down transformer and connect its secondary with a Galvanometer and primary winding with a DC battery through a rheostat. **P2.** Continuously variate the rheostat and observe the reading on the Galvanometer

Knowledge & Understanding

- What is magnet and magnetism?
- What is electromagnet?
- What is function of iron core
- How we can make strong magnet?
- How can we find the movement of current caring conductor which is placed in magnetic field?
- What is Fleming's left-hand rule?
- Define magnetic lines of force.

- Define magnetic field.
- How magnetic lines of force travel with respect to each other
- What is first law of Michal Faraday?
- What is second law of Faraday?
- How can we find the direction of induced EMF?
- What is the role of magnetic strength in Faraday's Law?
- What is the role of conductor's length or turns in Faraday's Law?
- What is Lenz's Law?
- What is induction?
- What is Faraday's first law of Electro-Magnetic Induction?
- What is meaning of coupled coils?
- Why EMF induced in 2nd coil, when voltage is applied to 1st coil?
- What is mutual induction?
- What is core?

Tool and Equipment.

SN	Tools
1	Iron nail as core
2	Thin coated copper wire
3	Rheostat
4	Current carrying conductor
5	Horse shoe magnet.
6	Dry cell battery
7	Magnet.
8	Connecting leads.
9	Transformer
10	Compass needle
11	Coil
12	Bar Magnet
13	Paper
14	Lead pencil.
15	Galvanometer

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in

this competency standard:

Take step down transformer and connect its secondary with a Galvanometer and primary winding with a DC battery through a rheostat.

Telecommunication Drawing

0714-E&A-5. Produce Templates, Title Block/ Strip& Draw Lines

Overview: This competency standard covers the skills and knowledge required toprepare report interpreting health & safety considerations as per national standards, Select, Identify & use drawing instruments &sheets and draw lines used in drawings.

Competency Units	Performance Criteria
CU-1: Investigate and prepare a short report on the health and safety considerations in construction of drawings.	**P1.** Observe **Considerations:** light (natural, artificial), **P2.** CAD (computer screens, electrical protection devices) **P3.** Observe neatness & cleanliness of drawing
CU-2: Select Instruments for drawings	**P1.** Identify instruments (adjustable drawing board, tee square, set square, scale rule, compasses, drawing pens/pencils, flexible curves, French curve and templates) **P2.** Select instruments in correct orientation for drawing lines - horizontal, vertical & inclined.
CU-3: Set out a drawing sheet	**P1.** Identify drawing sheets as per British, American and ISO standards. **P2.** Draw margins as per local standard. **P3.** Draw title strip as per standards on imperial & half imperial size sheet. **P4.** Draw title block as per standards on imperial & half imperial size sheet.
CU-4: Draw different types of lines.	**P1.** Draw lines and arrowheads used in construction drawings. **Lines:** basic construction line, main object outline, broken line, chain line, section line, grid line, cutting plane line, short break line, long break line. **P2.** Use correct grades of pencils. **P3.** Draw lines of correct weight. **P4.** Draw lines with standard measurements. **P5.** Observe principles of drawing lines, cleanliness.
CU-5: Store prepared	**P1.** Fold A0, A1, A2, A3, A4, drawing sheets as per

drawings.	requirements. **P2.** Fold Double elephant, Imperial- full, half, quarter, antiquarian, drawing sheets as per requirements. **P3.** Store the drawing sheet as per requirements

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

K-1. Statetheimportanceofcivildraftingasanengineeringcommunicationmedium.
K-2. Understand necessity of civil drafting in different engineering fields.
K-3. Indicate the link between drafting and other subjects of study in diploma course.
K-4. Describe the health and safety considerations involved in the production of construction drawings. **Considerations:** light (natural, artificial), CAD (computer screens, electrical protection devices), cleanliness.
K-5. Identify the various types of drawing medium available and describe their use. **Drawing medium:** cartridge paper, tracing paper.
K-6. Identify standard drawing sheet sizes. **Sizes:** A0, A1, A2, A3, A4, Double elephant, Imperial- full, half, quarter, antiquarian, A, B, C, D, E.
K-7. Identify and state the use of the various types of drawing equipment along with sizes. **Drawing Instruments:** adjustable drawing board, tee, square, set square, scale rule, compasses, drawing pens/pencils, flexible curves, French curve, templates.
K-8. Explain the different types of lines and arrowheads used in drawings. **Line types:** basic construction line, main object outline, broken line, chain line, section line, grid line
K-9. Explain the weight of lines, grades of pencils.
K-10. State the components of Title Block and Title Strip.

Critical Evidence(s) Required

The candidate needs to produce following critical evidences in order to competent in this competency standard.

- Report on health & safety considerations as per national standards.
- Drawing sheet of different types of of lines.
- Drawing of Title Block, Title Strip on half imperial and Quarter imperial sheets.

Instruments & Consumables

S No.	Description (Instruments)	S No.	Description (Consumable)
1	Drawing board	1	Drawing sheet
2	T square	2	Eraser
3	Pair of Set squares	3	HB, H, 2H, 3H Pencils
4	Drawing Box (Compasses, divider, protractor, rule)	4	Scotch tape
5	Sharpener/ Sand paper	5	Graph sheets
6	Handkerchief		
7	French Curves		
8	Set of Card board scales		

0714-E&A-6. Develop Symbols of Engineering Drawings

Overview: This competency standard covers the skills and knowledge required to prepare report on the health and safety considerations while preparing drawings, draw symbols of Engineering materials, components of building in plan, elevation & section, draw symbols of electrical installations, water supply installation, gas installations, sanitary installations.

Competency Units	Performance Criteria
CU-6: Investigate and prepare a short report on the health and safety considerations in preparing drawings.	**P4.** Observe **Considerations:** light (natural, artificial), **P5.** CAD (computer screens, electrical protection devices) **P6.** Observe neatness & cleanliness of drawing
CU-7: Draw symbols of engineering materials.	**P3.** Select the suitable instruments to draw symbols. **P4.** Distribute space of drawing sheet. **P5.** Draw symbols duly hatched as per local standards of-Sand, ballasts, metals, timbers, soil-natural, cutting, filling, fabrics, rock, glass, ceramics, plastics, asbestos.
CU-8: Draw symbols of building components in plan, section, & section.	**P1.** Select the suitable instruments to draw symbols. **P2.** Distribute space of drawing sheet. **P3.** Draw symbols in plan, section, & section duly hatched as per local standards of-brick work, stone work, block work, doors, windows, ventilators, RCC work, R.B. work, PCC, DPC, Lintels, stairs
CU-1: Draw symbols of electrical installations for ceiling and walls.	**P6.** Select the suitable instruments to draw symbols. **P7.** Distribute space of drawing sheet. **P8.** Draw symbols duly hatched as per local standards of-energy meter, main switches, sub-main switches, circuit breakers, kit kat, panel box, DFB, tube lights, holders, fans, bulbs, switches, socket, boards, circuit diagram
CU-2: Draw symbols of water supply and gas installations.	**P4.** Select the suitable instruments to draw symbols. **P5.** Distribute space of drawing sheet. **P6.** Draw symbols duly hatched as per local standards of- water pipe lines, mixers, valves, cocks, taps, showers, pump, meter, cooler. Gas pipe line, Gas meter, gas heater, gas light, gas geezer, gas burner.
CU-3: Draw symbols of sanitary installations.	**P1.** Select the suitable instruments to draw symbols. **P2.** Distribute space of drawing sheet.

	P3.	Draw symbols duly hatched as per local standards of- sewer lines, wash hand basins, water closets, bath tubs, urinals, sinks, dish washers, looking mirror, toilet paper holder, soap dish, shelf, towel rail, vent pipe, manhole, intercepting chambers, traps, grating.

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

K-11. Define conventional symbols and give its importance.

K-12. Enlist and sketch symbols of Engineering materials-Sand, ballasts, metals, timbers, soil-natural, cutting, filling, fabrics, rock, glass, ceramics, plastics, asbestos.

K-13. Enlist and sketch components of building in plan, elevation & section-brick work, stone work, block work, doors, windows, ventilators, RCC work, R.B. work, PCC, DPC, Lintels, stairs.

K-14. Enlist and sketch symbols of electrical installations-energy meter, main switches, sub-main switches, circuit breakers, kit kat, panel box, DFB, tube lights, holders, fans, bulbs, switches, socket, boards, circuit diagram.

K-15. Enlist and sketch water supply installation, gas installations- water pipe lines, mixers, valves, cocks, taps, showers, pump, meter, cooler. Gas pipe line, Gas meter, gas heater, gas light, gas geezer, gas burner.

K-16. Enlist and sketch sanitary installations- sewer lines, wash hand basins, water closets, bath tubs, urinals, sinks, dish washers, looking mirror, toilet paper holder, soap dish, shelf, towel rail, vent pipe, manhole, intercepting chambers, traps, grating.

Critical Evidence(s) Required

The candidate needs to produce following critical evidences in order to competent in this competency standard.

- Drawing symbols of Engineering materials.
- Drawing symbols of components of building in plan, elevation & section
- Drawing symbols of symbols of electrical installations
- Drawing symbols of water supply installation
- Drawing symbols of gas installations

- Drawing symbols of sanitary installations.

Instruments & Consumables

S No.	Description (Instruments)	S No.	Description (Consumable)
1	Drawing board	1	Drawing sheet
2	T square	2	Eraser
3	Pair of Set squares	3	HB, H, 2H, 3H Pencils
4	Drawing Box (Compasses, divider, protractor, rule)	4	Scotch tape
5	Sharpener/ Sand paper		
6	Handkerchief		
7	French Curves		
8	Set of Card board scales		

0714-E&A-7. Perform Telecom Drawing

Overview:

This competency standard will provide skills and knowledge related to telecom Drawing. Draw Lines, Strokes, Symbols, Alphabets, Electrical Diagrams, Telecommunication Diagram, VISIO Diagrams and Computer-Aided Design. You will be able to Draw Lines, Strokes, Symbols, Alphabets, Electrical Diagrams, Telecommunication Diagram, VISIO Diagrams and Computer-Aided Design after completing this. You can demonstrate your skills about Draw Lines, Strokes, Symbols and Alphabets.

Competency Units	Performance Criteria
1. Draw Stroke, Single Line and Multiline	**-** **P1.** Identification of Drawing Instruments **P2.** Organize Tools **P3.** Fix charts and graph paper on table **P4.** Draw Single Stroke **P5.** Draw Single Line **P6.** Draw Multi Lines **P7.** Joint Multi Strokes **P8.** Draw Outline of drawing chart
2. Draw Alphabets and numbers	**-** **P1.** Draw Capital Alphabets **P2.** Draw Small Alphabets **P3.** Draw Numbers
3. Draw Symbols and Shapes	**-** **P1.** Draw Electronics Symbols **P2**. Draw Electrical Symbols **P3**. Draw Telecommunication Symbols **P4**. Draw Title block **P5**. Draw Shapes **P6**. Draw single line diagram **P7**. Draw Multi-View Drawing **P8**. Draw Simple Pictorial Drawing **P9**. Draw in line and curve tracing **P10**. Draw oblique and isometric drawing
4. Draw Schematic Drawing of Electronics circuits	**P1**. Draw Half-wave rectifier circuits **P2**. Draw Full-wave Bridge rectifier circuits **P3**. Draw voltage Doubler circuits **P4**. Draw block diagrams **P5**. Draw Flow chart symbols
5. Draw Telecommunication Drawing	**P1**. Draw telephone wiring Diagram **P2**. Draw telephone outside plants/cables route diagrams **P3**. Drawing inter-rack/intercom wiring **P4**. Draw the layout plans of the equipment
6. Draw Electronics Diagram in VISIO Software	**P1**. Install Visio Software **P2**. Place Symbols, icons and Images in sheet **P3**. Connect Symbols and images using wires **P4**. Label symbols and wires

	P5. Draw voltage double circuits **P6**. Draw Half-wave rectifier circuits **P7**. Draw Full-wave Bridge rectifier circuits
7. Draw Telecommunication Diagram in VISIO Software	**P1**. Place Telecommunication Symbols, icon and images in sheet **P2**. Connect Symbols using wires P3. Label symbols and wires P4. Draw telephone wiring Diagram P5. Draw telephone outside plants/cables route diagrams P6. Draw inter-rack/intercom wiring P7. Draw the layout plans of the equipment
8. Install AutoCAD Software	P1. Run Setup P2. Install AutoCAD P3. Generate Key P4. Run Patch P5. Run Software
9. Create a Drawing	P1. Create a new File P2. Select Wizard or Template P3. Apply Unit setting P4. Set WCS and UCS P5. Set Drawing Limits and Drawing Aids P6. Draw simple Line, Multi line & Polyline P7. Draw, Arc, Circle and Ellipse, Spline, Rectangle, Text P8. Draw Simple 2D Drawing P9. Draw Simple 3 D Drawing P10. Draw Isometric Drawing P11. Save Drawing & Print
10. Create Electronics & Telecommunication Drawings	P1. Draw Half-wave Bridge rectifier circuits P2. Draw Full-wave Bridge rectifier circuits P3. Draw voltage doubler circuits P4. Draw Network diagram using Star Topology P5. Draw Network diagram using mesh Topology P6. Draw Network diagram using hybrid Topology P7. Draw telephone wiring Diagram P8. Draw telephone outside plants/cables route diagrams P9. Drawing inter-rack/intercom wiring P10. Draw the layout plans of the equipment
11. Modify Drawing	P1. Apply UNDO, REDO and Erase Commands P2. Identify Object Selection Methods P3. Apply Move, Rotate, Scale, Stretch, Break, Extend and Trim Commands P4. Edit Multiline & Polyline
12. Construct Object	P1. Create Arrays P2. Draw Mirror and Object P3. Draw Fillet and chamfer P4. Draw Offset and Object
A13. Apply Display Control Setting	**P1**. Apply Zoom Command P2. Apply Viewpoint, Render and Hide Commands P3. Apply Plotting 3 D P4. Select WCS and UCS

Knowledge & Understanding

This competency standard will provide knowledge related to:

- Geometry box
- Drawing tools
- Measuring units
- Scale setting
- How to fix the drawing paper on drawing board?
- Electrical and Telecommunication Symbols and Icons
- Dimensioning, System, Techniques and Kinds
- Electric Symbols and Icons
- Understand the Schematic Drawing
- Working of Rectifier, Voltage Doubler
- Block Diagram
- Flow Chart
- Telecommunication Drawing
- Installation of Telecommunication Equipment
- Telecommunication Layout
- Procedure of VISIO Software
- Electronics symbols & icons, wires
- Auto CAD Installation
- Measuring Units
- Initial Screen: Title Bar, Menu Bar, Scroll Bar, Toolbar, Command Line and Drawing Area
- Help Command
- File Save
- File Print
- AutoCAD tools.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Draw the single Line, Multiline, Alphabets and Symbols
- Draw the Basic Telecommunication /Schematic/Electronics Circuit Diagram in VISO
- Install the AutoCAD in System
- Make the new file, draw line, offset & object, save file and print in AutoCAD
- Create the 2D & 3D Diagram and set WCS & UCS scale in AutoCAD
- Create isometric drawings

0714-E&A-8. Generate Signals and Observe on CRO

Overview: This competency standard will provide skills and the fundamentals of Telecommunication. You will be able to calibrate CRO and demonstrate your skill in generating different Carrier based signals on Function generator.

Competency Units	Performance Criteria
C1. **Calibrate Analog and Digital Oscilloscopes to display a signal on the CRO.**	**-** **P1.** Connect probe to channel 1 of CRO and connect the other end to CAL port of the CRO. **P2.** Adjust the Time/Div and Voltage/Div Parameters so as the signal is displayed properly. **P3.** Calculate Vpp and Frequency of the signal displayed. **P4.** Compare these values to the rated calibration values. **P5.** Adjust the Sweep parameters if the results do not match and repeat the procedure from step 2. **P6.** Repeat the procedure for channel 2 of the CRO.
C2. **Generate a signal using Function Generator**	**-** **P1.** Power on CRO and Calibrate. **P2.** Power on the Function Generator. **P3.** Connect the function generator's output port to CRO. **P4.** Select the Wave-Shape for the signal to be generated. **P5.** Adjust the Amplitude and Frequency parameters to attain the required signals. **P6.** See the generated signal on CRO

Knowledge & Understanding

The candidate must be able to demonstrate below given knowledge and understanding required carrying out the tasks covered in this competency standard:

- Working of CRO
- Working of Function Generator
- Oscilloscope
- Frequency and its relation to Time Period.
- Calibration of CRO.
- Different wave shapes.
- Peak to Peak voltage

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

1. Calibrate Digital and Analog Oscilloscope
2. How to generate a signal on CRO using Function genarator

0714-E&A-9. Install PABX and FAX Machine

Overview: This competency standard will provide skills and the fundamentals of installation of RJ-45 and RJ-11 connectors, PABX and Fax Machine.

Competency Units	Performance Criteria
C1. **Install RJ11 and RJ45 Connectors on Cables**	**P1.** Peel off some part of the cable as per standard using knife. **P2.** Untwist and arrange the wire pairs as per standard according to their colours. **P3.** Cut off the excess length of the wires using the blade of Crimping tool. **P4.** Insert the arranged wires inside the RJ-11/ RJ-45 connector. **P5.** Place the connector inside the suitable port on the Crimping tool. **P6.** Press the handles of the crimping tool firmly so as to lock the wires inside the connector. **P7.** Repeat the above steps for the other end of the cable. **P8.** Use cable tester to check if connectors on both ends of the wire are perfectly installed. **P9.** Repeat the steps 1 through 6 if the connector is not installed correctly after cutting the faulty connector off the wire.
C2 **Installation and Configuration of Private Automatic Branch Exchange (PABX)**	**P1.** Lay 2-Pair Telephone drop wire around the premises. **P2.** Plug the telephone cord into your PBX console in an input that says, "Telephone Line." **P3.** Connect the other end into a wall jack. This allows your PBX system to send and receive phone calls. **P4.** Insert the PBX plug into the console. Plug the other end into the wall outlet. Wait for your PBX system to light up. This lets you know that you have properly installed the system. **P5.** Pick up the receiver to place a call. Dial the extension or phone number you would like to reach. Wait for the caller to answer on the other end. **P6.** Wait for the system to ring and light up, which means you have an incoming call. Pick up the receiver and answer the call. You can also press "Intercom" or "Hands Free" to answer the call
C3. **Install and configure FAX Machine**	**P1.** Remove all of the components of the fax machine from the box. **P2.** Shake gently the ink toner cartridge to evenly distribute the toner. **P3.** Insert the toner cartridge into the Fax machine. **P4.** Install RJ-11 connector on both ends of 2-Pair telephone drop wire. **P5.** Connect one end of the wire to Fax machine and the other to the Rosset Box connected to the telephone line. **P6.** Load paper into the machine. **P7.** Power on the Fax machine **P8.** Run a test sheet through the machine.

Knowledge & Understanding

The candidate must be able to demonstrate below given knowledge and understanding required carrying out the tasks covered in this competency standard:

- Working of PABX
- Twisted Pair Cable
- Applications and usage of RJ-11 and RJ-45 connectors and their datasheet.
- Installation of RJ-11 Connectors on cable.
- Operation of Telephone Set
- Installation of Rosset box on Telephone line.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

1. Install RJ 45 connector with cable
2. Install and configure the PABX
3. Install and configure Fax Machine

0714-E&A-10. Identify the Parts of Analog & Digital Telephone Set & Verify their Function

Overview:

This competency standard covers the skills and knowledge required toDismantle and identify the parts of automatic telephone set, Dismantle and identify the parts of digital telephone set, Demonstrate the operation of Telephone buzzer, Perform the operation of Transmitter & receiver, Identify the parts of rotary dial& verify its function and Identify the parts of digital dial& verify its function.

Competency Units	Performance Criteria
CU.1 Dismantle and identify the parts of automatic telephone set	**P1.** Select the automatic telephone set and establish a method for disassembling activity as per SOP. **P2.** Use standard tools described in user manual **P3.** Apply disassembling techniques **P4.** Organize the tag-identification of the parts/components/wires of telephone set. **P5.** Identify the parts (magneto bell, dial, antiskid tone circuit, transmitter, receiver, cradle switch etc.) **P6.** Check for the proper operation/ functionality **P7.** Apply assembling techniques.
CU2. Dismantle and identify the parts of digital telephone set	**P1.** Select the digital telephone set and establish a method for disassembling activity as per SOP. **P2.** Use standard tools described in user manual **P3.** Apply disassembling techniques **P4.** Organize the tag-identification of the parts/components/wires of telephone set. **P5.** Identify the parts (telephone buzzer, dial, Dial IC, speech IC transmitter, receiver, bridge rectifier, cradle switch etc.) **P6.** Check for the proper operation/ functionality **P7.** Apply assembling techniques.
CU3. Demonstrate the operation of Telephone	**P1.** Connect the telephone set to telephone line. **P2.** Dial the telephone No. which is connected to line, form any mobile/telephone.

buzzer	**P3.** Hear the ringing tone in mobile/telephone and note what happen in telephone set connected to line.
CU4. Perform the operation of Transmitter & receiver	**P1.** Connect the telephone set to telephone line. **P2.** Dial the telephone No. which is connected to line, form any mobile/telephone. **P3.** On hearing ringing bell, pic up hand set and speak on the lower portion of hand set (transmitter). **P4.** On replying form other side note the effect from upper portion of hand set (receiver).
CU5. Identify the parts of rotary dial& verify its function.	**P1.** Select automatic telephone set. **P2.** Identify the dial plate of dialer. **P3.** Identify the dial hole on dial plate. **P4.** Identify the finger stop. **P5.** Dial any number from rotary dial **P6.** Note the sound of pulsed on receiver and count them and compare them to dial number.
CU6. Identify the parts of digital dial& verify its function.	**P1.** Select digital telephone set. **P2.** Identify Key paddialer on the telephone set. **P3.** Press different numbers from key paddialer. **P4.** Note and compare the difference of sound effect in receiver against each dial number.

Knowledge & Understanding

- Define telephone set.
- Define telephone transmitter and receiver.
- Define antiside tone circuit.
- Define function of telephone buzzer.
- Describe the function of balancing circuit.
- What is the function of cradle switch?
- Define telephone set.
- Define telephone transmitter and receiver.
- Define antiside tone circuit.
- Define function of telephone buzzer.
- Describe the function of balancing circuit.
- What is the function of cradle switch?

Tool and Equipment

SN	Tools
1	Screw drivers
2	tweezers
3	Wire Cutter
4	Test probes
5	Nose plier
6	Electrical test bench
7	Electrical test bench
8	Nose plier
9	Power source (AC/DC
	Multimeter
	Tweezers
	Wire Cutter
	Test probes
	Power source (AC/DC)

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

0714-E&A-11. Demonstrate Demodulation, Multiplexing & De Multiplexing of Information Signal

Overview:

This competency standard covers the skills and knowledge required toPerform Amplitude Modulation of Information Signal, Perform Demodulation of Modulated AM Signal, calculate band width and modulation index, Perform Frequency Modulation of Information Signal, Perform Demodulation of Modulated FM Signal, Perform Pulse Code Modulation (PCM) of an analog signal, Perform Time Division Multiplexing (TDM) and De-multiplexing and Perform Frequency Division Multiplexing and De-multiplexing

Competency Units	Performance Criteria
CU1. Perform Amplitude Modulation of Information Signal	**P1.** Calibrate CRO. **P2.** Generate Low Frequency Message signal and observe on channel 1 of CRO. **P3.** Apply the Message and Carrier signals to the AM Modulator Section of the AM Trainer. **P4.** Connect the output of the modulator to channel 2 of CRO and observe the signal.
CU2. Perform Demodulation of Modulated AM Signal	**P1.** Calibrate CRO. **P2.** Generate AM Modulated signal and observe on channel 1 of CRO. **P3.** Apply the Modulated and Carrier signals to the AM De-Modulator Section of the AM De-Modulation Trainer. **P4.** Connect the output of the de-modulator to channel 2 of CRO and observe the signal. **P5.** Compare the Message signal to the Demodulated signal.
CU3. Calculate band width and modulation index	**P1.** Calibrate CRO. **P2.** Measure the frequency and voltage of Low frequency and carrier frequency signal with oscilloscope. **P3.** Calculate modulation by formula $m = \frac{\text{Modulating Voltage}}{\text{Carrier Voltage}} = \frac{V_m}{V_c}$ **P4.** Calculate bandwidth by formula $\Delta B = USB - LSB$ Where as

	$USB = f_c + f_m$, $LSB = f_c - f_m$
CU4. Perform Frequency Modulation of Information Signal	**P1.** Calibrate CRO. **P2.** Generate Low Frequency Message signal and observe on channel 1 of CRO. **P3.** Apply the Message and Carrier signals to the FM Modulator Section of the FM Trainer. **P5.** Connect the output of the modulator to channel 2 of CRO and observe the signal.
CU5. Perform Demodulation of Modulated FM Signal	**P1.** Calibrate CRO. **P2.** Generate FM Modulated signal and observe on channel 1 of CRO. **P3.** Apply the Modulated and Carrier signals to the FM De-Modulator Section of the FM De-Modulation Trainer. **P4.** Connect the output of the de-modulator to channel 2 of CRO and observe the signal. **P4.** Compare the Message signal to the Demodulated signal.
CU6. Perform Pulse Code Modulation (PCM) of an analog signal	**P1.** Generate Sine wave signal and observe on channel 1 of CRO. **P2.** Apply the generated signal and Clock signal to the PCM Modulator using jumpers. **P5.** Observe the output on channel 2 of CRO and also note the pattern of blinking of output LEDs.
CU7. Perform Time Division Multiplexing (TDM) and De-multiplexing	**P1.** Generate multiple low frequency signals. **P2.** Apply the signals to TDM Multiplexer. **P3.** Observe the multiplexed output on channel 1 of CRO. **P4.** Apply to multiplexed output to the De-multiplexer. **P5.** Observe output for first message signal on channel 1 of CRO and compare the output signal with the relative Message signal by observing it on channel 2 of CRO. **P3.** Repeat the step 5 for all the DE multiplexed signals one by one.
CU8. Perform Frequency Division Multiplexing	**P1.** Generate multiple message signals. **P2.** Generate multiple carrier signals of different frequencies. **P3.** Apply each of the message and carrier signal pairs to their respective Balanced Modulators.

and De-multiplexing	**P4.** Combine the modulated signals using Adder and observe this FDM Multiplexed output on Channel 1 of CRO. **P5.** Apply the multiplexed signal to respective Band-Pass filters for each DE multiplexer section (or user). **P6.** Apply the output of each Filter to their respective Demodulators. **P6.** Observe the demodulated and hence FDM DE multiplexed signals for each user and compare them to their respective Transmitted signals by viewing both on CRO at the same time.

Knowledge & Understanding

- Calibration of CRO.
- Working Principle of AM Modulator
- Working Principle of AM Demodulator.
- Define low frequency or information signal
- Define high frequency or carrier signal.
- Define modulation index
- Define bandwidth.
- Define USB “Upper side band”
- Define LSB “Lower side band
- Calibration of CRO.
- Working Principle of FM Modulator
- Working Principle of FM Demodulator.
- Sine wave and its different parameters.
- Calibrating and using CRO.
- Working principle of PCM
- Working principle of TDM.
- Calibrating and Using CRO
- Calibrating and Using CRO.
- Working principle of CRO.
- AM DSB and SSB
- AM demodulation
- Filtering

Tool and Equipment

SN	Tools
1	Oscilloscope with probes
2	Oscilloscope with probes
3	Frequency Modulation Trainer
4	FM Demodulation Trainers
5	Jumpers
6	FM Trainer
7	AM Trainer
8	Signal generator
9	Oscilloscope with probes
10	AM Demodulation Trainers
11	Jumpers

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

0714-E&A-12. Select Computer Specification and Work with Windows

Overview:

This Competency standard deals with the skills and knowledge required to identify computer requirements and assembles procedures, Make a set of requirements for a personal computer, Use DOS to write a script, Work on windows, Environment and Install the required operating System with Device drivers.

Competency Units	Performance Criteria
CU1. Identify computer requirements and assemble procedures	**P1.** Select the hardware components of Computer. **P2.** Install the necessary plug-ins **P3.** Install the required computer software's for operations of peripherals
CU2. Make a set of requirements for a personal computer	**P1.** Arrange processer, RAM, Hard drive, Graphic card according to the requirement. **P2.** Identify requirements for a computer to run windows MS Office and Eclipse IDE
CU3. Work on windows Environment and Install the required operating System with Device drivers.	**P1.** Install and execute test of required Application Software's. **P2.** Make the Ghost of Hard Disk / Partitions. **P3.** Apply the appropriate operation and execution of system as per standard **P4.** Perform loading and shutdown of operating system. **P5.** Create items (icons, shortcut, folders etc) and modifying taskbar. **P6.** Change the wallpaper, screensaver, and resolution. **P7.** Check the control panel items (add/remove, time and date, mouse, and create user account.)

Knowledge & Understanding

- Define Basic purpose of computer
- Describe basic components of computer.
- Describe relevant software according to your work.
- Describe Input and Output devices
- Explain different parts of a functions on present computer
- Explain specification of processor RAM, Hard drive and Graphic cards
- Explain DOS system
- Explain Commands used in Dos system
- Explain type of Installation, Testing and inspection of operating system and their applications

Tool and Equipment

SN	Tools
1	Power Cables,
2	Presentation manuals, Handouts Hardware, equipment
3	Tool kits and Windows
4	Relevant Software Disks
5	Internet
6	Keyboard,
7	Printer
8	CPU
9	Monitor
10	Multimedia
11	Multimedia Screen
12	DVDs,6,10 etc.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in

this competency standard:

- Arrange processer, RAM, Hard drive, Graphic card according to the requirement

0714-E&A-13. Carryout Basic Programming

Overview:

This Competency standard deals with the skills and knowledge required to write a program to perform arithmetic operations, write a program in C++ to preparing logical operation, and write a program to sort a string of numbers.

Competency Units	Performance Criteria
CU1. Make a program to perform arithmetic operations	**P1.** Install eclipse or other IDE with C++ **P2.** Make a program that can take inputs from users and perform arithmetic operations like a calculator **P3.** Run the program and verify the results
CU2. Make a program in C++ to preparing logical operation	**P1.** Make a program that takes two numbers and decides which is bigger and which is smaller **P2.** Make a program that takes number of lights, fans in a house and calculate load
CU3. Make a program to sort a string of numbers	**P1.** Make a script to take 10 numbers as input and display **P2.** Make a program to sort numbers in increasing order **P3.** Run the program and verify the results

Knowledge & Understanding

- Define Arithmetic operations
- Explain Arithmetic and logical operations in C++
- Define Loop operations in C++

Tool and Equipment

SN	Tools
1	Computer

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Create a program in C++ for loop

0714-E&A-14. Perform Internet Browsing

Overview:

This Competency standard deals with the skills and knowledge required to draw pin diagram of electronic IC using of search engine, Browse data sheets and symbols, Browse manuals

Competency Units	Performance Criteria
CU1. Draw pin diagram of electronic IC using of search engine	**P1.** Open the Internet browser. **P2.** Identify various search engines **P3.** Open google.com and carry out searching related to course **P4.** Open Yahoo.com and carry out searching related to course **P5.** Open Ask.com and carry out searching related to course **P6.** Open Wikipedia.com and carry out searching related to course **P7.** Identify best search engine
CU2.Browse data sheets and symbols	**P1.** Search data sheet of various electronic components from the Internet **P2.** Search various symbols of electrical components **P3.** Search the Electric design software **P4.** Prepare a report for the best software and their application
CU3.Browse manuals	**P1.** Search various manuals available on the internet related to course **P2.** Read the key terms **P3.** Clear your concepts from the manual

Knowledge & Understanding

- Define search engine
- Describe different types of search engine.
- Determine frequently use search engine.
- Define different parameters
- Define data sheets.
- Determine symbols
-

Tool and Equipment

SN	Tools
1	Computer

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Elaborate Datasheet.

0714-E&A-15. Perform the Different Engineering Curves Used in Various Mechanism

Overview:

This competency standard covers the skills and knowledge required to Construct inscribe and circumscribe figures, Construct a pentagon, Hexagon and Octagon by circumscribe method, Construct a pentagon, Hexagon and Octagon by inscribe method, Construct a Tangents of circles (Inside & Outside)When the centre of the given circle is known and when the circle of centre is not known, Construct an Ellipse by Concentric Circle Method, Rectangle Method, Oblong Method, Arcs of Circle Method, Rhombus Method and Basic Locus Method, Construct a parabola curve by Rectangle Method, Method of Tangents(Triangle Method) and Basic Locus Method, Construct a hyperbola curve, Construct a Archimedean Spiral curve, Construct a involutes curve of square rectangle hexagon and circle and Construct of cycloid, epicycloids, and hypocycloid.

Competency Units	Performance Criteria
CU1. Construct inscribe and circumscribe figures.	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw square, triangle and hexagon according to dimension.
CU2. Construct a pentagon, Hexagon and Octagon by circumscribe method.	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw pentagon, Hexagon and Octagon .
CU3. Construct a pentagon, Hexagon and Octagon by inscribe method	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw pentagon, Hexagon and Octagon.
CU4. Construct a Tangents	**P1.** Prepare Drawing sheet.

	of circles (Inside & Outside)When the centre of the given circle is known and when the circle of centre is not known.	**P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw Tangents of circles
CU5.	**Construct an Ellipse by Concentric Circle Method, Rectangle Method, and Oblong Method, Arcs of Circle Method, Rhombus Method and Basic Locus Method.**	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw an Ellipse.
CU6.	**Construct a parabola curve by Rectangle Method, Method of Tangents(Triangle Method) and Basic Locus Method**	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw a parabola curve.
CU7.	**Construct a hyperbola curve.**	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw a hyperbola curve.
CU8.	**Construct a Archimedean Spiral curve**	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw spiral curve.
CU9.	**Construct a involutes curve of square rectangle hexagon and circle.**	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar

	P5. Divide the sheets in different equal parts. **P6.** Draw involute curve.
CU10. Construct of cycloid, epicycloids, and hypocycloid.	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw the generating circle and the base line equal to the circumference of the generating circle **P7.** Divide the circle and the base line in to equal number of parts **P8.** Draw by completing the cycloid.

Knowledge & Understanding

- Describe Techniques of sketching straight lines in different directions
- Define Triangles, Quadrilateral and Polygons
- Describe circular arc using different line method
- Describe circular arc
- Types of Geometric Shape
- Describe Two-dimensional shapes
- Describe Three-dimensional shapes
- Describe Types of Geometric Shape
- Describe Two-dimensional shapes
- Describe Three-dimensional shapes
- Describe Types of Geometric Shape
- Define Regular Polyhedrons
- Describe Methods of drawing Tangents & Normal
- Define ellipse
- Describe different methods of sketching ellipse
- Describe parabola
- Describe different methods of parabola
- Describe hyperbola curve
- Describe different methods of hyperbola curve
- Describe spiral curve
- Describe involute curve
- Describe cycloid
- Describe epicycloids

- Describe hypocycloid

Tool and Equipment

SN	Tools
1	Graph and drawing sheet
2	Drawing Board/Table
3	Tea-Square
4	Set Square
5	Temple
6	Geometry Box

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

Construct a Tangents of circles

0714-E&A-16. Measure Quality of Service for GSM and LAN network

Overview:

This standard will provide the knowledge, skills and attitudes needed to apply quality standards in the workplace. This standard also includes the application of relevant safety procedures and regulations, requirements Organization procedures and customer. You will be able measure QoS of GSM and LAN networks.

Competency Units	Performance Criteria
C1. Measurement of QoS for GSM	P1. Obtain document related with operating GSM specification. P2. Connect protocol analyzer with BTS. P3. Identify the problems in the cellular network P4. Make report on faults and causes of fault
C2. Measurement of QoS for LAN Network	P1. Obtain the document of Work instructions and work is carried out in accordance with standard operating procedures P2. Check inter department and intra department connectivity P3. test Load on Network Devices when under full capacity P4. Test all LAN Devices for switching loops. P5. Make a report on fault and causes of fault.
C3. Measurement of Quality of Voice call in GSM	P1. Obtain document related with operating GSM specification. P2. Make calls on specific time P3. Check the number of calls established. P4. Note down the number of dropped calls P5. Calculate the dropout calls ratio
C4. Measurement of quality of Data Communication	P1. Obtain document related with operating GSM specification. P2. Download data on specific time of one GSM operator P3. Check the download speed number of specificoperators. P4. Download the same data with another GSM operator P5. Check the download speed. P6. Compare the download speed of both GSM operators. P7. Upload the specific data by using one GSM operator P8. Upload the same data with another GSM operator. P9. Compare the upload speed of both operators. P10. Submit the report of QoS of both operators

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- Characteristics of materials/components used in production processes
- Workplace procedures, Safety and environmental aspects of production Processes
- Fault identification and reporting writing
- Quality checking procedures
- Workplace procedures
- Fault identification procedure
- OHS procedure and practice
- Personal protective equipment
- Hazard and risk identification procedure
- Voice communication
- Report writing
- Networking
- Switching
- GSM
- Data communication
- Upload and download Excel sheet

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard.

-

0714-E&A-17. Assess Quality of Given Equipment and works

Overview:

This standard will provide the knowledge, skills and attitudes needed to apply quality standards in the workplace. You will be able to assess the quality of following equipment:

1 different GSM operators
2 LAN network
3 Voice calls
4 Data communication

Competency Units	Performance Criteria
1. Assess Quality of Given Equipment	P1. Obtain the document of Work instructions and work is carried out in accordance with standard operating procedures P2. Check Received equipment or component parts against workplace standards and Specifications P3. Identify Faulty material or components related to work P4. Identify the causes of faults P5. Record and Report the Faults and causes to the supervisor concerned in accordance with workplace procedures P6. Replace the Faulty materials or components accordance with workplace procedures
2. Assess work on site	P1. Obtain the Document relative to quality within the company P2. Check Completed work according to workplace standards P3. Faulty pieces are identified P4. Record the Information on the quality and other indicators of production performance according with workplace procedures P5. Report the Deviations from specified quality standards and causes according with the workplace' standards operating procedures
3. Evaluate Hazards and Risk	P1. Identify the Hazards and risks in the workplace and their corresponding indicators to minimize or eliminate risk at workplace accordance with organization procedure. P2. Identify the Effect of hazards P3. Identify the OHS issues P4. Submit the report to designated personnel in accordance with workplace requirements and relevant workplace OHS legislation

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- Characteristics of materials/components used in production processes
- Workplace procedures, Safety and environmental aspects of production Processes
- Fault identification and reporting writing
- Quality checking procedures
- Workplace procedures
- Fault identification procedure
- OHS procedure and practice
- Personal protective equipment
- Hazard and risk identification procedure

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard.

- **Assess Quality of Given Equipment**
- **Assess work on site**
- **Evaluate Hazards and Risk**

Tools and Equipment
• Product manual • Drawing • LLD/HLD of task • hand tools • cleaver/cutter • stripper • polishing papers • Personal protection equipment • Pigtail patch code • Cable tester ➢ Previous and Current Floor plans ➢ Equipment and equipment's checklist ➢ GPS ➢ GIS software ➢ Site Data Sheet ➢ Measuring tools, DMM, Mechanical/Electrical tool kit ➢ Laptop, Software tools, Communication devices, Compass ➢ Electrical and mechanical tool kit and hardware ➢ Laptop, Site master ➢ Ethernet cable

- PPE
- First Aid Box

0714-E&A-18. Maintain Occupational Health and Safety

Overview:

After this Competency Standard, the Trainee will be able to develop skill and competence required to maintain Occupational Health and Safety and take remedial measures to deal with the emergencies in a professional manner, thus minimizing the losses and providing a safe and healthy working environment.

Competency Units	Performance Criteria
CU1. Ensure personal protective equipment (PPE)	**P1.** Arrange personal protective equipment as per requirements **P2.** Wear correct personal protective equipment **P3.** Store PPE at appropriate place after use.
CU2. Maintain First-aid Box	**P1.** Ensure availability of first aid box **P2.** Check first aid box for requisite emergency **P3.** Check expiry of medicines **P4.** Perform first aid treatment against electric shocks **P5.** Perform first aid treatment/bandages against minor injuries.
CU3. Maintain Fire Extinguisher	**P1.** Check expiry of fire extinguisher **P2.** Operate fire extinguisher **P3.** Replace fire extinguisher **P4.** Ensure that the fire brigade is at stand by(for major emergency)
CU4. Ensure Safeguard of Machines	**P1.** Maintain radiator shield **P2.** Maintain alternator fan shield **P3.** Maintain heat resister material on silencer **P4.** Cover main circuit breaker **P5.** Lock canopy doors

CU5. Adopt company policies and procedures	**P1.** Ensure company's safety policy **P2.** Adopt company safety procedure **P3.** Advocate worker with company safety policy **P4.** Implement Safety sign board as per standard
CU6. Attain health & safety training	**P1.** Take required health and safety training **P2.** Implement work hazardous material information system (WHMIS) **P3.** Adopt first aid cardio respiratory, resuscitation and CPR
CU7. Prepare for emergencies	**P1.** Take emergency response training **P2.** Ensure practice of emergency exercises **P3.** Check the emergency alarms **P4.** Ensure regular practice of gathering the workers in assembly area during the emergency.
CU8. Respond to emergencies	**P1.** Follow emergency plan **P2.** Communicate instructions to co workers **P3.** Assess risk and determine course of action **P4.** Operate emergency equipment and supplies **P5.** Ensure that the ambulance is at stand by (for emergency)

Knowledge & Understanding

- Factors affecting Health & Safety in the workplace.
- Personal Protective Equipment (PPE)
- First-Aid-Box.
- Emergency medicines and expiry
- Methods of treatment against electric shock
- Methods of treatment against minor injuries
- Types of Fire Extinguisher
- Uses of Fire Extinguisher
- Company policies and procedures
- Understand various safe guards
- Safety measures
- Work permit/no objection certificate(NOC)
- Types of work site Hazards
- Hazardous chemical control procedures

- Methods of first aid cardio respiratory Procedure
- Types of emergencies
- Response various types of emergencies
- Emergency equipment, supplies and their operation
- Methods of communication during
- emergency

Tool and Equipment

SN	Tools
1	Protection suite
2	Safety shoes
3	Safety goggles
4	Hearing protection
5	Respiratory mask
6	First Aid Box
7	First Aid Kit
8	Stretcher
9	Fire Buckets
10	Fire Extinguisher
11	Emergency Alarm/Bell
12	Emergency response Plan
13	Fall Protection Plan

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Types of hazards that are most likely to cause harm to health and safety
- Health and safety signs and precautions
- Techniques and methods to identify the risks of hazards at workplace
- Safety reporting procedures and documentation
- Describe fire-fighting methods
- Demonstrate use of appropriate Personal Protective Equipment (PPE) for the assigned job
- Demonstrate removal and disposal of PPE.

0714-E&A-19. Adopt Safety Regulations, Labour Protection Laws, Environmental Protection Laws at Workplace

Overview:

After this Competency Standard, the Trainee will be able to develop skill and competence required to maintain Occupational Safety, Health and Environment at the workplace according to the National and International Protection Agencies Standards and take remedial measures for Personal, Occupational and Environmental Protection. The Trainee will be able to deal with the emergencies in a professional manner, thus minimizing the losses and providing a safe and healthy working environment.

Competency Units	Performance Criteria
CU1: Implement International Safety Standards in your work environment	**P1.** Recognize Electrical Safety hazards as per International Electro-Technical Commission (IEC) Standards **P2.** Determine Environmental Pollution risk factors as per Protection Agency (EPA) standards **P3.** Identify Electrical Safety Hazards as per Institute of Electrical and Electronics Engineers (IEE) standards **P4.** Categorize the Electrical Safety Hazards as per Electrical Safety Foundation International(ESFI) standards **P5.** Identify Labor Protection Laws as per International Labor Organization(ILO) rules **P6.** Identify the steps to minimize the Electrical hazards and Environmental Pollution. **P1.** Prepare a report for all the above activity.
CU2: Implement National Safety Standards in your work environment	**P1.** Identify Factory associated hazard as per Chapter 3 of Factories Act, 1934 **P2.** Determine Environmental Pollution factors as per Pakistan Environmental Protection Act, 1997 **P3.** Recognize the Labor protection laws as per Labor Protection Policy 2006 **P4.** Identify the workplace hazards as per Occupational health and safety (OHS) standards **P5.** Identify the steps to minimize the Electrical hazards, Environmental Pollution and Labor Safety **P6.** Prepare a report for all the above activity.

CU3: Implement International and National Labor Protection Laws	**P1.** Identify Labor Protection Laws as per International Labor Organization(ILO) rules **P2.** Recognize the Labor protection laws as per Labor Protection Policy 2006 **P3.** Identify the Bonded Labor and Child Labor policy. **P4.** Determine the leaves policy and compensation policy for the Labor. **P5.** Recognize the minimum wage for the Labor **P6.** Identify the remedial steps for protection and prosperity of Labor. Prepare a report for all the above activity.
CU4: Implement National and International Environmental protection laws	**P1.** Determine Environmental Pollution risk factors as per Protection Agency (EPA) standards **P2.** Identify the steps to minimize the Electrical hazards and Environmental Pollution. **P3.** Determine Environmental Pollution factors as per Pakistan Environmental Protection Act, 1997 **P4.** Identify the requirements for Initial Environmental Examination (IEE) **P5.** Identify the requirements for Environmental Impact Assessment (EIA) **P6.** Prepare a report for all the above activity.
CU5: Prepare for emergencies	**P1.** Take emergency response training **P2.** Ensure practice of emergency exercises **P3.** Ensure the availability of first aid box and fire extinguisher **P4.** Check the expiry of medicines and fire extinguishers **P5.** Check the emergency alarms **P6.** Ensure regular practice of gathering the workers in assembly area during the emergency.
CU6: Respond to emergencies	**P1.** Follow emergency plan **P2.** Communicate instructions to co workers **P3.** Assess risk and determine course of action **P4.** Operate emergency equipment and supplies **P5.** Ensure that the ambulance and fire brigade is at stand by (for major emergency)
CU7: Adopt company policies and	**P1.** Ensure company's safety policy **P2.** Adopt company safety procedure **P3.** Advocate worker with company safety policy

procedures	**P4.** Implement Safety sign board as per standard

Knowledge & Understanding

- Factors affecting Health & Safety in the workplace.
- Personal Protective Equipment (PPE)
- First-Aid-Box.
- Emergency medicines and expiry
- Methods of treatment against electric shock
- Methods of treatment against minor injuries
- Types of Fire Extinguisher
- Uses of Fire Extinguisher
- IEC/EPA/IEE/ESFI Standards
- Factories Act 1934
- Pakistan Environmental Protection Act, 1997
- Occupational health and safety (OHS) standards
- Labor Protection Policy 2006
- Company policies and procedures
- Understand various safe guards
- Safety measures
- Work permit/no objection certificate(NOC)
- Types of work site Hazards
- Hazardous chemical control procedures
- Methods of first aid cardio respiratory Procedure
- Types of emergencies
- Response various types of emergencies
- Emergency equipment, supplies and their operation
- Methods of communication during emergency
- Factors affecting Health & Safety in the workplace.
- Personal Protective Equipment (PPE)
- First-Aid-Box.
- Emergency medicines and expiry
- Methods of treatment against electric shock
- Methods of treatment against minor injuries

- Types of Fire Extinguisher
- Uses of Fire Extinguisher
- IEC/EPA/IEE/ESFI Standards
- Factories Act 1934
- Pakistan Environmental Protection Act, 1997
- Occupational health and safety (OHS) standards
- Labor Protection Policy 2006
- Factors affecting Health & Safety in the workplace.
- Personal Protective Equipment (PPE)
- First-Aid-Box.
- Emergency medicines and expiry
- Methods of treatment against electric shock
- Methods of treatment against minor injuries
- Types of Fire Extinguisher
- Uses of Fire Extinguisher
- IEE/EIA Standards
- Factories Act 1934
- Pakistan Environmental Protection Act, 1997
- Occupational health and safety
- OHS) standards
- Labor Protection Policy 2006

Tool and Equipment

SN	Tools
1	Respiratory mask
2	First Aid Box
3	First Aid Kit
4	Stretcher
5	Fire Buckets
6	Fire Extinguisher
7	Emergency Alarm/Bell
8	Fall Protection Plan
9	International Safety Standards Manual
10	Emergency response Plan
11	National Safety Standards Manual

12	Plan
13	National Safety Standards Manual
14	WHMIS Handbook
15	International Safety Standards Manual
16	Safety shoes
17	Hearing protection
18	Safety goggles
19	Emergency response
20	Emergency Alarm/Bell
21	Fire Extinguisher
22	Fire Buckets
23	Stretcher
24	First Aid Box
25	Respiratory mask
26	First Aid Kit
27	Protection suite
28	Protection suite
29	Hearing protection
30	WHMIS Handbook
31	National Safety Standards Manual
32	International Safety Standards Manual
33	Fall Protection Plan
34	Emergency response Plan
35	Emergency Alarm/Bell
36	Fire Extinguisher
37	Fire Buckets
38	Stretcher
39	First Aid Kit
40	Respiratory mask
41	First Aid Box
42	Safety shoes
43	Safety goggles

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in

this competency standard:

:

- Types of hazards that are most likely to cause harm to health and safety
- Health and safety precautions
- Health and safety signs and symbols
- Techniques and methods to identify the risks of hazards at workplace
- Dealing with hazards to avoid any accident or injury
- Safety reporting procedures and documentation
- Describe fire-fighting methods
- Demonstrate use of appropriate Personal Protective Equipment (PPE)

0714-E&A-20. Develop Professionalism

Overview:

This competency standard covers the skills and knowledge required to Demonstrate work ethic, Aware of factors affecting personal health, Resolve problems or disagreements with others, participate in professional development, Work with others, Work independently, Speak and listen effectively, interpret documentation, communicate using signals, and communicate Using electronic equipment.

Competency Units	Performance Criteria
CU1. Demonstrate work ethic	**P1.** Follow principles of work ethics in all situations **P2.** Adopt professional behavior
CU2. Select factors affecting personal health	**P1**. Follow factors affecting personal health **P2**. Aware about the situations/conditions that cause stress in professional and personal life
CU3. Resolve problems or disagreements with others	**P1.** Communicate effectively **P2.** Adopt peaceful approach **P3.** Regulate cause of problem or disagreement **P4.** Resolve issues
CU4. Participate in professional development	**P1**. Assess own knowledge and skills **P2**. Acquire information about training opportunities **P3**. Adopt to Learn through various methods, such as on job training, reading, courses and co-workers
CU5. Work with others	**P1**. Work as a team member to achieve common goals **P2**. Keep mind open. **P3**. Participate in work place meetings **P4**. Communicate accurately and clearly **P5**. Co-ordinate job related activities **P6**. Cooperate with others
CU6. Work independently	**P1.** Confirm and clarify assignment **P2.** Take initiative, anticipate and prepare for next steps in job **P3.** Identify and resolve potential and actual problems **P4**. Communicate with other site personnel **P5**. Complete assignment
CU7. Speak and listen effectively	**P1**. Listen carefully to what is said **P2**. Confirm understanding, such as repeat instructions **P3**. Communicate message clearly and accurately to others

	P4. Exchange information with others, such as supervisor, signaler, general public, inspectors, other operators and trade people
CU8. Interpret documentation	**P1.** Access and maintain documents **P2.** Provide complete, legible and accurate information in documents **P3**. Interpret equipment inspection documentation from previous shifts before conducting pre-operational inspection
CU9. Communicate with signals	**P1.** Identify and work with signals **P2**. Communicate with audible signals, such as back-up alarm, and site emergency horn **P3**. Communicate with hand signals
CU10. Communicate with electronic equipment	**P1.** Check communication devices to verify operating condition, such as complete radio checks **P2.** Deliver and receive messages using communication equipment **P3**. Follow communication protocol

Knowledge & Understanding

- Explain Principles of work ethic and expectations.
- Factors/situations/conditions that cause stress in professional and personal life
- Working conditions on construction site
- Impact of fatigue on job performance.
- Applicable legislation, such as harassment
- Conflict resolution techniques.
- Own role and responsibilities
- Roles and responsibilities of
- Others in industry.
- Work assignment, location, and working conditions
- Importance of effective communication
- Roles of individuals on job site, such as supervisor, inspector, other trades people
- Types of documentation required, such as log books, safety reports, maintenance reports, inspection reports, time cards
- Importance of complete, legible, and accurate documentation

- Role and responsibilities of signalers
- Signalers on job site
- Audible and warning signals used on job site
- Types of communication equipment used on job site

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Handle and set Lightening for Current affair program Own current mental, emotional, and physical state.
- Working conditions on construction site.
- Effective communication.
- Maintain log books, safety reports, maintenance reports, inspection reports, time cards
- Signalers on job site
- Audible and warning signals used on job site
- Communication equipment used on job site

0714-E&A-21. Maintain Tools & Equipment

Overview:

This Competency Standard covers the skills and knowledge required to arrange tools/equipment, maintain tool box, insulate tools/equipment, calibrate measuring tools and manage proper inventory of used/unused tools/equipment. Trainee will be expected to follow the procedures to maintain the tools/equipment.

Competency Units	Performance Criteria
CU1. Arrange Tools and Equipment	**P1.** Identify tools and equipment **P2.** Interpret job card **P3.** Prepare list of tools and equipment as per requirement **P4.** Collect tools and equipment from store
CU2. Maintain Tool Box	**P1.** Check physical conditions of tools and equipment before use **P2.** Perform preventive maintenance as per standards **P3.** Perform corrective maintenance of tools as per requirements **P4.** Clean tools and equipment after use **P5.** Place tools and equipment at appropriate place
CU3. Insulate Tools and Equipment	**P1.** Select insulated tools and equipment **P2.** Adopt insulated tools and equipment as per standards
CU4. Calibrate measuring tools	**P1.** Check calibration status of the measuring tools **P2.** Perform calibration of measuring tools as per standards **P3.** Record calibration test results
CU5. Manage Inventory of tools and equipment	**P1.** Check tools and equipment as per record **P2.** Report for faulty tools and equipment to supervisor

	P3. Generate demand for deficit tools and equipment **P4.** Maintain all records of tools and Equipment

Knowledge & Understanding

- Explain Various tools and equipment and their functions
- Define Job card/work order
- How an Arrangement of tools/equipment as per job is required?
- Differentiate between corrective and preventive maintenance
- Arrange tools
- and equipment in tool box
- Storage methods of tools and equipment
- Insulation procedure
- Types of insulation
- Methods of insulated tools and equipment.
- Types of calibration
- Methods of equipment calibration
- Methods of tools and equipment inventory
- Report writing of faulty tools and equipment

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Describe functions of various tools and equipment
- Define job card
- Storage methods of tools and equipment
- Types of insulation
- Use of insulated tools and equipment
- Method of equipment calibration
- Report writing

0714-E&A-22. Make Cable/Wire Joints for Single Phase Wiring

Overview:

This Competency Standard covers the skills and knowledge required to make joints of cable during wiring and breakage of wires, Make Cross/Twist joint, Make Straight/Married joint, Make T- Joint, Make Rat tail joint, Make Britannia joint**.**

Competency Units	Performance Criteria
CU1. Make Cross/Twist joint	**P1.** Select the cable. **P2.** Strip the wire according to 50mm. **P3.** Twist the conductors. **P4.** Solder the conductor **P5.** Insulate the joint
CU2. Make Straight/Married joint	**P1.** Select the cable. **P2.** Strip wire to 75mm according to joint requirement. **P3.** Intermingle the conductors to 60mm into each other. **P4.** Twist 60mm conductors leaving behind 15mm of each cable. **P5.** Solder the conductor. **P6.** Insulate the joint.
CU3. Make T- Joint	**P1.** Select the cable. **P2.** Remove the insulation of cable 1 to 50mm from where a connection is required. **P3.** Separate conductors of cable 1 equally. **P4.** Take another 12 mm stripped wire 2. **P5.** Insert between two equally half conductors of cable 1 and twist. Half conductors clockwise and half anti-clock wise of cable 2. **P6.** Solder the joint.
CU4. Make Rat tail joint	**P1.** Select the single conductor wires. **P2.** Strip both the wires to 5mm. **P3.** Twist the conductor. **P4.** Insulate the joint. **P5.** Solder the joint.

CU5. Make Britannia joint	**P1.** Select the cable. **P2.** Strip both cables to 75mm. **P3.** Bend the tips of both cable right angle about to 6mm. **P4.** Hold the two cables overlap 50mm with tips in opposite direction. **P5.** Take another bare conductor of 1mm and wrap around in both directions to 6mm. **P6.** Solder the joint. **P7.** Insulate the joint.

Knowledge & Understanding

- Define conductor.
- Differentiate between cable and wire.
- Describe the type of soldering.
- Differentiate between stripping and insulation removing.
- Describe the type of joints.
- Describe the procedure of jointing & soldering.
- Explain the composition of solder and soldering flux

Tool and Equipment

SN	Tools
1	Cables
2	Wires.
3	Wire stripper.
4	Solder wire.
5	Soldering paste
6	Plier.
7	Nose plier.
8	Insulation remover.
9	Solder.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard: :

Striping of cables.

Twisting of cable.

Soldering of joints

0714-E&A-23. Prepare and Install Distribution Boards for Single Phase.

Overview:

This Competency Standard covers the skills and knowledge required to prepare and install distribution board according to provide protection and load division to wiring, prepare estimate for wiring material, Prepare Distribution Board, Install Distribution Board and wiring.

Competency Units	Performance Criteria
CU1. Prepare estimate for wiring material.	**P1.** Develop Basic Drawing **P2.** Perform Estimation of Materials **P3.** Calculate Labor Cost
CU2. Prepare Distribution Board	**P1.** Select Distribution board w.r.t. size, current rating, voltage, No. of C.Bs and phases. **P2.** Select Main Incoming Residual Current Circuit Breaker (RCCB) having minimum sensitivity. **P3.** Select outgoing Miniature Circuit Breaker (MCB) according to load. **P4.** Provide space for future MCB. **P5.** Select Voltmeter, ampere meter and indicator according to load and phases. **P6.** Select wire according to load and for wiring in DB. **P7.** Make neutral common for all load. **P8.** Connect accessories according to the circuit diagram.
CU3. Install Distribution Board and wiring	**P1.** Fix the distribution board. **P2.** Take wire from DB to load without joint. **P3.** Distribute load equally on all phases.

Knowledge & Understanding

- Define distribution board.
- Describe D.B. w.r.t. size, current rating, voltage, No. of C.Bs and phases etc.
- Name parts of distribution board.

- Define sensitivity of RCCB.
- Define MCB.
- Differentiate fuse and breaker.
- Define wiring accessories
- State purpose of each accessory.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Use accurate MCB for load.
- Make common neutral.
- Provide cost effective and quality oriented Bill of Quantity (BOQ).

0714-E&A-24. Carryout Basic Electrical Installation for Single phase

Overview:

This Competency standard deals with the skills and knowledge required to lay cables, perform single & three phase connections, basic electric wiring and wiring test for carrying out basic electrical Air Condition (AC) installation. The trainee will be required to follow company guidelines as well as the procedure for carrying out basic electrical AC installation.

Competency Units	Performance Criteria
CU1. Lay cables	**P1** Interpret electrical drawing/ document **P2.** Identify cables **P3.** Lay cables **P4.** Perform earthling
CU2. Perform single-phase Connection	**P1.** Select cable gauge **P2.** Select cables colors **P3.** Connect cables **P4.** Insulate Joints
CU3. Perform three phase Connection	**P1.** Select cable Gauge **P2.** Select cables colors **P3.** Connect cables **P4.** Insulate Joints
CU4. Perform Basic Electrical wiring	**P1.** Measure cables as per requirement **P2.** Connect cables **P3.** Perform joints **P4.** Insulate Joints
CU5. Conduct wiring Test	**P1.** Operate multi-meter for voltage and current **P2.** Perform continuity test **P3.** Perform polarity test **P4.** Perform earthling test

	P5. Perform insulation test **P6.** Record test results

Knowledge & Understanding

- Explain Types of cables
- Explain Gauges of cables
- Define single phase connection
- Types of joints
- Define conductor and insulator
- Define three phase connection
- Knowledge about cable gauging
- Knowledge about color code of cables / phase sequence.
- Methods of Wiring
- Types of wiring
- Types of connections
- Types of wiring tests
- Describe various wiring test
- Color of cables
- Distinguish between different wiring systems
- Name of necessary materials required for each type of wiring.
- Explain the uses of each type of wiring.

Tool and Equipment

SN	Tools
1	Cables
2	Solder
3	Wire stripper
4	Plier
5	Wires
6	Nose plier
7	Solder wire
8	Soldering paste
9	Insulation remover

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Color of Cables
- Single phase connection
- Three phase connection
- Color code of cables / Phase sequence
- Cable gauging
- Types of wiring
- Types of connections

0714-E&A-25. Install Simple Electrical Wiring

Overview:

This Competency Standard covers the skills and knowledge required to Make single pole switch circuit, make single pole switch socket circuit, make two-way switch circuit, make series/test lamp circuit. Make intermediate switch circuit., Make of Tunnel circuit, Make of impulse switch circuit.

Competency Units	Performance Criteria
CU1. Make single pole switch circuit.	**P1.** Draw wiring diagram of single pole switch circuit. **P2.** Draw Current path diagram of single pole switch circuit. **P3.** Draw layout diagram of single pole switch circuit. **P4.** Mark on working board according to layout diagram. **P5.** Install accessories according to layout diagram. **P6.** Lay wires in duct/pipe according to layout diagram. **P7.** Make connections according to wiring diagram. **P8.** Check the circuit before connect the main supply. **P9.** Make connection with main supply. **P10.** Check the function of circuit after connect the main supply
CU2. : Make single pole switch socket circuit.	**P1.** Draw wiring diagram of single pole switch socket circuit. **P2.** Draw Current path diagram of single pole switch socket circuit. **P3.** Draw layout diagram of single pole switch socket circuit. **P4.** Mark on working board according to layout diagram. **P5.** Install accessories according to layout diagram. **P6.** Lay wires in duct/pipe according to layout diagram. **P7.** Make connections according to wiring diagram. **P8.** Check the circuit before connect the main supply. **P9.** Make connection with main supply. **P10.** Check the function of circuit after connect the main supply
CU3. Make two-way switch circuit.	**P1.** Draw wiring diagram of two-way switch circuit. **P2.** Draw Current path diagram of two-way switch circuit. **P3.** Draw layout diagram of two-way switch circuit.

	P4. Mark on working board according to layout diagram. **P5.** Install accessories according to layout diagram. **P6.** Lay wires in duct/pipe according to layout diagram. **P7.** Make connections according to wiring diagram. **P8.** Check the circuit before connect the main supply. **P9.** Make connection with main supply. **P10.** Check the function of circuit after connect the main supply
CU4. : Make series/test lamp circuit.	**P1.** Draw wiring diagram of series circuit. **P2.** Draw Current path diagram of series circuit. **P3.** Draw layout diagram of series circuit. **P4.** Mark on working board according to layout diagram. **P5.** Install accessories according to layout diagram. **P6.** Lay wires in duct/pipe according to layout diagram. **P7.** Make connections according to wiring diagram. **P8.** Check the circuit before connect the main supply. **P9.** Make connection with main supply. **P10.** Check the function of circuit after connect the main supply
CU5. : Make intermediate switch circuit.	**P1.** Draw wiring diagram of intermediate switch circuit. **P2.** Draw Current path diagram of intermediate switch circuit. **P3.** Draw layout diagram of intermediate switch circuit. **P4.** Mark on working board according to layout diagram. **P5.** Install accessories according to layout diagram. **P6.** Lay wires in duct/pipe according to layout diagram. **P7.** Make connections according to wiring diagram. **P8.** Check the circuit before connect the main supply. **P9.** Make connection with main supply. **P10.** Check the function of circuit after connect the main supply
CU6. Make of Tunnel circuit	**P1.** Draw wiring diagram of tunnel circuit. **P2.** Draw Current path diagram of tunnel circuit. **P3.** Draw layout diagram of tunnel circuit. **P4.** Mark on working board according to layout diagram. **P5.** Install accessories according to layout diagram. **P6.** Lay wires in duct/pipe according to layout diagram. **P7.** Make connections according to wiring diagram.

	P8. Check the circuit before connect the main supply. **P9.** Make connection with main supply. **P10.** Check the function of circuit after connect the main supply
CU7. Make impulse switch circuit.	**P1.** Draw wiring diagram of impulse switch circuit. **P2.** Draw Current path diagram of impulse switch circuit. **P3.** Draw layout diagram of impulse switch circuit. **P4.** Mark on working board according to layout diagram. **P5.** Install accessories according to layout diagram. **P6.** Lay wires in duct/pipe according to layout diagram. **P7.** Make connections according to wiring diagram. **P8.** Check the circuit before connect the main supply. **P9.** Make connection with main supply. **P10.** Check the function of circuit after connect the main supply

Knowledge & Understanding

- Define single pole switch.
- What is lamp?
- Explain single pole switch circuit and its use.
- Define current, voltage, power and resistance.
- Define single pole switch.
- What is lamp?
- Explain single pole switch socket circuit and its use.
- Define current, voltage, power and resistance.
- Describe socket
- Define single pole switch.

- What is lamp?
- Explain two-way switch circuit and its use.
- Define current, voltage, power and resistance.
- Describe two-way circuit.
- Define two-way switch
- Define single pole switch.
- What is lamp?
- Explain series circuit and its use.
- Define current, voltage, power and resistance.
- Describe socket.
- Define series circuit.
- Define parallel circuit.
- Define intermediate switch.
- What is lamp?
- Explain intermediate switch circuit and its use.
- Define current, voltage, power and resistance.
- Describe socket.
- Define series circuit.
- Define parallel circuit
- Define single pole switch.
- What is lamp?
- Explain tunnel circuit and its use
- Define current, voltage, power and resistance.
- Describe socket.
- Define series circuit.
- Define parallel circuit.
- Define two-way switch.
- What is lamp?
- Explain impulse switch circuit and its use.
- Define current, voltage, power and resistance.
- Describe socket.
- Define series circuit.
- Define parallel circuit.
- Define impulse switch.
- Define push button.

Tool and Equipment

.

SN	Tools
1	Electrician Tool kit.
2	PVC Pipe/Duct.
3	PVC clamp.
4	Woden/PVC board.
5	PVC wire according to load
6	Circuit Breaker.
7	Screw
8	Single pole switch.
9	Lamp holder
10	Lamp
11	AVO meter.
12	Test Indicator

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

:

0714-E&A-26. Verify installation equipment and installation plan

Overview:
In this competency standard the student will learn and perform techniques related to verificationof Installation equipment and installation plan.

Competency Units	Performance Criteria
1. Verify Installation requirements	P1. Verify type of installation P2. Verify either technology Expansion or New Site installation P3. Collect previous layout of installed equipment for expansion work, P4. Ensure allied work completion and detail floor plan for new site.
2. Collection of Required Equipment	P1. Verify delivered equipment according to plan P2. Arrange parts according to plan. P3. Test functionality of Cables and connector before installation
3. Verify Site Data	P1. Check proper Site ID according to TCN Number P2. Check Site Location P3. Ensure accessibility of the located site P4. Tally data with material supplied
4. **Verify Plan**	P1. Verify installation plan from Network Operation Centre (NOC) P2. Verify each technology (2G, 3G, 4G) status with concerned department P3. Ensure logistics required are available P4. Confirm timing of equipment installation (Very critical for Expansion Sites)

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes:

- Reading BoQ
- Reading Telecom Drawings
- Arrangement of equipment
- Using Google Earth
- Knowledge of telecom equipment
- Knowledge of NOC operations

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Arrange BTS equipment according to given floor plan.

0714-E&A-27. Install BTS Cabinet and Accessories

Overview: This competency standard will provide skills and the fundamentals of Telecommunication. You will be able to install BTS cabinet with accessories

Competency Units	Performance Criteria
1. Prepare Cabinet Installation	**P1.** The cabinet is delivered to the site. **P2.** Unpack the cases. **P3.** Check the items in the cases.Ensure that all the equipment required for the installation is available
2. Install Cabinet on Concrete Floor	**P1.** Check the installation position of the equipment, such as cable racks, in the equipment room for easy cabling **P2.** Install cabinet directly on the concrete floor. No other types of materials are required. **P3.** Ensure that you have arranged sufficient cabinets as required. **P4.** Mark template as per Equipment room floor plan. **P5.** Determine the drilling positions using mark template **P6.** Drill the holes at marking position. **P7.** Install expansion bolt assemblies. **P8.** Place the cabinet in the specified position and Align the installation holes in the cabinet with the holes on the floor **P9.** Securing the cabinet **P10.** Testing the Insulation of the Cabinet
3. Install cabinet on ESD (Electrostatic Discharge) Floor	**P1.** Check the installation position of the equipment, such as cable racks, in the equipment room for easy cabling **P2.** Install Series Support and the Guide Rails. **P3.** Ensure that you have arranged sufficient cabinets as required. **P4.** Mark template as per Equipment room floor plan. **P5.** Determine the drilling positions using mark template **P6.** Drill the holes at marking position. **P7.** Install expansion bolt assemblies. **P8.** Place the cabinet in the specified position and Align the installation holes in the cabinet with the holes on the floor **P9.** Securing the cabinet **P10.** Testing the Insulation of the Cabinet
4. Install the Power Cables and PGND	**P1.** Categories the power cables in external power cables and internal power cables. **P2.** Install the connector on power cables. **P3.** Connect external power cables Power Distribution Frame (PDF) to the power distribution box at the top of the cabinet. **P4.** Connect the external and internal power cables of the cabinet. **P5.** Route and Bind the power cables and PGND cables **P6.** Install the Power Cables and PGND Cables Between the Cabinet and the PDF

5. Install the Accessories in the Cabinet	**P1.** Install side panels **P2.** Install front and back doors. **P3.** Install PGND cables of doors and side panels
6. Attach Engineering Labels to the Equipment	**P1.** Attach the row labels to the side panels of the cabinets that stand near the aisle at the two ends of each cabinet row. **P2.** Attach the column labels to the door head of the cabinet front, with label 00 to the first cabinet near the main aisle, 01 to the second one, 02 to the third one, and so on. **P3.** Check whether the product labels are attached to the front and back doors of the cabinet. If no, obtain the product labels from the delivery accessories. **P4.** Attaching the Engineering Labels to the Power Cables and PGND Cables **P5.** Remove the temporary labels from the power cables and PGND cables

Knowledge & Understanding

The candidate must be able to demonstrate below given knowledge and understanding required carrying out the tasks covered in this competency standard:

1. BTS
2. Cabinet Design
3. Foundation

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

3. Unpack and inspect equipmet
4. Install BTS and Label each part of equipment

Tools and Equipment
• Product manual • Drawing • LLD/HLD of task • hand tools • cleaver/cutter • stripper • polishing papers • Personal protection equipment • Pigtail patch code • Cable tester ➢ Previous and Current Floor plans ➢ Equipment and equipment's checklist ➢ GPS ➢ GIS software

- Site Data Sheet
- Measuring tools, DMM, Mechanical/Electrical tool kit
- Laptop, Software tools, Communication devices, Compass
- Electrical and mechanical tool kit and hardware
- Laptop, Site master
- Ethernet cable
- PPE
- First Aid Box

0714-E&A-28. Install and Configure BTS

Overview:
In this competency standard the student will learn and perform techniques related to Installation and implementation of 2G, 3G and 4G (LTE) networks Technologies.

Competency Units	Performance Criteria
C1. Install New Site	P1. Check availability of electricity prior to actual installation P2. Verify BTS dimensions with the planned work P3. Verify standard of racks, shelves and cable trays P4. Verify dimensions of pole and pole mast
C2. **Install Expansion Site**	P1. Verify technologies installed P2. Check existing alarms in all technologies prior to installation P3. Lock technology whose equipment going to be replaced P4. Shutdown power only to the equipment going to be replaced
C3. **Implement Installation Standards**	P1. Tie cables in cable trays P2. Ensure cards must be in tier respective cabinets (2G, 3G and 4G) P3. Make sure proper labelling of all the cables and equipment P4. Verify incoming and outgoing points are insulated
C4. Verify and Test Technologies after Installation	P1. Power on Installed equipment after installation P2. Check for any alarms, and if occur remove them P3. Unlock each technology one by one. P4. Verify performance of each technology i.e. 2G, 3G and LTE
C5. **Confirm Health and Safety Requirement**	P1. Ensure compliance with site risk control, OHS, environmental and quality requirements as per company's norms P2. Ensure that work is carried out in accordance to the level of competence and legal requirements P3. Ensure that hazards associated with the workplace that have not beenpreviously controlled, are reported in accordance with appropriate procedures P4. Ensure compliance with all organizational security arrangements (like usingvalid ID cards) and approved procedures P5. Use and maintain protective equipment according to work requirements P6. Ensure availability of first aid box at site P7. Ensure escalation of safety incidents to relevant authorities as per

	guidelines

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes:

- Understanding of 2G, 3G, LTE Equipment
- Installation for New and expansion sites
- Understanding about SCO (Site Change Order) or POs (Purchase Orders)
- Knowledge of telecom equipment
- Knowledge of GIS software for tracing and layout
- Knowledge of MS office
- Knowledge of NOC operations
- Knowledge of cables, distribution panels both AC and DC for telecom equipment, and about racks for all Technologies cards.
- Understanding of Installation equipment
- Alarms, power distribution system of BTS, Electrical/Mechanical tilts, Azimuth concepts
- Knowledge of telecom cable ties, labelling, insulation, RRU, RETs, single band and multi- band Antennas, PSU, PDUs etc.
- Equipment functioning and associated alarms

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Install BTS as per given installation plan
- Align cards and Cables in the rack as per given order.
- Power on BTS and remove alarms if any

0714-E&A-29. Install Telecom Network Equipment

Overview:
This competency standard will provide skills and knowledge related Telecommunications Network Equipment installation. It describes performance outcomes to effectively install and test telecommunications network equipment. It includes processes for checking plans, obtaining and proper handling of equipment and supplies

Competency Units	Performance Criteria
1 **Plan for Installation of Telecommunications Network Equipment**	**-** P1. Prepare for given work according to relevant occupational health and safety (OHS) and environmental requirements. P2. Notify customer to arrange site access if necessary P3. Assess existing and potential site hazards. P4. Verify location of proposed network equipment installation according to the appropriate plans obtained from authorized personnel. P5. Develop installation plans to ensure minimal disruption to the workplace and according to relevant codes, regulations and standards. P6. Obtain tools and test equipment required for safe work practice. P7. Notify affected parties of possible network outage if required.
2 **Install Network Hardware and Cabling**	**-** P1. Install network equipment according to the plan and manufacturer's instructions using safe industry practices. P2. Insert equipment cards and modules. P3. Install all interconnecting cables to specification. P4. Ensure service interruption is within limits agreed with the customer. P5. Document all installation drawings for the customer
3 **Install Equipment Accessories**	**-** P1. Install alarms system according to instruction manuals and to specification P2. Install operations administration and maintenance system according to specification P3. Install communication facilities for operational staff according to specification P4. Install operator communication facilities according to specification.
4 Configure and Test the System	**-** P1. Install software and configuration instructions according to system specifications if required. P2. Test to verify the system performance according to customer requirements. P3. Recommend any possible changes and confirm with customer. P4. Record all test results.
5. **Clean-up worksite and Complete Documentation**	**-** P1. Remove and dispose of installation waste and debris from worksite according to environmental requirements.

	P2. Restore changes made to the work area during installation to the customer's satisfaction. P3. Complete all installation documents and present to the customer. P4. Notify the customer and obtain signoff.

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- Waste handling and environmental compliances in its disposal
- Electrical and or optical properties to be measured.
- Typical performance parameters and faults that may be encountered in customer equipment and related connection and transmission media.
- Various test equipment types suitable for tests to be made.
- Able to Read Layout diagrams.
- Cabling types, connectors and cabling structures
- Connections to carrier infrastructure or equipment
- Overview knowledge of network and equipment

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Plan and install network hardware and cabling according to equipment/system manuals and specifications
- Configure and test installation and Verify cable continuity as per given requirement.
- Comply with all related OHS requirements and work practices

Tools and Equipment	
• Site/Working Area Cleaning Tools • Testing Tools • Configuration Manual and Plan	• Standard installation Toolkit • Layout Documents • Approval for down time.

0714-E&A-30. Upgrade Transmission System

Overview:

This competency standard will provide skill and knowledge related to Change Management Activity. You will be able to carry System Up gradation of Transmission Nodes

Competency Units	Performance Criteria
1. Determine configuration requirements	- P1. Receive change request from the relevant team. P2. **identify timelines for carrying out the changes** P3. **Check gradation plan and identify dependencies if any** P4. **Assess the potential impact of the proposed activity and plan for possibleoutage of the activity** P5. **ensure that Network Operating Centre (NOC) is notified prior to undertakingthe change activities**
2. Arrange Specific Tools and spares	- P1. **Ensure availability of necessary tools and test equipment's with the field team** P2. **Ensure availability of spare hardware equipment** P3. **Request for spares, in case the same are not available** P4. **ensure that the login user id and password to the system are current**
3. Perform Change Activities at Transmission Nodes	- P1. **Login to the transmission nodes and optimize signal parameters - power and transmission frequency to the designed levels** P2. **Optimize transmission capacity levels (number of STMs and E1s required and available capacity).** P3. **Ensure the software version of the transmission nodes is current, as per the details available from the NOC.** **In case field support is required, ensure coordination with the field engineers to carry out change activities at transmission nodes.** P4. **Ensure remote support from NOC/ control room is provided to the field team. FM engineers while the change activities are carried out.** P5. **Ensure completion of the requested change task as per requestor's requirement.** P6. **Ensure continuous monitoring of progress of change and notify change requestor of problems encountered if any.** P7. **Abort change and implement contingency plan should the change plan not be realized without**

	major disruption to network. P8. **Ensure compliance with the defined SLA for carrying out changes.** P9. **Ensure unresolved faults/ instances of delays in resolution are escalated as per Company's policy.**
4. **Test Effectiveness and Close Activity**	- P1. **Confirm effectiveness of the change process, by monitoring site's alarm status in co-ordination with the NOC team.** P2. **Ensure completion of administrative jobs like site clearance, return of test equipment.**
5. **Perform Health and Safety**	- P1. *P1.* **Ensure compliance with site of risk control, OHS, environmental and quality requirements as per company norms.** P2. **Ensure that work is carried out in accordance with level of competence and legal requirements.** P3. **Ensure that hazards with workplace that have not been previously controlled are reported in accordance with appropriate.** P4. **Use and maintain protective according to their work environment.** P5. **Ensure availability of first aid box.** P6. **Ensure escalation of safety incident to relevant authorities as per guidelines.**
6. **Report and Records**	- P1. **ensure all relevant parties (including BSS/ BTS support engineer, NOC team, other supervisors) are notified of the results of the fault management/ corrective maintenance activities and the sign-off is obtained** P2. **Ensure that documents that are required to be updated are identified.** P3. **Ensure completion of routine maintenance logs, activity logs and spare tracker within stipulated timelines.** P4. **Ensure that documents are available to all appropriate authorities to inspect.**

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes:

- Logs.
- Activity logs.
- Different types of logs documents.
- OHS.
- Different hazards.
- Site Clarence.
- Administrative jobs.
- Transmission frequency
- Capacity level.
- Contingency plan.
- Different hardware equipment's like radio, microwave, fiber.
- Different tools for upgrade and configuration change requirements.
- Functionality of telecommunication transmission nodes.
- Signal strength and quality KPI.
- Networking Monitor system.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Read up-gradation plan and notify all key stakeholders
- Perform up-gradation activity as per plan while ensuring health and safety measures.

Tools and Equipment	
• Word Sheet Software • TEMS (Transmission and Evaluation and Monitor System). • Health and Safety tools.	• Multiplexer • Optical light meter • Power meter • OTDR (Optical Time domain Reflector) • Mini link Erricsion

0714-E&A-31. Install Telecom Equipment

Overview:

This competency standard will provide skills and Construction Practices and Installation of field equipment. You will be able to demonstrate your skills in Project Management Techniques, Laying and Jointing of Optical Fiber Cables, Earthling of Telecom Towers, Mounting and Installation of antennas and RRU (Remote Radio Unit), Installation of GPS and Rack Installation.

Competency Units	Performance Criteria
1 **Use safety equipment for Telephone Cable Laying and Radio Tower Installation**.	**-** **P1.** Identify hazards correctly in accordance with OHS standards **P2.** Identify safety signs and symbols **P3.** Wear proper PPE as per nature of job **P4.** Store PPE at appropriate place after use. **P5.** Ensure availability of first aid box. **P6.** Communicate with Cluster In charge and Site Engineer
2 **Perform Jointing of Telephone (Copper Wire) Cable.**	**-** **P1.** Lay single-pair drop-wire. **P2.** Patch one end of the cable to Distribution box and the other to Rosset Box. **P3.** Install RJ-11 connectors on both ends of a Two-Pair Drop Wire. **P4.** Install Two-Pair drop-wire.
3 **Lay Optical Fiber Cable**	**-** **P1.** Obtain OFC route plan. **P2.** ensure cable drum is placed near site location and test cable on drum for optical continuity **P3.** ensure trenching is carried out by labour workers as per the route plan requirements and site terrain **P4.** Lay OFC using either Blowing or pulling techniques whichever would be suitable as per the situation. **P5.** Maintain minimum radius where bends are necessary **P6.** Close ends of ducts with End Plugs to avoid ingress of mud, water or dust.
4 **Splicing of Optical Fiber cable**	**-** **P1.** Prepare cables appropriately for Jointing based on colour and/ or sequence matching. **P2.** Splice OFC using standard fusion/ mechanical splicing mechanisms **P3.** Prepare fiber for splicing (strip jacket, dress buffer tubes & fibers, strength members, remove buffer coating) **P4.** Perform fiber cleaving **P5.** Perform splicing
5 **Perform Earthling of Telecom Tower.**	**-** **P1.** Excavate 1.5m x 1.5m area to depth of 3m. **P2.** Fill half of the pit with a mixture of lime powder, coal powder, sand and salt. **P3.** Place the Earth Plate in middle of the pit and fill the pit with sand

	or clay. **P4.** Connect the earth plate to the equipment to be earthed, installed on surface **P5.** Ensure that system impedance to the ground is less than 5 Ohm
6 **Mount Antennas on a Telecom Tower.**	**-** **P1.** Ensure all line items required for installation are available on the site. **P2.** Check the installation plan **P3.** Fix the installation bracket to the back of the antenna with the nuts, spring washers, and flat washers. **P4.** Fix the elevation adjustable bracket to the installation bracket. **P5.** Fix the antenna support to the pole. **P6.** Mount the antenna on tower using fixed-pulley mechanism and rope. **P7.** Fix the antenna to antenna support on the tower. **P8.** Apply thread bolts through the antenna support and elevation adjustable bracket. **P9.** Put on flat washers, spring washers, and nuts to fix the bolts. **P10.** Adjust the antenna angle and tighten all of the four nuts.
7 **Connect RF Cables to Antennas**	**-** **P1.** Peel the cable. **P2.** Install the connector body. **P3.** Tighten the connector on the cable. **P4.** Put the cable through the heat-shrink tube. **P5.** Route the cable on the tower and connect to the connection port of the antenna. **P6.** Label the cable end properly.
8. **Mount Remote Radio Unit (RRU) on pole**	**-** **P1.** Determine a position for installing the mounting bracket as per Installation Plan. **P2.** Mount bracket hoisted onto the tower. **P3.** Adjust the position of the nut and remove one end of the square-neck bolt from the slot on the auxiliary bracket. **P4.** slide the mounting brackets onto the pole horizontally and insert the square-neck bolt into the slot **P5.** Install the RRU onto the main bracket
9. Lay and install Cabling of RRU	**-** **P1.** Route the cable according to the specified cabling requirements to prevent signal interference. **P2.** Route Cables neatly along the specified cabling direction and secured with cable clips. **P3.** Make power cable connector. **P4.** Install Power cables must be in the position specified in engineering design documents. **P5.** Connect PGND cables for the base station to the same ground bar. **P6.** Check E1 cables are straight and bound neatly with cable ties.
10. **Install RF Jumper from RRU to Antenna**	**-** **P1.** Connect the male connector at one end of the RRU RF jumper to the ANT port on the RRU and use a torque wrench to tighten the connector.

	P2. Connect the other end of the RF jumper to the external antenna system. **P3.** Waterproof the connectors of the RF jumper. **P4.** Verify that dustproof caps are not removed.
11 **Install GPS Antenna.**	**-** **P1.** Install the GPS antenna on the GPS antenna and use four screws to secure it **P2.** Install the mounting bracket according to the direction. **P3.** Lead the hose clamps through the holes in the multi-functional accessory. **P4.** Wear the hose clamps around the pole body and tighten the hose clamps. **P5.** Remove the rubber plug and connect the GPS feeder. **P6.** Connect the other end of the feeder to the GPS antenna and secure the joint. **P7.** Install surge arrester to protect interface lightning.
12. **Install Rack**	**-** **P1.** Mark points for drilling as per given plan. **P2.** Drill holes onto the marked points. **P3.** Fix Ravel Bolts into the holes. **P4.** Place Rack onto the bolts. **P5.** Tighten Nuts on the bolts

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- . Mount and Install RF Antenna as per given installation plan.
- Install RRU alongside the installed RF Antenna and connect RF Fiber Cable.
- Install Power Cable and PGND from RRU to Rectifier Unit.

0714-E&A-32. Install and Configure CPE

Overview: This competency standard will provide skills and knowledge related to CPE installation. CPE installer is responsible for installation, configuration and testing of CPE (modem, routers, and switches) for broadband access. He also establishes connectivity between CPE and end-user device at customer premises and carries out basic troubleshooting for identifying, localizing & rectifying cable faults

Competency Units	Performance Criteria
1. Prepare for wiring and equipment installation	P1. Arrange access to site according to required procedure P2. Organize tools, equipment and materials for a given work P3. Match cable type and connectors to installation environment and customer Requirements. P4. check cable length for continuity P5. Verify cable route is free of electrical hazards and obstructions both outdoors and indoors. P6. Verify that the cable running length is within the permissible limit to ensure designed throughput P7. Select suitable location for equipment installation accordance to power point and signal coverage.
2. Undertake Wiring and Install System Hardware	P1. Ensure structured wiring from Point of Presence to Customer premise Junction Box. P2. Ensure neat wiring and clipping within customer premise P3. Ensure proper cable termination and use of appropriate connectors P4. Test the cable & joints for transmission loss and strength. Re-terminate if loss exceeds prescribed limits P5. Install equipment by following electrical safety principals and manufacturer's instructions P6. Power-up the system ensuring proper earthing arrangement
3. Configuring CPE	P1. Connect laptop/PC, Smart/IP TV and other appropriate device to the CPE (modem, router, switch) and establish connectivity P2. Access CPE setting using default login credentials P3. Configure CPE as per the base setting (IP, Gateway, and Mask etc.)
4. Establish connectivity with service provider gateway	P1. ensure all cables/connectors are correctly plugged in P2. Ping service provider gateway P3. Analyse test results for connectivity and throughput parameters
5. Establish connectivity between CPE and end user device	P1. Configure end user device to establish LAN connectivity with the CPE P2. Ping CPE from end user device and analyse response

6. **Record configuration setting and testing steps for customer**	P1. Record CPE configuration settings. P2. Record end user device configuration setting. P3. Record ping procedure and expected result parameters. P4. Brief customer on basic trouble-shooting steps/self-help.
7. **Locate and troubleshoot cable Fault**	P1. Differentiate between types of cables P2. Identify correct cable pairs P3. Undertake continuity check and localize fault distance
8. **Troubleshoot CPE fault**	P1. Understand relevance of various indicative lights on the CPE. P2. Connect CPE to laptop/CPU/portable device for fault diagnostic P3. Install CPE access software, if required. P4. Access CPE through browser/software application and run diagnostic application P5. Decipher results to localize fault
9. **Rectify the faults with cable, connectors and CPE**	P1. Carry out crimping (of cable pairs with connector) or replace cable, if required P2. Re-configure the CPE to correct settings P3. Reset CPE, if required.
10. **Prepare documentation and clean-up worksite**	P1. Record steps undertaken for fault localization/isolation P2. Record changes undertaken for fault rectification P3. Restore any changes made to the worksite during fault repair to the client's satisfaction.
O11. **UPS installation & Domestic Power Supply checks**	P1. Carry out voltage, current checks P2. Carry out earthing checks P3. Install UPS P4. Route of power supply through ups P5. Calculate equipment load P6. UPS battery checks and replace if required
12. **Clean up worksite and complete documentation**	P1. Remove and proper dispose of installation waster P2. Restore worksite to customer's satisfaction P3. Update plans and records with details of installation and test results P4. Complete all installation documents and customer signoff

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- Basic concepts of network topologies, broadband network elements, gateways, TCP/IP, IP address, subnet masks, Ethernet address, MAC address, IPv4, IPv6
- Basic commands like ping & IP configuration and acceptable round-trip time for IP packets
- **Overview knowledge of CPE, wiring etc.**
- **Ports and cables Types**
- Knowledge of customer premise equipment (modem, routers, switches)
- **Site Survey**
- Safety Health & Environment

- Knowledge of Technical report Writing
- UPS & types of UPS
- Power rating of UPS
- Basic load calculations
- Knowledge of supported cable lengths to achieve designed throughput
- Basic knowledge of EMI/EMC and preventive approach specific to modem
- Use of test equipment
- Factory reset a CPE.
- Knowledge of Technical report Writing
- Correct identifications of cables and cable pairs
- Knowledge of cable connectors
- Crimping or soldering expertise
- **Different basic network commands Ping route** IP config, Tracert, Netstat etc
- Liaison and coordination skills/knowledge.
- **Features and operating requirements of test equipment**
- **How to test the speed of connection and to demonstrate same to customer**

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Plan for wiring and equipment installation and perform wiring & Install system hardware
- Configure CPE and establish connectivity with service provider gateway, locate and trouble shoot cable & connector fault
- Establish connectivity between CPE and end user device and troubleshoot CPE faults.
- Record configuration setting and testing steps for customer.
- Complete documentation and clean-up worksite.

Tools and Equipment	
1. Laptop/ PC **2.** CPE **3.** Ethernet Cable **4.** Laptop/ PC with Windows OS. **5.** Laptop/PC **6.** CPE	**7.** Installation Plan **8.** Network Equipment **9.** Network Cables **10.** Toolkit

0714-E&A-33. Install Telephone (Copper Wire) Cable

Overview:

This competency standard will provide skills and Construction Practices related to the installation of Telephone (copper wire).

Competency Units	Performance Criteria
C1. Use safety equipment for Telephone Cable Laying.	**P7.** Identify hazards correctly in accordance with OHS standards **P8.** Identify safety signs and symbols **P9.** Wear proper PPE as per nature of job **P10.** Store PPE at appropriate place after use. **P11.** Ensure availability of first aid box. **P12.** Communicate with Cluster Incharge and Site Engineer
C2. Lay Telephone cable	**P7.** Obtain route plan. **P8.** Ensure cable drum is placed near site location **P9.** Lay telephone cable using either blowing or pulling techniques whichever would be suitable as per the situation. **P10.** Close ends of ducts with End Plugs to avoid ingress of mud, water or dust.
C3. Install Telephone (Copper Wire) Cable.	**P5.** Lay single-pair drop-wire. **P6.** Patch one end of the cable to Distribution box and the other to Rosset Box. **P7.** Install RJ-11 connectors on both ends ofa Two-Pair Drop Wire. **P8.** Install Two-Pair drop-wire.

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- Laying drop wire
- Rosset box
- Cable patching
- Installing RJ-11 Connectors

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Install Telephone cable and connect to telephone set.

0714-E&A-34. Install and Configure ISDN Link and ADSL

Overview: This competency standard will provide skills required to install and configure ISDN link and ADSL.

Install ISDN Link	**P1.** Check installation equipment of ISDN **P2.** Complete information from your telephone company about your ISDN Service. **P3.** Mount on wall **P4.** Select one of the three options for line connection. BRI port, PRI port or NET port. **P5.** Connect a Category Ethernet cable between the Ethernet port and the LAN network **P6.** Connect a RS-232 Serial cable (not included) between the COM port **P7.** Connect a Category 5 Ethernet cable between the Video System port and the Ethernet 1 port on the endpoint **P8.** Connect the supplied power adapter between the power connector and an electrical outlet.
Configure ISDN link	**-** **P1.** Connect a Category 5 Ethernet cable between the Ethernet port and the LAN network **P2.** Connect a RS-232 Serial cable between the COM port and the PC/laptop. **P3.** Check software version **P4.** Install software Configure the system
Install and configure ADSL	**-** **P1.** Connect Line port to PTCL wire. **P2.** Connect modem port to the DSL jack of the ADSL CPE (Customer Premises Equipment) **P3.** Phone port connects to a telephone set. **P4.** Connect the Power Adapter to the AC power plug and attach the connector of adapter to the CPE and switch it on. **P5.** Attach one end of LAN wire (RJ-45) to the LAN interface of CPE and the other end to the LAN wire to the LAN interface of computer's LAN card. **P6.** Look link Indicator lights will lit up and show the connectivity **P7.** Configure ADSL **P8.** Configure CPE as per the base setting (IP, Gateway, and Mask etc.)

Knowledge & Understanding

This competency standard will provide knowledge related to:

- Reading BOQequipment
- Equipment room floor plan.
- Connections of power cables
- Connection PGND cables

- Differentiate between accessories.
- Know about row labels, column labels, and product labels.
- Installing RJ-11 Connectors on cable.
- cabling types LAN, serial and connectors (RJ-45, RJ11and RS232)
- Knowledge of customer premise equipment (modem, routers, switches)
- Basic concepts of network topologies, broadband network elements, gateways, TCP/IP, IP address, subnet masks, Ethernet address, MAC address, IPv4, IPv6
- Basic commands like ping & IP config and acceptable round-trip time for IP packets
- Connectivity options and methods for CPE & end user device configuration settings at CPE (wired & wireless) & end user device
- Command line access and command prompts to execute basic commands KB6.
- cabling types (OFC, UTP, STP, Twisted Pair etc.) and connectors (RJ-45, RJ11)

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Check the equipment on site as per BOQ.
- Route the cables as per plan
- Install and configure ADSL

Construct Power Supply

Overview: This competency standard will provide skill and knowledge required to Construct a Basic Power Supply. You will be able to perform Construct /Design Filtered power supply and Zener Diode Regulated Power supply

Competency Units	Performance Criteria
1. Construct half wave rectifier	**-** P1. Identify and select Diodes, Transformers and Resistors. P2. Draw the Circuit Diagram of Half wave rectifiers P3. Connect the components according to the diagram. P4. Apply AC Input. P5. Check output with oscilloscope P6. Draw out put wave form and note and observe the results
2. Construct full wave rectifier/Bridge Rectifier	**-** P1. Identify the Diodes and centre tape Transformers, Resistors. P2. Draw the Circuit Diagram of Full wave rectifiers P3. Connect the components according to the diagram P4. Apply AC Input. P5. Check output with oscilloscope P6. Check Output with Multi Meter. P7. Draw out put wave form, note and observe the results
3. Construct voltage doubler and Tripler Circuit.	P8. Identify the Diodes and Transformers, Resistors, Capacitors. P9. Draw the Circuit Diagram of Voltage Doubler and Tripler. P10. Connect the components according to the diagram. P11. Apply AC Input. P12. Check output with oscilloscope P13. Check Output with Multi Meter. P14. Draw out put wave form, note and observe the results
4. Construct filtered power supply.	**-** P1. Check the Diodes and Transformers, Resistors, capacitors. P2. Draw the Circuit Diagram of filtered power Supplies. P3. Connect the components according to the diagram. P4. Apply AC Input. P5. Check output with oscilloscope. P6. Check Output with Multi Meter. P7. Draw out put wave form, note and observe the results
5. Construct Zener Diode Regulated Power Supply	**-** P1. P1. Check and identify Zener Diodes, Diodes and Transformers, Resistors, capacitors. P2. Draw the Circuit Diagram of Zener Diode regulated power Supply. P3. Connect the components according to the diagram. P4. Apply AC Input. P5. Check output with oscilloscope P6. Check Output with Multi Meter. Measure and Note the results

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes:

- Polarities of Diodes and characteristic curves of diodes.
- How to check the transformer primary and secondary windings.
- Types of transformers.
- Working of half wave rectifier.
- Input and output wave forms of half wave rectifier.
- Polarities of Diodes and characteristic curves of diodes.
- Centre tape transformers
- Working centre tape transformer
- Working of Full wave rectifier.
- Input and output wave forms of full wave rectifier.
- Polarities of Diodes and working of diodes, Capacitors and Resistors.
- Transformer identification of primary and secondary windings.
- Working of Voltage doubler and Tripler Circuits.
- Input and output voltage levels.
- Use of voltage doubler and Tripler Circuits.
- Working of Capacitor.
- Boost charging, under and over AC voltage setting.
- Diodes, filters and transformer.
- working of diodes, filters and transformers.
- Use of resistor and capacitor as filter.
- Filter power supply working and applications.
- Ripple factor.
- Input and output voltage levels. Wave forms.
- Difference between filter and simple power supply.
- Working principle and use of Zener Diodes.
- Zener Diode Regulated Power Supplies. Regulation Methods
- Zener Regulated power supply working and applications.
- Input and output voltage levels.
- Line regulation and load regulation
- Rectifier working.
- rectifier input and output power connections.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

1. full wave rectifier/Bridge Rectifier
2. Install the Rectifier / UPS system at a telecom site as per given plan.
3. voltage doubler and Tripler Circuit**.**
4. Zener Diode Regulated Power Supply
5.

Tools and Equipment	
• Power Supply • Trainer • Multi meter • Connecting wire. • Diodes • Transformers • Power Supply • Trainer • Digital Oscilloscope • Connecting wire. • Digital voltmeter. • Socket wrench, insulated. • Rubber gloves.	• Resistors • Toolkit of spanners and wrenches • Complete Electrical Tools kit. • Earth Tester. • Multi Meter • Full face shield. • Impedance Meter • Complete Tool kit of screws and wrenches.

0714-E&A-35. Install and Maintain Battery

Overview: This competency standard will provide skill and knowledge required to Install and maintain Batteries. You will be able to Install and Maintain Valve Regulated Lead Acid Battery (VRLA)/Sealed Lead Acid Batteries (SLA), Conduct different Tests of VRLA/SLA Battery, Perform Maintenance of Valve Regulated Lead Acid Battery

Competency Units	Performance Criteria
1. Installation of Valve Regulated Lead Acid Battery (VRLA)/Sealed Lead Acid Batteries (SLA) for Telecom Equipment	**-** P1. Develop/Draw system schematic diagram which identifies how the individual batteries are to be placed on the rack, interconnected and numbered. P2. Install 3 tier rack for batteries. P3. Locating/Fixed the Batteries on the Racks P4. Prepare Battery Terminals. P5. Prepare and install the Inter tier, inter row and Inter rack Connections. P6. Connect the Load/Charger with Batteries.
2. Conduct different Tests of VRLA/SLA Battery.	P1. Perform High rate momentary load test. P2. Measurements of resistance/ conductance/impedance of battery. P3. Conduct Performance test of battery.
3. Perform Maintenance of Valve Regulated Lead Acid Battery	P1. Measure and record overall float voltage measured at the battery terminals. P2. Measure and record charge output current and voltage. P3. Measure and record ambient temperature of battery room or cabinet P4. Check condition of ventilation and monitoring equipment. P5. Visual inspection of cell/unit integrity for evidence of corrosion at terminals, connections, racks, or cabinets and area around batteries accessibilities P6. Check for excessive jar/cover distortion Measure and record DC float current (per string) using equipment P7. Measure and record cell/unit internal ohmic values. P8. Measure and record temperature of the negative terminal of each cell/unit of battery. P9. Measure and record voltage of each cell/unit Measure and record cell to cell and terminal connection detail resistance of entire battery. Measure and record AC ripple current and/or voltage imposed on the battery

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes:

- Input and output voltage levels.
- Boost charging, under and over AC voltage setting.
- Input and output voltage levels. Wave forms.
- Battery resistance/conductance/impedance.
- Battery without load and on load test
- Valve regulated batteries.
- Installation of VRLA batteries
- Battery connection
- Inter Row, Inter Rack, Inter battery String Connections.
- Battery rack installation.
- Battery charger/ load.
- Battery Performance test
- Ambient temperature, ventilation, float voltage, terminal corrosion, negative terminal temperature, battery resistance, Ripple current and voltage

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

Installation of Valve Regulated Lead Acid Battery (VRLA)/Sealed Lead Acid Batteries (SLA) for Telecom Equipment
Conduct different Tests of VRLA/SLA Battery.
Perform Maintenance of Valve Regulated Lead AcidBattery

Tools and Equipment	
• Power Supply • Trainer • Multi meter • Connecting wire. • Diodes • Transformers • Trainer • Connecting wire. • Digital voltmeter. • Socket wrench, insulated. • Battery lifting equipment • Rubber gloves. • Full face shield.	• Resistors • Toolkit of spanners and wrenches • Torque wrench calibrated in inch-pounds, insulated. • Box end wrench, insulated • Rubber gloves • Complete Electrical Tools kit. • Spanners and box wrenches. • Complete Electrical tools kit. • Earth Tester. • .RLC Meter • Impedance Meter •

0714-E&A-36. Install PDU, SPD, ATS & BRAKERS

Overview: This competency standard will provide skill and knowledge required to Install PDU, SPD, ATS, Brakers of different types. You will be able to PDU, SPD, ATS, Brakers of different types in different Telecommunication systems.

Competency Units	Performance Criteria
1) Installation of Power Distribution Unit Installation (PDU)	P1. Install the PDU Rack as per given layout. P2. Attach the cord retention trays to the Rack PDU, using four flat-head screws (provided) per tray. P3. Attach a cord to the tray by looping the cord and securing it to the tray, using a wire Tie. P4. Mounting PDU. P5. Mount Horizontally PDU. Install the brackets on the Rack PDU and then attach the PDU to the rack using caged nuts. P6. Mounting of Tool less type PDU. Slide both mounting pegs into the holes located in the channel in the rear panel of the enclosure. P7. Mounting of PDU (Bracket Mounting). **Vertical mounting.** To mount the Rack PDU vertically. Attach the vertical-mounting brackets to the PDU. P8. Install the rack PDU on a vertical mounting rail in rack or enclosure using the supplied screws and cages nuts. P9. Mounting PDU Horizontally. Choose a mounting position for the Rack PDU with either the display or the rear facing out of the enclosure. P10. Attach the mounting brackets to the Rack PDU using flat head screws. Insert caged nuts. Above and below a notched hole on each vertical mounting rail. Align the mounting holes of the brackets with the installed caged nuts. Insert and tighten the screws.
2) Install Surge Protection Device for Telecom (SPD) System	P1. Install/Fixed the SPD in the main power distribution unit and in rectifier unit. P2. Connect SPD with main AC input supply. P3. Connect SPD with circuit Breakers and main ground/earth panel. P4. Connect SPD with rectifier system.
3) Install Auto Transfer Switch (ATS) for Telecom System	P1. Install/Mount the ATS panel at the specific place mention in given site plan. P2. Install Magnetic contactors, Relays, Phase Missing Relays P3. Connect Main AC Supply, Diesel Generator and Rectifier system with ATS.

4) Install different Circuit Breakers for Telecom System	P1. P1. Determining Where to Install the Circuit Breaker P2. TURN OFF THE MAIN Supply. P3. Remove the panel cover. P4. Remove old circuit breaker. P5. CONNECT THE MCB (Miniature circuit Breaker). P6. CONNECT THE input and output wire with circuit breaker. P7. PUT THE PANEL COVER ON. P8. Turn On the main power. P9. Perform all steps mention above for these circuit breaker MCB, MCCB Molded case circuit Breaker, Single Pole Circuit Breaker, Double pole circuit breaker, GFI or GFCI circuit breaker (Ground fault interrupter), Install Arc Fault circuit interrupter (AFCI) P10. Testing the Installation.

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes:

- Polarities of Diodes and characteristic curves of diodes.
- How to check the transformer primary and secondary windings.
- Types of transformers.
- Working of half wave rectifier.
- Input and output wave forms of half wave rectifier.
- Polarities of Diodes and characteristic curves of diodes.
- Centre tape transformers
- Working centre tape transformer
- Working of Full wave rectifier.
- Input and output wave forms of full wave rectifier.
- Polarities of Diodes and working of diodes, Capacitors and Resistors.
- Transformer identification of primary and secondary windings.
- Working of Voltage doubler and Tripler Circuits.
- Input and output voltage levels.
- Use of voltage doubler and Tripler Circuits.
- Working of Capacitor.

- Boost charging, under and over AC voltage setting.
- Diodes, filters and transformer.
- working of diodes, filters and transformers.
- Use of resistor and capacitor as filter.
- Filter power supply working and applications.
- Ripple factor.
- Input and output voltage levels. Wave forms.
- Difference between filter and simple power supply.
- Working principle and use of Zener Diodes.
- Zener Diode Regulated Power Supplies. Regulation Methods
- Zener Regulated power supply working and applications.
- Input and output voltage levels.
- Line regulation and load regulation
- Rectifier working.
- rectifier input and output power connections.
- SPD connection with rectifier.
- Commissioning of rectifier system.
- Ambient temperature, ventilation, float voltage, terminal corrosion, negative terminal temperature, battery resistance, Ripple current and voltage
- Horizontal, vertical, Tool less and Bracket PDU Mounting
- Understanding of PDU.
- PDU installation and its wiring connections.
- Connections of SPD with other devices like PDU, Circuit Breaker and rectifier
- SPD Devices and their working.
- Types of SPD devices.
- Different types of circuit breakers, their use and working.
- ATS switch devices and their working.
- Connection of ATS with other power sources like Diesel Generator, Main Ac supply and UPS system.
- DG Operation.
- Common faults in DG.
- Fault rectification of DG system.
- Solar system working and different ratings.
- Installation of solar panels and charge controller system.
- Grounding/ Earthling of Telecom System.
- Types of Earthling systems. (Earth Pit and Boring Method).
- Lightening arrester.
- Installation and working of lightening arrester.
- How to comprehend formats and checklists for PM (preventive maintenance) and site hygiene.
- Preventative maintenance and testing services ensure power equipment continues providing the conditioned power required to maximize uptime for network and extend the longevity of infrastructure.
- Formats and checklists for PM (preventive maintenance) and site hygiene.
- Asset layout as per company standards.

- Preventative maintenance and testing services ensure power equipment continues providing the conditioned power required to maximize uptime for network and extend the longevity of infrastructure.
- . different power plant related faults and their remedy
- Circuit breaker and it's working.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

6. Installation of Power Distribution Unit Installation (PDU)
7. Install Surge Protection Device for Telecom (SPD) System
8. Install Auto Transfer Switch (ATS) for Telecom System
9. Install different Circuit Breakers for Telecom System

Tools and Equipment	
• Power Supply • Trainer • Multi meter • Connecting wire. • Diodes • Transformers • Power Supply • Trainer • Digital Oscilloscope • Connecting wire. • Digital voltmeter. • Socket wrench, insulated. • Battery lifting equipment • Rubber gloves. • Full face shield. • Impedance Meter • Complete Tool kit of screws and wrenches.	• Resistors • Complete Electrical Toolkit • Toolkit of spanners and wrenches • Torque wrench calibrated in inch-pounds, insulated. • Box end wrench, insulated • Rubber gloves • Complete Electrical Tools kit. • Spanners and box wrenches. • Complete Electrical tools kit. • Earth Tester. • Digging Equipment • Wrenches. • Box Wrenches and other tools required for Preventive Maintenance • RLC Meter • Multi Meter

0714-E&A-37. Install and maintain Diesel Generator, solar power System, earthing

Overview: This competency standard will provide skill and knowledge required to Install and maintain Diesel Generator, Solar power system, Earthing, Lightening Arrester. You will be able to Install and maintain Diesel Generator, Solar power system, Earthing, Lightening Arrester.

Competency Units	Performance Criteria
1) Trouble Shooting of Diesel Generator Faults of Telecom System	P1. Identify the possible faults in DG. P2. Rectify auto starting issue by checking Fuel Level, Engine Oil Level, Heat alarm and inspect Radiator of DG. P3. Perform required action to rectify the above mention faults. P4. Rectify the fault DG starts automatically main AC supply is also available. P5. Measure the AC input voltage .in case of low voltage and any phase missing this fault occur. P6. Rectify the above mention reasons. P7. Rectify common faults like Weak battery, Self-fault. Loose connection in ATS. Low RPM.
2) Install Solar Power System for Telecom System	P1. Install/Mount Solar Panels racks at Roof at a suitable place P2. Fixed the solar panels on racks/stands. P3. Install charge controller at a specified place. P4. Lay the cables for connection of charge controller, panels and batteries. P5. Connect solar panels with charge controller and charge controller with Batteries.
3) Construct Grounding/Earthling System for Telecom System	P1. Excavate/ dig a 5x5ft (1.5×1.5m) pit about 20-30ft (6-9 meters) in the ground. (Note that, depth and width depend on the nature and structure of the ground) P2. Bury an appropriate (usually 2' x 2' x 1/8" (600x600x300 mm) copper plate in that pit in vertical position. P3. Tight earth lead through nut bolts from two different places on earth plate. P4. Connect two earth leads with each earth plate (in case of two earth plates) and tight them. P5. Put grease around joints to protect from corrosion. P6. Collect all the wires in a metallic pipe from the earth electrode(s). Make sure the pipe is 1ft (30cm) above the surface of the ground. P7. Fill 1ft (30cm) layer of powdered charcoal (powdered wood coal) and lime mixture around the earth plate of around the earth plate. P8. Connect telecom system by using thimble and nut bolts to connect tightly wires to the system. Each system should be earthed from two different places. The minimum distance between two earth electrodes should be 10 ft. (3m). P9. Conduct Earth continuity test. P10. Test the overall earthing system through earth tester. If everything is going about the planning, then fill the pit with soil. The maximum allowable resistance for Earthing is 1Ω. Earth resistance without load (up to 1 Ohm) and with Load (up to 3 to 5 Ohm).

4) Install Lightening Arrester for Telecom System	P1. Install/Mount Lightening Arrester rod on top of the Telecom Tower, System. P2. Connect and lay the cable from Lightening arrester to Down converter system and system earth point. P3. Connect Lightening arrester to earth point.

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes:

- Polarities of Diodes and characteristic curves of diodes.
- How to check the transformer primary and secondary windings.
- Types of transformers.
- Working of half wave rectifier.
- Input and output wave forms of half wave rectifier.
- Polarities of Diodes and characteristic curves of diodes.
- Centre tape transformers
- Working centre tape transformer
- Working of Full wave rectifier.
- Input and output wave forms of full wave rectifier.
- Polarities of Diodes and working of diodes, Capacitors and Resistors.
- Transformer identification of primary and secondary windings.
- Working of Voltage doubler and Tripler Circuits.
- Input and output voltage levels.
- Use of voltage doubler and Tripler Circuits.
- Working of Capacitor.
- Boost charging, under and over AC voltage setting.
- Diodes, filters and transformer.
- working of diodes, filters and transformers.
- Use of resistor and capacitor as filter.
- Filter power supply working and applications.
- Ripple factor.
- Input and output voltage levels. Wave forms.
- Difference between filter and simple power supply.
- Working principle and use of Zener Diodes.
- Zener Diode Regulated Power Supplies. Regulation Methods
- Zener Regulated power supply working and applications.
- Input and output voltage levels.
- Line regulation and load regulation
- Rectifier working.

- rectifier input and output power connections.
- SPD connection with rectifier.
- Commissioning of rectifier system.
- Battery resistance/conductance/impedance.
- Battery without load and on load test
- Valve regulated batteries.
- Installation of VRLA batteries
- Battery connection
- Inter Row, Inter Rack, Inter battery String Connections.
- Battery rack installation.
- Battery charger/ load.
- Battery Performance test
- Ambient temperature, ventilation, float voltage, terminal corrosion, negative terminal temperature, battery resistance, Ripple current and voltage
- Horizontal, vertical, Tool less and Bracket PDU Mounting
- Understanding of PDU.
- PDU installation and its wiring connections.
- Connections of SPD with other devices like PDU, Circuit Breaker and rectifier
- SPD Devices and their working.
- Types of SPD devices.
- Different types of circuit breakers, their use and working.
- ATS switch devices and their working.
- Connection of ATS with other power sources like Diesel Generator, Main Ac supply and UPS system.
- DG Operation.
- Common faults in DG.
- Fault rectification of DG system.
- Solar system working and different ratings.
- Installation of solar panels and charge controller system.
- Grounding/ Earthling of Telecom System.
- Types of Earthling systems. (Earth Pit and Boring Method).
- Lightening arrester.
- Installation and working of lightening arrester.
- How to comprehend formats and checklists for PM (preventive maintenance) and site hygiene.
- Preventative maintenance and testing services ensure power equipment continues providing the conditioned power required to maximize uptime for network and extend the longevity of infrastructure.
- Formats and checklists for PM (preventive maintenance) and site hygiene.
- Asset layout as per company standards.
- Preventative maintenance and testing services ensure power equipment continues providing the conditioned power required to maximize uptime for network and extend the longevity of infrastructure.
- . different power plant related faults and their remedy
- Circuit breaker and it’s working.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this

competency standard:

1. Install Solar Power System for Telecom System
2. Install Solar Power System for Telecom System
3. Construct Grounding/Earthling System for Telecom System

Tools and Equipment	
• Power Supply • Trainer • Multi meter • Connecting wire. • Diodes • Transformers • Power Supply • Trainer • Digital Oscilloscope • Connecting wire. • Digital voltmeter. • Socket wrench, insulated. • Battery lifting equipment • Rubber gloves. • Full face shield. • Impedance Meter.	• Resistors • Complete Electrical Toolkit • Toolkit of spanners and wrenches • Torque wrench calibrated in inch-pounds, insulated. • Box end wrench, insulated • Spanners and box wrenches. • Earth Tester. • Digging Equipment • Wrenches. • Box Wrenches and other tools required for Preventive Maintenance • RLC Meter •

0714-E&A-38. Preventive maintenance of Telecom Power System

Overview: This competency standard will provide skill and knowledge required for preventive maintenance of Telecom power System. You will be able to prevent and maintain Different Telecom Power Systems.

Competency Units	Performance Criteria
1. Perform/Conduct Preventive Maintenance of Telecom Power System	P1. Inspect power Relays, rectifiers, inverters, converters & ring plants. P2. Verify plant operating voltages and load balancing. P3. Check operation & calibration of plant metering, shunts, local/remote sensing, voltage & amperes. P4. Rectify/Verify all major & minor alarming across plant: - Fuse Alarm - High Voltage Alarm - Low Voltage Alarm - Low Voltage Drop Out/Pick Up Points. - Battery Disconnect Set Points. - Rectifier Fail Alarm. Power major/ Minor Alarm. -Battery Discharge Alarm.
2. Perform Preventive Maintenance of Telecom Power System (Battery	P1. Complete visual inspection of battery cells, cable connections, inter-cell connections & electrolyte levels

Plant)	P2. Check all batteries terminal & strap connections. P3. Verify battery cell and string voltage operating levels P4. Perform battery testing analysis & specific gravity testing P5. Measure float current, cell temperatures, resistance breakdown leakage testing and plate polarization P6. Measure C Message noise of battery plant to industry standard P7. Perform load capacity testing using IEEE testing parameters P8. Analyse Battery room ventilation P9. Prepare and Provide report outlining battery capacity, conditions, concerns & recommendations
3. Perform/Conduct Corrective Maintenance of Telecom Power System	P1. Detect faults for corrective maintenance. P2. Rectify the rectifier major alarm by replacing rectifier module. P3. Rectify the rectifier minor alarm by replacing SPD. P4. Rectify main power failure alarm by checking/ replacing of circuit breaker and Input main AC supply. P5. Rectify low battery voltage alarm by checking and tightening battery connections, check and repair battery drainage problems.

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes:

- Polarities of Diodes and characteristic curves of diodes.
- How to check the transformer primary and secondary windings.
- Types of transformers.
- Working of half wave rectifier.
- Input and output wave forms of half wave rectifier.
- Polarities of Diodes and characteristic curves of diodes.
- Centre tape transformers
- Working centre tape transformer
- Working of Full wave rectifier.
- Input and output wave forms of full wave rectifier.
- Polarities of Diodes and working of diodes, Capacitors and Resistors.
- Transformer identification of primary and secondary windings.
- Working of Voltage doubler and Tripler Circuits.

- Input and output voltage levels.
- Use of voltage doubler and Tripler Circuits.
- Working of Capacitor.
- Boost charging, under and over AC voltage setting.
- Diodes, filters and transformer.
- working of diodes, filters and transformers.
- Use of resistor and capacitor as filter.
- Filter power supply working and applications.
- Ripple factor.
- Input and output voltage levels. Wave forms.
- Difference between filter and simple power supply.
- Working principle and use of Zener Diodes.
- Zener Diode Regulated Power Supplies. Regulation Methods
- Zener Regulated power supply working and applications.
- Input and output voltage levels.
- Line regulation and load regulation
- Rectifier working.
- rectifier input and output power connections.
- SPD connection with rectifier.
- Commissioning of rectifier system.
- Battery resistance/conductance/impedance.
- Battery without load and on load test
- Valve regulated batteries.
- Installation of VRLA batteries
- Battery connection
- Inter Row, Inter Rack, Inter battery String Connections.
- Battery rack installation.
- Battery charger/ load.
- Battery Performance test
- Ambient temperature, ventilation, float voltage, terminal corrosion, negative terminal temperature, battery resistance, Ripple current and voltage
- Horizontal, vertical, Tool less and Bracket PDU Mounting
- Understanding of PDU.
- PDU installation and its wiring connections.
- Connections of SPD with other devices like PDU, Circuit Breaker and rectifier
- SPD Devices and their working.
- Types of SPD devices.
- Different types of circuit breakers, their use and working.
- ATS switch devices and their working.
- Connection of ATS with other power sources like Diesel Generator, Main Ac supply and UPS system.
- DG Operation.
- Common faults in DG.
- Fault rectification of DG system.
- Solar system working and different ratings.
- Installation of solar panels and charge controller system.
- Grounding/ Earthling of Telecom System.
- Types of Earthling systems. (Earth Pit and Boring Method).

- Lightening arrester.
- Installation and working of lightening arrester.
- How to comprehend formats and checklists for PM (preventive maintenance) and site hygiene.
- Preventative maintenance and testing services ensure power equipment continues providing the conditioned power required to maximize uptime for network and extend the longevity of infrastructure.
- Formats and checklists for PM (preventive maintenance) and site hygiene.
- Asset layout as per company standards.
- Preventative maintenance and testing services ensure power equipment continues providing the conditioned power required to maximize uptime for network and extend the longevity of infrastructure.
- . different power plant related faults and their remedy
- Circuit breaker and it's working.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

10. Perform/Conduct Preventive Maintenance of Telecom Power System
11. Perform Preventive Maintenance of Telecom Power System (Battery Plant)
12. Perform/Conduct Corrective Maintenance of Telecom Power System

Tools and Equipment	
• Power Supply • Trainer • Multi meter • Connecting wire. • Diodes • Transformers • Power Supply • Trainer • Digital Oscilloscope • Connecting wire. • Digital voltmeter. • Socket wrench, insulated. • Battery lifting equipment • Rubber gloves. • Full face shield. • Impedance Meter • Complete Tool kit of screws and wrenches.	• Resistors • Complete Electrical Toolkit • Toolkit of spanners and wrenches • Torque wrench calibrated in inch-pounds, insulated. • Box end wrench, insulated • Rubber gloves • Complete Electrical Tools kit. • Spanners and box wrenches. • Complete Electrical tools kit. • Earth Tester. • Digging Equipment • Wrenches. • Box Wrenches and other tools required for Preventive Maintenance • RLC Meter • Multi Meter

0714-E&A-39. Perform Basic Mathematics Calculations in C++

Overview:

This competency standard covers the skills and knowledge required to. Generate Addition Program. Generate Subtraction Generate Subtraction Program. Generate Multiplication Program. Generate Division Program. Generate Program for Power Calculations. Generate Program for Roots Calculations. Generate Program for Exponential Calculations. Generate Trigonometric Function Program. Generate Inverse Trigonometric Function Program. Generate the Program And Calculate Impedance in Polar. Generate the Program and Calculate Impedance in Rectangular. Generate the Program And Calculate Impedance in Polar. Generate the Program and Calculate Impedance in Rectangular. Generate Rectangular to Polar Form Conversion program. And Generate Polar Form To Rectangular Form program

Competency Units	Criteria Performance
CU1. Generate Addition Program	**P1.** Open turbo c++ software **P2.** Create new file **P3.** Write a program for addition. **P4.** Save and run the program **P5.** Identify the error in compiler **P6.** Remove the error if required
CU2. Generate Subtraction Program	**P1.** Open turbo C++ software **P2.** Create new file **P3.** Write a program for addition. **P4.** Save and run the program **P5.** Identify the error in compiler **P6.** Remove the error if required
CU3. Generate Multiplication Program	**P1.** Open turbo C++ software **P2.** Create new file **P3.** Save and run the program **P4.** Identify the **P5.** Error in compiler **P6.** Remove the error write a program for multiplication **P7.** If required

CU4.Generate Division Program	**P1**. open turbo C++ software **P2**. create new file **P3**. Write a program for division. **P4**. save and run the program **P5**. identify the error in compiler **P6**.Remove the error if required
CU5. Generate Program For Power Calculations	**P1**. open turbo C++ software **P2**. create new file **P3**. Write a program for power calculation. **P4**. save and run the program **P5**. identify the error in compiler **P6**.Remove the error if required
CU6. Generate Program For Roots Calculations	**P1**. open turbo C++ software **P2**. create new file **P3**. Write a program for roots calculation. **P4**. save and run the program **P5**. identify the error in compiler **P6**.Remove the error if required
CU7. Generate Program For Exponential Calculations	**P1**. open turbo C++ software **P2**. create new file **P3**. Write a program for exponential calculation. **P4**. save and run the program **P5**. identify the error in compiler **P6**.Remove the error if required
CU8. Generate Trigonometric Function Program	**P1**. open turbo C++ software **P2**. create new file **P3**. Write a program for trigonometric function. **P4**. save and run the program **P5**. identify the error in compiler **P6**.Remove the error if required
CU9.Generate Inverse Trigonometric Function Program	**P1.** Open turbo C++ software **P2.** Create new file **P3.** Write a program for inverse trigonometric function. **P4.** Save and run the program **P5.** Identify the error in compiler **P6.** Remove the error if required
CU10.Generate The Program And Calculate	**P1**. open turbo C++ software **P2**. create new file

Impedance In Polar	**P3**. Write a program for Impedance in polar. **P4**. Save and run the program. **P5**. identify the error in compiler **P6**.Remove the error if required
CU11. Generate The Program And Calculate Impedance In Rectangular	**P1**. open turbo C++ software **P2**. create new file **P3**. write a program for impedance in rectangular form **P4**. save and run the program **P5**. identify the error in compiler **P6**.Remove the error if required
CU12.Generate The Program And Calculate Impedance in Polar	**P1**. open turbo C++ software **P2**. create new file **P3**. Write a program for Impedance in polar. **P4**. save and run the program **P5**. identify the error in compiler **P6**.Remove the error if required
CU13. Generate The Program And Calculate Impedance In Rectangular	**P1**. open turbo C++ software **P2**. create new file **P3**. write a program for impedance in rectangular form **P4**. Save and run the program. **P5**. identify the error in compiler **P6**.Remove the error if required
CU14. Generate Rectangular To Polar Form Conversion program	**P1**. open turbo C++ software **P2**. create new file **P3**. Write a program for conversion of rectangular to polar form. **P4**. save and run the program **P5**. identify the error in compiler **P6**.Remove the error if required
CU15. Generate Polar Form To Rectangular Form program	**P1**. open turbo C++ software **P2**. create new file **P3**. Write a Program for conversion polar to rectangular form function. **P4**. save and run the program **P5**. identify the error in compiler **P6**.Remove the error if required

Knowledge & Understanding

- Define C++ language
- Describe basic purpose of C++ language.
- Describe Data Type
- Describe operational procedure of C++.
- Define C++ language
- Describe basic purpose of C++
- Language.
- Describe Data Type
- Describe operational procedure of C++.
- Define C++ language
- Describe basic purpose of C++ language.
- Describe Data Type
- Describe operational procedure of C++.
- Define C++ language
- Describe basic purpose of C++ language.
- Describe Data Type
- Describe operational procedure of C++.
- Define C++ language
- Describe basic purpose of C++
- Language.
- Describe Data Type
- Describe operational procedure of C++.
- Define C++ language
- Describe basic purpose of C++ language.
- Describe Data Type
- Describe operational procedure of C++.
- Define C++ language
- Describe basic purpose of C++ language.
- Describe Data Type
- Describe operational procedure of C ++.
- Define C++ language
- Describe basic purpose of C++
- Language.
- Describe Data Type
- Describe operational procedure of C++.
- Define C++ language
- Describe basic purpose of C++ language.
- Describe Data Type

- Describe operational procedure of C++.
- Define C++ language
- Describe basic purpose of C++ language.
- Describe Data Type
- Describe operational procedure of C++.
- Define C++ language
- Describe basic purpose of C++ language.
- Describe Data Type
- Describe operational procedure of C++.
- Define C++ language
- Describe basic purpose of C++ language.
- Describe Data Type
- Describe operational procedure of C++.
- Define C++ language
- Describe basic purpose of C++ language.
- Describe Data Type
- Describe operational procedure of C++.
- Define C++ language
- Describe basic purpose of C++ language.
- Describe Data Type
- Describe operational procedure of C+ +.
- Describe of complex number and rectangular and polar form.
- Describe formula for conversion of rectangular to polar form
- Define++ language
- Describe basic purpose of C++ language.
- Describe Data Type
- Describe operational procedure of C++.
- Describe of complex number and rectangular and polar form.
- Describe formula for conversion of rectangular to polar form

Tool and Equipment

SN	Tools
1	Relevant Software Disks
2	Internet
3	Presentation manuals
4	Multimedia Screen
5	Multimedia

6	Printer
7	Power Cables
8	Hardware equipment
9	Monitor
10	Keyboard
11	CPU

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Installation techniques

0714-E&A-40. Perform Basic Circuit Analysis in C++

Overview:

This competency standard covers the skills and knowledge required to**.** Generate R.L.C Solution Program. Generate Series Circuit Function Program and Generate Parallel Circuit Function Program

Competency Units	Performance Criteria
CU2. Generate Series Circuit Function Program	P1. open turbo C++ software **P2**. create new file **P3**. Write a program for series circuit function. **P4**. save and run the program **P5**. identify the error in compiler **P6**.Remove the error if required
CU3. Generate Parallel Circuit Function Program	**P1**. open turbo C++ software **P2**. create new file **P3**. Write a program for parallel circuit function. **P4**. save and run the program **P5**. identify the error in compiler **P6**.Remove the error if required

Knowledge & Understanding

- Define C++ language
- Describe basic purpose of C++ language.
- Describe Data Type
- Describe operational procedure of C++.
- Define C++ language
- Describe basic purpose of C++ language.
- Describe Data Type
- Describe operational procedure of C++.
- Define C++ language
- Describe basic purpose of C++ language.
- Describe Data Type
- Describe operational procedure of C++.

Tool and Equipment

SN	Tools

1	Relevant Software Disks
2	Internet
3	Presentation manuals
4	Multimedia Screen
5	Multimedia
6	Printer
7	Power Cables
8	Hardware equipment
9	Monitor
10	Keyboard
11	CPU

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

: Installation techniques

0714-E&A-41. Perform Electrical Analysis in C++

Overview:

This competency standard covers the skills and knowledge required to Calculate A.C Powers Solution Program. Solve Active Component Function Program. Solve Reactive Component of Function Program. And Generate Program for Improvement of Power Factor calculate A.C Powers, active and reactive components in C++.

Competency Units	Performance Criteria
CU1.Calculate A.C Powers Solution Program	**P1**. open turbo C++ software **P2**. create new file **P3**. Write a program for A.C power solution. **P4**. save and run the program **P5**.identify the error in compiler
CU2. Solve Active Component Function Program	**P1**. open turbo C++ software **P2**. create new file **P3**. Write a program for active component function. **P4.** save and run the program **P5**. identify the error in compiler **P6**.Remove the error if required
CU3. Solve Reactive Component Of Function Program	**P1**. open turbo C++ software **P2**. create new file **P3**. Write a program for reactive component function. **P4**. Save and run the program. **P5**. identify the error in compiler **P6**.Remove the error if required
CU4.Generate Program For Improvement Of Power Factor	**P1**. open turbo C++ software **P2**. create new file **P3**. Write a program for power factor improvement. **P4**. save and run the program **P5**. identify the error in compiler **P6**.Remove the error if required

Knowledge & Understanding

- Define C++ language
- Describe basic purpose of C++ language.
- Describe Data Type
- Describe operational procedure of C++.
- Define C++ language
- Describe basic purpose of C++ language.
- Describe Data Type
- . Describe operational procedure of C++.
- Define C++ language
- Describe basic purpose of C++ language.
- Describe Data Type
- Describe operational procedure
- Define C++ language
- Describe basic purpose of C++ language.
- Describe Data Type
- Describe operational procedure

Tool and Equipment

SN	Tools
1	Relevant Software Disks
2	Internet
3	Presentation manuals
4	Multimedia Screen
5	Multimedia
6	Printer
7	Power Cables
8	Hardware equipment
9	Monitor
10	Keyboard
11	CPU
12	Presentation manuals
13	Handouts Hardware
14	Equipment

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

0714-E&A-42. Install VSAT for Satellite Communication

Overview: This competency standard will provide skill required to install VSAT (Very Small Aperture Terminal).You will be able to perform testing of data transmission using a Satellite and VSAT.

Competency Units	Performance Criteria
1. Inspect the VSAT Equipment	P1. Check components of VSAT like antenna, transceiver, modem and cables P2. perform a full inspection of the equipment immediately upon its arrival P3. identify any missing item
2. Prepare the Antenna Site	P1. contact satellite operator in order to get the settings for the angle in an upward direction that is necessary for the antenna to hit the satellite P2. azimuth, which is the compass bearing from the client's location to the satellite, and the elevation, which is the P3. Confirm that there are no trees, buildings or other obstructions that prevent the antenna from having a clear view of the satellite. P4. Ensure site must be positioned conveniently close to the main building that will house the electronics and provide the electrical power to the antenna. P5. Build special concrete pads for larger antennas for smaller antennas of 3.8m or less can often sit on the roof of a building or on a firm flat piece of ground
3. Mount VSAT Equipment	P1. Start Building the antenna P2. Put Antenna on the mounting supports and bolts P3. Keep loose the antenna position to enable final alignment with the satellite. P4. Mount transceiver on the antenna support frame, with the IF cables being connected back into the building where the modem and Internet routers are housed. P5. Power up All items of equipment via UPS to prevent damage in the event of power cuts
4. Perform Alignment of the Antenna	P1. use a spectrum analyser find target satellites are located a few degrees apart P2. Ensure correct alignment of the antenna and the polarizer so that the antenna is not interfering with adjacent satellites with other poles on the same satellite.

5. Perform Testing of Data Transmission	P1. Check download speed P2. Check upload speed P3. Check the application responds quickly P4. Check application can handle maximum user load

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes:

- Knowledge of Geostationary Orbit, Global Coverage
- Transmission Delay
- Orbits and polar coverage MEO, LEO, HEO
- The Radio Frequency bands
- Earth Station equipment
- Antenna and Feeds
- Types of Satellite Earth Stations
- Costumer requirement

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Perform equipment inspection required for installation of VSAT.
- Assemble Antenna and mount on base as per design with correct alignment to satellite on given angle.
- Install Transceiver on antenna and connect with modem as per specifications
- Perform testing as per requirements and plan.

Tools and Equipment
➢ Product manual ➢ Drawing ➢ LLD/HLD ➢ Cellular or Satellite phone ➢ GPS ➢ Spectrum Analyzer ➢ Sighting compass ➢ Bubble level ➢ Laptop with iSite software ➢ Ethernet Cables ➢ Allen wrenches, ➢ screwdriver, ➢ Crimp tool ➢ Block Diagram of a typical ➢ Satellite Communication Link ➢ Digital Voltmeter

- Speed tester
- Android mobile

0714-E&A-43. Install Satellite TV systems and equipment

Overview:
This competency standard will provide skill required to install satellite TV cable, TV and IP TV systems. You will be able to commission and test TV receiving

Competency Units	Performance Criteria
1. Prepare Installation of TV Receiving Equipment	P1. Verify & assess Power requirements and equipment operational parameters assessed according to the standards P2. Assess Required Signal quality from relevant sources
2. Install, Configure and Test Customer Premises, TV Receiving Equipment	P1. Install Equipment as per plans and specifications adhering to safe practices and requirements P2. Configure Equipment as per service provider's standards P3. Test Equipment using relevant test equipment as per manufacturer's instructions and specifications
3. Install TV Set -Top Unit	P1. Set top box layout procedure verified with the customers P2. Identify and ensure Required signal level at the wall plate and fly lead lengths by taking measurements P3. Check Customer' home video system for audio, video signal and power P4. Complete Installation by carrying out standard steps while adhering to standard specifications specified
4. Test Installation (TV Set-Top Unit)	P1. Determine Quality of receiving signal by carrying out functional tests as recommended and in the presence of the customer P2. Verify Meeting of customer's channel requirements and confirmed through cross checking made with customer P3. Maintain Picture quality by fine tuning
5. Carry out Handing over Activity to Customer (TV Set- Top Unit)	P1. Give Demonstrations on the use of equipment to customer P2. Give Required instruction sheets to customer and explanations as required P3. Ensure Meeting of customer requirements

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- Equipment required for satellite TV/Cable TV
- Installation plan

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Perform equipment inspection required for installation of satellite TV/ cable TV.

- Install power up and configure equipment of TV set as per specifications of manual.
- Achieve signal level and test quality of service as per costumer requirement
- Brief costumer about usage of device hand over equipment manuals.

Tools and Equipment
• Combination pliers • Long nose pliers • Bent nose pliers • Flat nose pliers • Side cutters • cable layout diagrams • schematic diagrams • block diagrams • Oblique cutters • Crimping tool • coaxial twisted pairs • Connectors • flow charts • test sequence • Operation manuals of equipment • Service manuals of equipment • Cables • Continuous heat irons • Soldering iron • Solder sucker

0714-E&A-44. Perform Line of site survey for Microwave Link

Overview:

This competency standard will provide skill and knowledge required perform Line of Site survey of installation of microwave link. You will be able to prepare LOS report.

Competency Units	Performance Criteria
1. Find Latitude and Longitude of your location using GPS and Google map	**-** P1. Power on GPS device P2. Check GPS connected to Satellite P3. Enter to the **location** P4. Write your location name in the search bar P5. Drag the resulting marker to the precise position. P6. Note Latitude &Longitude of your location P7. Get LAT& LONG using Google Map of your location P8. Compare both
2. Perform Line of Site survey for Microwave	**-** P1. Get LATITUDE &LONGITUDE of 2 points where wireless communication required P2. Use MAP Info to calculate Azimuth /Degree /path of transmission P3. Use MAP Info and reach on required location P4. check visually path of second point /Tower P5. use binocular/Magnifier glass if Opposite Tower is not visible P6. conduct balloon test if required P7. Perform mirror test if required P8. Chose height and place on tower to install antenna P9. Note cable length required P10. Check space in rack for indoor unit installation P11. Check spare circuit breaker for power
3. Prepare LOS report	P1. Take panoramic pictures from tower P2. Fill all data required in LOS report in Annex A P3. Prepare LOS report
. Prepare Link budget	P1. Start Pathloss software P2. Feed LAT and LONG of sites in Pathloss P3. Set all parameter as per transmission plan P4. Create link budget P5. Print LB

Knowledge & Understanding:

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes:

- Microwave repeater is used where direct communication between two points is not possible due to line of site blockage like there is some mountain or building here, we use microwave repeater
- Knowledge of LATITUDE &LONGITUDE
- How to find path length between 2 points
- How to find azimuth from 1 point to 2 point
- Understanding of GPS device functions
- How to use GPS for different purposes in telecom
- . microwave transmission
- Knowledge of features of currently available microwave system
- Understanding of Commercially use of microwave
- Knowledge of Antennas and Radio system
- Knowledge of different types of microwaves in market ZTE, NEC, NERA, HUAWEI, Alcalde, Ericssionect
- Information about DC power source -48V
- Information of rectifier
- Power connection of microwave with rectifier
- Bandwidth
- Congestion
- Generation of alarms
- Interference
- Latency
- Quality of service
- Redundancy
- Coaxial cable types
- Connectors types
- Knowledge of multi meter usage
- MAP Info use to find azimuth
- Knowledge of planning software
- Terrain information
- Knowledge of balloon test
- Knowledge of mirror test
- Report writing skill

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competencystandard:

- Perform LOS survey as per provided plan .
- Prepare LOS report of microwave
- Prepare link budget.

Tools and Equipment	
• Binocular /Mirror • Camera • Compass •	• GPS device • Manual of GPS device • Android mobile with Google map • Laptop Computer • Pathloss software • Balloon of different colour •

0714-E&A-45. Install Microwave Link

Overview:

This competency standard will provide skil land knowledge required to install and perform testing of microwave link. You will be able to make power and IF connectors, installation and testing of link performance.

Competency Units	Performance Criteria
3 Make IF Cable Connector	- P1. Check IF cable size P2. Check IF connector size P3. Check connector formation diagram P4. Make connectors as per diagram P5. Test connector with multi meter
4. Make Power Connector of Microwave and power on system	- P1. Check power cable & Connectors P2. Check Power connection diagram of MW P3. Make connectors as per diagram P4. Test connector with multi meter P5. Connect MW with power source -48V P6. Check system is power on.
5. Install Microwave link on Table & Configure	- P1. Unpack microwave equipment P2. Identify component of Microwave like IDU, ODU and Antenna. P3. Make block diagram of microwave P4. Install microwave link on table P5. Configure microwave link parameter according to LB. P6. Check Transmit power P7. Check receive power P8. Check bit error rate P9. Open remote end
6. Test data Communication between two PC	- P1. Install microwave link on table P2. Configure microwave link P3. Configure LAN ports of microwave links on both ends P4. Assign IP of same subnet to both PCs P5. Connect PCs to microwave P6. Send file from one PC to other via link. P7. Check transferred file is complete and there on data loss.

7. Build Microwave repeater for transmission between two points	**-** P1. Identify component of Microwave P2. Generate block diagram of microwave repeater P3. Install microwave links as per diagram P4. Configure microwave link from A to repeater P5. Configure microwave link from Repeater to B. P6. Make cross connect at repeater P7. Connect PC between A and B P8. Send some data from A and receive at B

Knowledge & Understanding:

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes:

- Microwave repeater is used where direct communication between two points is not possible due to line of site blockage like there is some mountain or building here, we use microwave repeater
- Knowledge of LATITUDE &LONGITUDE
- How to find path length between 2 points
- How to find azimuth from 1 point to 2 point
- Understanding of GPS device functions
- How to use GPS for different purposes in telecom
- . microwave transmission
- Knowledge of features of currently available microwave system
- Understanding of Commercially use of microwave
- Knowledge of Antennas and Radio system
- Knowledge of different types of microwaves in market ZTE, NEC, NERA, HUAWEI, Alcalde, Ericssionect
- Information about DC power source -48V
- Information of rectifier
- Power connection of microwave with rectifier
- Bandwidth
- Congestion
- Generation of alarms
- Interference
- Latency
- Quality of service
- Redundancy
- Coaxial cable types
- Connectors types
- Knowledge of multi meter usage
- MAP Info use to find azimuth

- Knowledge of planning software
- Terrain information
- Knowledge of balloon test
- Knowledge of mirror test
- Report writing skill

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competencystandard:

.

- Make coaxial and Power connectors as per specifications
- Install microwave link as per link budget.
- Test microwave link performance using standard tests

Tools and Equipment	
• IF cable of Microwave • IF connectors • Tool kit • Multi Meter • 19' rack. • PC for configuration. • Software if required for configuration. • Link budget. • system manuals, handbooks • Plans and Specifications • Microwave • 2 PC for testing • LAN cables • DC power source -48V • Microwave hardware link and repeater	• Power cable of MW • Power connectors • Digital multimeter (DMM) • Laptop Computer • Screwdrivers (flat, Phillips, posidrive), pliars, files, hammers, hand - cutters, hacksaw, terminating tools. Spanners (open end, ring and, shifters) chisels, (wood and metal) • Wrenches (vice grips, multi grips, Still sons, torque) • Hammers (claw, ball Pein) • Crimping tool (UTP coaxial twisted pairs, power cables) (UTP – unshield twisted pair • Allen keys • Rulers, measuring tape measures, squares • Ladder, cable tester, cable cutters

0714-E&A-46. Place, Secure, Splice and Terminate Optical Fiber Cable

Overview:
This competency standard will provide skill and knowledge required to make direct termination of optical fiber to a connector and allows for direct fiber to fiber connection with a similarly prepared connector or terminating unit. Student will be able to work at domestic, commercial or industrial sector.

Competency Units	Performance Criteria
1. Prepare for installation	- **P1.** Identify nature of work and interpreted from installation plan and site condition **P2.** Determine Layout of job from plan and other existing services identified **P3.** Check Approved alterations to the design in accordance with enterprise policies and procedures
2. Verify Optical Fiber Cable Placement	- P1. Verify Optical fiber cable installation with the installation plan P2. Confirm no Sheath damage, if any, through visual checks
3. Place Optical Fiber Cable	- P1. Check Correct optical fiber cable type, free from damage. P2. select intended installation which environment and meet customer requirements P3. Test Cable for optical continuity, P4. install in a safe manner to meet design and manufacturer's specifications
4. Secure Optical Fiber Cable	- P1. Keep Bend ratios mention to manufacturer's specifications and appropriate securing method selected to avoid damage. P2. Attach Over voltage protection devices to all cables with metallic component wherever required.
5. Install Optical Fiber Connectors for Direct Termination where Required	P1. Select Connector to match terminating frame to suit design specifications P2. Expose Cable end and remove sheath. P3. Use Optical fiber in accordance with connector type. P4. Remove Coatings from exposed optical fiber to eliminate all possible contaminants P5. Fit Connector and crimped without causing damage to fiber or thread P6. Hold Fiber firm within connector using adhesive P7. Direct termination for signal strength to manufacturers design and requirements. P8. Utilize Strain relief boots/sleeve to protect connector and fiber cord cable.

	P9. Utilize Protection boots/sleeve are to protect connector and fiber from exposure to contaminants P10. Ensure Connection end polished to a smooth flat surface for no optical path redirection after connection is made
6. **Fuse Splice Optical Fiber Cable where Required**	- P1. Cable end is stripped, and sheath removed to expose optical fiber in accordance with splicing method in use. P2. Handle Optical fiber cables in a safe manner to avoid risk of injury. P3. Remove Coatings from exposed optical fiber to remove all possible contaminants. P4. Apply Cleaner to ensure a clean flat surface is available for joining. P5. Use Fiber fuse manufacturers fusion splicing machine P6. Align fused fiber absolutely straight line with no bubbles or cracks in joint. P7. Test Joint according to manufacturer's specifications and design requirements. P8. Cover Bare fiber joint with standard heat shrinkable sleeve P9. Fit Splice protector in accordance with manufacturer's specifications. P10. Support fused fiber joints in a suitable splice tray or rack.
7. **Join Optical Fiber Mechanically where Required**	**-** P1. Cable stripped and sheath removed to expose optical. P2. Place fiber in accordance with mechanical joining requirements P3. Handle Optical fiber in a safe manner to avoid risk of injury P4. Remove Coatings from exposed optical fiber to remove possible contaminants P5. Apply cleaver to ensure a clean flat surface is available for joining P6. Utilize Index matching gel at joint to reduce variation in refractive index P7. Test Joint according to manufacturer's specifications and design requirements P8. Joint fiber and supported in a suitable Closure unit

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- Optical fiber cable installation splicing and termination by confirming signal strength through relevant test

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Read lay out plan and check alteration required.
- Lay Optical cable in secure manners as per standard.
- Strip and splice cable as per required specification.
- Test Joint according to manufacturer's specifications and design requirements

Tools and Equipment
• Drawing • LLD/HLD • hand tools • cleaver/cutter • stripper • patch code • Cable tester • Optical time domain reflectometer • Patch cord • Waste disposal containers - drop sheets, sharps containers • Fusion and splicing machine with necessary tools for • microscope • crimping tool • polishing papers • splicing • Fiber Cables • Cleaning liquid • Personal protection equipment • Pigtail

0714-E&A-47. Install Aerial and Underground Fiber cables

Overview:
This competency standard will provide skill and knowledge required to installation aerial and underground cables. You will be able to identify safe support structures and apply good work practices associated with cable hauling, securing and cable sealing processes
.

Competency Units	Performance Criteria
1. Install Aerial Support Structures	- P1. Obtain Necessary approvals and information on proposed locations from relevant authorities P2. check Location of proposed installation for conformity to appropriate plans P3. construct Support foundations to specifications and provide for safe and secure operation of support structure as required P4. Install Stable aerial supports in accordance with enterprise guidelines P5. Install Aerial fixing accessories securely in accordance with organization standards
2. Prepare Site for Underground Installation	- P1. Obtain Necessary approvals and information on proposed locations from relevant authorities P2. Check Location of proposed installation for conformity to appropriate plans P3. Clear and prepare Site to pave unrestricted access for installation activities P4. Select Appropriate tools and equipment for use safely as per manufacturers specifications P5. Ensure Suitability of excavation work as per the standards and regulation
3. Install Aerial Cable	- P1. Identify Cable installation requirements from plan aerial route P2. clear obstructions using suitable methods P3. secure Guard wire permanently to support structure and tensioned to meet relevant height and minimum sag requirements, as specified P4. Keep Sufficient allowance of cable loop on support structure for jointing and maintenance, and water drip point requirements
4. Install Enclosure and Pipe / Conduit	- P1. Install Enclosure and pipe / conduit as per plan to required designed specifications using specified materials P2. Install Pipe /conduit as per organization requirements and specifications P3. Make Pipe / conduit internal surfaces free from impediments to cable hauling P4. Establish Cable support structure and access facilities in

	enclosures as per organization standards and specifications
5. **Prepare Cable Hauling**	**-** P1. Ensure safety of site for cable installation P2. Clear Debris and obstructions from pipe/conduit and cable ends sealed to exclude ingress of foreign matter
6. **Haul cable**	**-** P1. Fix Cable to hauling feeder running through the pipe/conduit in accordance with cable type and manufacturers specifications P2. Avoid Damage to sheath when hauling cables P3. Lubricate Cable and hauled evenly at correct tension to minimize cable damage
7. **Splice Cable**	**-** P1. Select closure unit as per manufactures instructions P2. Prepare the cabling for splicing adequate length for cable standard P3. select Connector as per standard P4. join Pairs according to standard code cord P5. protect unit sealed with heat shrinkable closure from water perpetration

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- Reading skill of drawing, specifications charts and product manuals
- Standard colour code
- Cable routing standards
- Student can perform visual check of cable, joints, terminations, cable supports and enclosures
- specifications charts and product manuals
- Standard colour codes use for splicing
- Plan Reading skills

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Prepare Arial/ underground structure for fiber cable installation as per provided plan.
- Install and fix Cable and Splice according to standard coding.
- Test splicing by using standard equipment and Clear debris.
-

Tools and Equipment

- Product manual
- Drawing
- LLD/HLD of task
- hand tools
- cleaver/cutter
- stripper
- polishing papers
- Personal protection equipment
- Pigtail patch code
- Cable tester
- Optical time domain reflectometer
- Patch cord
- Waste disposal containers - drop sheets, sharps containers
- Fusion and splicing machine with necessary tools for microscope
- Crimping
- Cleaning liquid
- splicing
- Fiber Cables

0714-E&A-48. Splice Optical Fiber Cable

Overview: This competency standard will provide skills and the fundamentals of Splicing of Optical Fiber cable. You will be able to splice the optical fiber cable by Fusion and Mechanical Splice methods.

C1. **Fusion Splice Optical Fiber Cable where Required**	- P11. Cable end is stripped, and sheath removed to expose optical fiber in accordance with splicing method in use. P12. Handle Optical fiber cables in a safe manner to avoid risk of injury. P13. Remove Coatings from exposed optical fiber to remove all possible contaminants. P14. Apply Cleaner to ensure a clean flat surface is available for joining. P15. Use Fiber fuse manufacturers fusion splicing machine P16. Align fused fiber absolutely straight line with no bubbles or cracks in joint. P17. Test Joint according to manufacturer's specifications and design requirements. P18. Cover Bare fiber joint with standard heat shrinkable sleeve P19. Fit Splice protector in accordance with manufacturer's specifications. P20. Support fused fiber joints in a suitable splice tray or rack.
C2. **Mechanical Splicing of Optical Fiber cable**	**-** P9. Cable stripped and sheath removed to expose optical. P10. Place fiber in accordance with mechanical joining requirements P11. Handle Optical fiber in a safe manner to avoid risk of injury P12. Remove Coatings from exposed optical fiber to remove possible contaminants P13. Apply cleaver to ensure a clean flat surface is available for joining P14. Utilize Index matching gel at joint to reduce variation in refractive index P15. Test Joint according to manufacturer's specifications and design requirements P16. Joint fiber and supported in a suitable Closure unit

Knowledge & Understanding

The candidate must be able to demonstrate below given knowledge and understanding required carrying out the tasks covered in this competency standard:

1. Construction of Optical fiber cable
2. Safety precautions for handling of optical fiber cable
3. Fusion splicing method

4. Mechanical splice methods

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

1. Splice the two ends of optical fiber cable by Fusion method
2. Splice the two ends of optical fiber cable by Mechanical splice method

0714-E&A-49. Install LAN Switch

Overview: This competency standard will provide skills and knowledge of LAN switch and fundamentals of Switching. You will be able to install switch and configure LAN switch

C1. **Install the Switch**	**P1.** Unpack switch **P2.** Check equipment is physical ok **P3.** Check switch accessories are as per requirement
C2. **Install the Switch**	**P4.** Mount the rack. **P5.** Removing Screws from the Switch **P6.** Attaching Brackets to the Switch **P7.** Mounting the Switch in a Rack **P8.** Attaching the Cable Guide **P9.** Installing SFP Modules into SFP Module Slots. **P10.** Insert the SFP Module Patch Cable **P11.** Connect LAN cable to an Ethernet Port **P12.** Connecting to Fiber-Optic SFP Modules **P13.** Connect to a Dual-Purpose Port
C2. **Connect Power and configure Switch**	**P14.** Make switch power connector as per diagram **P15.** Connect switch with power supply **P16.** Connect Laptop with console port of switch **P17.** Configure switch 2 ports in access mode for testing **P18.** Connect 2 PCs on these ports and ping each other

Knowledge & Understanding

The candidate must be able to demonstrate below given knowledge and understanding required carrying out the tasks covered in this competency standard:

- Switches
- SFP module
- Cable Patching

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

1. Unpack switch and inspect it.
2. Install switch in rack and patch cables
3. Connect power supply and configure it

Tools and Equipment
• Product manual • Drawing • LLD/HLD of task • hand tools • cleaver/cutter

- stripper
- polishing papers
- Personal protection equipment
- Pigtail patch code
- Cable tester

- Previous and Current Floor plans
- Equipment and equipment's checklist
- GPS
- GIS software
- Site Data Sheet
- Measuring tools, DMM, Mechanical/Electrical tool kit
- Laptop, Software tools, Communication devices, Compass
- Electrical and mechanical tool kit and hardware
- Laptop, Site master
- Ethernet cable
- PPE

- First Aid Box

0714-E&A-50. Configure Switches

Overview:
This competency standard will provide skill and knowledge related to installation and configuration of switches. You will be able to configure protocols of switches and perform maintenance.

Competency Units	Performance Criteria
1. Configure and Identify Access switch.	- P1. Obtain Layout Map from Team Lead. P2. Switch Rack Assembling. P3. Mount Access switch in rack. P4. Install and Mount Patch Panel. P5. Connect all related Cable to switch. P6. Choose correct Cable to connect End Device to switches. P7. Choose correct Cable to connect Switches to Switches. P8. Install and connect ups to switch. P9. Connect power cables from switches to PDU (power distribution unit).
2. Arrange Specific Tools and spares	- P1. Ensure necessary tools and test equipment is available with the field team. P2. Ensure console cable is connected to switches console port. P3. Ensure the equipment specific software is installed in laptop device of field team. P4. Ensure that the software of switch is latest and updated and ready to use.
3. Configure Access Switches	- P1. Obtain topology for switches. P2. Install configuration tool for access switches in PC and Laptop. P3. Configure IP Address of switch to remote Access P4. Configure password for access switches. P5. Configure VLAN in switch. P6. Configure STP for preventing loop. P7. Perform Switch configuration and operating system backup to USB and pc. P8. Perform restore configuration and operating system from USB and PC
4. Co-ordinate Maintenance Activity	- P1. Coordinate performance of maintenance activities on periodic basis (monthly, quarterly, half year) P2. Obtain the performance of switches from NOC Team and Monitor Switch Ports for operational Activity. P3. Optimize switch parameters to ensure that they stay within designed value.

	P4. Review media errors in transmission media. P5. Ensure adequacy of redundancy of critical network elements like switch to core nodes. P6. Inspect the installation site for moisture, loose wires, or cables and excessive dust. P7. Make sure that airflow is unobstructed around the switches and into the air intake vents. P8. Check the status-reporting devices interfaces, system alarms, LED. P9. Inspect the air filter and fan trays at the rear of the switches and check for optimum cooling systems performance. P10. Ensure the remote support is provided to the remote field team while the change activity carried out. P11. Ensure the timely completion of maintenance activity of performed by field engineer. P12. Ensure compliance to enterprise policy without delays.
5. **Perform Health and safety**	**-** P1. Ensure compliance with environmental and quality requirements as per company norms. P2. Ensure that work is carried out in accordance to the level of competence and legal requirements. P3. Ensure with all organization security arrangements and approved procedure. P4. Maintain protective equipment according work requirements.
6. Report and Records	**-** P1. Ensure all relevant parties (including Team Lead, NOC Team and other supervisor) are notified of the results of the installation and maintenance activities and sign off is obtained from relevant persons. P2. Ensure the documents are required to be updated are identified. P3. Ensure completion of routine maintenance logs, activity logs and spare tracker within stipulated timelines. P4. Ensure that all documents are available to all appropriate authorities to inspect.

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes:

- Switches racks.
- OSI Layers.
- Switches working at different Layers.
- Technology provided by switches.
- Switches chassis and slots.
- Cables for switches connectivity.
- Power of switches as per country.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Mount and Install Switches and patch panel in the Racks and Attached relevant cables to the Switches.
- Install software (putty, secure CRT) in Laptop for Configuring Switches.
- Configure different protocols in Switches according to given topology.
- Conduct maintenance of Switches as per SLA (Service Level Agreement)/SOP (Standard Operating Procedure)

0714-E&A-51. Identify Basic Electronics Components

Overview:

This competency standard covers the skills and knowledge required to Identify Various Diodes, Identify Resistors in circuit, Identify Capacitor in circuit, identify Inductor in circuit and Identify IC's Packages**.** After this competency standard the candidate will be able to identify variety of basic electronic components and their usage in industry.

Competency Units	Performance Criteria
CU1. Identify Various Diodes	**P1.** Identify the Diodes **P2.** Identify its types & polarities **P3.** Draw Diode characteristics curves in forward and reverse Biased
CU2. Identify Resistors in circuit	**P1.** Identify Resistor & its types **P2.** Recognize Coding &Color coding of resistor **P3.** Design series & Parallel circuit of Resistor **P4.** Use formulas for Series & parallel circuit of resistors
CU3. Identify Capacitor in circuit	**P1.** Identify Capacitor & its types **P2.** Recognize Coding &rating of Capacitor **P3.** Design Parallel and series circuit of Capacitor **P4.** Use formulas for Series & parallel circuit of Capacitor
CU4. Identify Inductor in circuit	**P1.** Identify an Inductor **P2.** Recognize Coding & Rating of Inductor **P3.** Use formulas for Series & Parallel circuit of Inductor **P4.** Analyze Circuit of Inductor
CU5. Identify IC's Packages.	**P1**. Identify IC Packages & types. **P2**. Apply the appropriate ICs Packages in circuit

Knowledge & Understanding

- Describe the diodes, polarities & their applications in circuits
- Explain the uses of Multimeter& power Supply
- Explain the data sheets
- Explain Resistor & their applications in Parallel & Series circuits
- Explain the uses of Multimeter& power
- Supply

- Explain the data sheets
- Describe Capacitor& their applications in circuits
- Explain the uses of Multimeter& power Supply
- Explain the data sheets
- Describe the Inductor& their applications in circuits
- Explain the uses of Multimeter& power Supply
- Explain the data sheets
- Describe the basics of IC Packages
- Understand the data sheets

Tools & Equipment

SN	Tools
1	Multimeter
2	Power supply
3	Trainer
4	Resistor
5	Inductor
6	ICs
7	Capacitor
8	Source of data sheets

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

0714-E&A-52. Design a Rectifier Using Diode

Overview:

This competency standard covers the skills and knowledge required to. This Identify The parameter of Diode and Draw the characteristic curve of Diode, Design Full Wave Rectifier (two diode rectifier) and Design Full Wave Rectifier using Diode Bridge competency standard will help the candidate in construction of Diode rectifier and its uses in industry.

Competency Units	Performance Criteria
CU1. Identify The parameter of Diode and Draw the characteristic curve of Diode	**P1.** Identify the Diodes and there terminal (Anode and Cathode) whit the Help of Datasheet **P2.** Describe Different parameter (Current, Voltage, and power rating) of Diode Using Diode Data sheets. **P3.** Implement the Diode in forward and Revers Configuration **P4.** Perform the forward and reveres biases operation **P5.** Monitor the Output waveform on oscilloscope **P6.** Draw the characteristic curves in forward and reverse Biased **P7.** Generate the Lab report
CU2. Design half wave and Full Wave Rectifier (two diode rectifier	**P1.** Identify Full Wave and half wave Rectifier components **P2.** Draw circuit Diagram of half wave Rectifier **P3.** Draw circuit Diagram of Full Wave Rectifier **P4.** Observe the INPUT and Output wave form on oscilloscope **P5.** Calculate the ripple Factor **P6.** Calculate output voltage using proper formulas
CU3. Design Full Wave Rectifier using Diode Bridge	**P1.** Identify Full Wave Rectifier components **P2.** Draw circuit Diagram of Full Wave Rectifier **P3.** Observe the INPUT and Output wave form on oscilloscope **P4.** Calculate the ripple Factor **P5.** Calculate output voltage

Knowledge and understanding

- . Study the basic of diodes, & their applications in circuits
- Knowledge of basic electronics

- Understand Multimeter& power Supply
- Understand the data sheets
- Explain basics of diodes, AC & DC
- Voltages, transformers & Rectifiers.
- Explain the uses of multimeter
- Explain the uses oscilloscope and Power Supply
- Understand the data sheets
- Explain the basics of diodes, AC & DC voltages, Transformers & Rectifiers.
- Explain the uses of multimeter
- Explain the uses of oscilloscope and power Supply

Tools & Equipment

SN	Tools
1	Multimeter
2	Power supply
3	Trainer
4	Diodes
5	Digital
6	Oscilloscope
7	Datasheets

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

0714-E&A-53. Carry Out Diode Application

Overview:

This competency standard covers the skills and knowledge required toMake voltage regulator using Zener diode and**.** Make Seven Segment Using Light Emitting Diode After completing this competency standard, the student will be able to design a voltage regulator circuit using a Zener diode to maintain a constant DC output voltage across the load in spite of variations in the input voltage or changes in the load current.

Competency Units	Performance Criteria
CU1.Make voltage regulator using Zener diode	**P1.** Draw the voltage Regulator circuit **P2.** Select the Zener diode and components as per requirement for voltage regulator **P3.** Placed the components for voltage regulator circuits. **P4.** Measure Input and outputs of the voltage regulator **P5.** Verify the required output **P6.** Generate the output report
CU2. Make Seven Segment Using Light Emitting Diode	**P7.** Draw the Seven Segment Display Circuit **P1.** Select required components for seven segment display **P8.** Placed the components for Seven Segment Display Circuit **P9.** Perform basic operations of Seven Segment Display and Verify the required output **P2.** Generate the output report

Knowledge & Understanding

- Learn basic knowledge offender Diode& its applications
- Learn knowledge of components
- Learn to use oscilloscope &power Supply
- Understand the data sheets
- Learn to Solder the Components
- Learn adequate
- knowledge of hand tools
- Learn basic knowledge of LED & its applications
- Learn knowledge of components
- Learn to use power Supply
- Understand the data sheets

- Learn to Solder the Components

Tools & Equipment

SN	Tools
1	Oscilloscope
2	Zener diode
3	Resistor,
4	Variable DC power supply, Millimeter
5	Soldering iron
6	Connecting wire
7	Resistor
8	Variable DC power supply, Millimeter
9	Voltmeter
10	Light Emitting diode
11	Soldering iron
12	Connecting wire

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

0714-E&A-54. Implement Bipolar Junction Transistor (BJT) in Different Applications

Overview:

This competency standard covers the skills and knowledge required to Perform the Biasing of Transistors, Implement Transistor as an amplifier using CB Configuration, Implement Transistor as an amplifier using CC Configuration, Implement Transistor as an amplifier using CE Configuration, Design the circuit of Class A Power Amplifier and Implement BJT as a switch After completion of this competency standard the student will be able to regulate the current or voltage flow and implement a switch for electronic signals.

Competency Units	Performance Criteria
CU1. Perform the Biasing of Transistors	**P1**. Identify the Transistor& its types. **P2**. Identify the base collector & Emitter of transistors **P3**. Perform the standard Biasing of PNP & NPN Transistor
CU2. Implement Transistor as an amplifier using CB Configuration.	**P1.** Draw the Circuit of CB configuration of transistor **P2.** Select the components for CB configurations. **P3.** Place the components for CB amplifier **P4.** Calculate the gain of transistor in CB modes. **P5.** Draw VI characteristics curve for CB
CU3. Implement Transistor as an amplifier using CC Configuration.	**P1.** Draw the Circuit of CC configuration of transistor **P2.** Select the components for CC configurations. **P3.** Place the components for CC amplifier **P4.** Calculate the gain of transistor in CC modes. **P5.** Draw VI characteristics curve for CC
CU4. Implement Transistor as an amplifier using CE Configuration.	Draw the Circuit of CE configuration of transistor **P1.** Select the components for CE configurations. **P2.** Place the components for CE amplifier **P3.** Calculate the gain of transistor in CE modes. **P4.** Draw VI characteristics curve for CE
CU5. Design the circuit of Class A Power Amplifier	**P1.** Identify the Class a Power Amplifier **P2.** Select the component for ClassaPower Amplifier **P3.** Implement the circuit of PNP OR NPN transistor in Class a Power Amplifier Configuration

	P4. Analyze the different parameter of ClassaPower Amplifier **P5.** Monitor the Output waveform on oscilloscope **P6.** Draw the characteristic curves of ClassaPower Amplifier **P7.** Calculate the Voltage gain and Power Gain of ClassaPower Amplifier **P8.** Generate the Lab report
CU6. Implement BJT as a switch.	**P1.** Draw the Circuit of transistor in switching configuration. **P2.** Select the components for switching circuits **P3.** Place the components **P4.** Operate an LED using transistor as a switch **P5.** Measure the output and generate the report

Knowledge &Understanding

- .Learn basic concepts of transistor & Biasing
- Study semiconductor theory
- Learn Doping Procedure.
- Study the datasheet of transistor
- Learn basic concepts & working principles of transistor
- Study semiconductor theory
- Procedure.
- Learn basics of Coupling Capacitor.
- Learn the V-I Characteristics
- Learn basic concepts & working principles of transistor
- Study semiconductor theory
- Learn Doping Procedure.
- Learn basics of Coupling Capacitor.
- Learn the V-I Characteristics
- Learn basic concepts & working principles of transistor
- Study semiconductor theory
- Learn Doping Procedure.
- Learn basics of Coupling Capacitor.
- Learn the V-I Characteristics
- Study the basic of BJTs, & their applications in circuits
- Knowledge of basic electronics
- Understand Multimeter, Oscilloscope

- & power Supply
- Understand the data sheets
- Learn basic concepts of transistor
- Study semiconductor theory
- Procedure.
- Learn basics of Coupling Capacitor.

Tools & Equipment

SN	Tools
1	Power
2	Oscilloscope
3	Trainer
4	Supplies
5	Resistors
6	Datasheets
7	Transistors
8	Trainer
9	MultiMate
	Capacitors

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

0714-E&A-55. Implement Field Effect Transistor (FET) In Different Applications

Overview:

This competency standard covers the skills and knowledge required to perform the Biasing of FET, Implement MOSFET as a switch, Draw the VI characteristics curves for FETs, Design the circuit of Common Drain (CD) Amplifier, Design the circuit of Common Gate (CG) Amplifier, design a switching Circuit Using MOSFET and Design a Low voltage transistor based regulated power supply**.** After completion of this competency standard the student will be able to implement the FET (Field Effect Transistor) to control the current flow through the device.

Competency Units	Performance Criteria
CU1. Perform the Biasing of FET	**P1**. Identify the FET & its types. **P2**. Identify the Drain, Gate & Source of FET **P3**. Perform the standard Biasing of MOSFET (N-channel, P-channel) **P4**. Measure the Gate-Source voltage (Veg's) & Threshold Voltage (Vth)
CU2. Implement MOSFET as a switch.	**P1.** Draw the Circuit of MOSFET in switching configuration. **P2.** Select the components for switching circuits **P3.** Place the components **P4.** Operate an LED using MOSFET as a switch **P5.** Measure the output and generate the report
CU3. Draw the VI characteristics curves for FETs	**P1**. Construct an amplifier circuit using FETs **P2**. Apply Vds&Vgs **P2**. Measure the drain current **P4**. Draw VI characteristic curves
CU4.Design the circuit of Common Drain (CD) Amplifier	**P1.** Identify the FET and there terminal (gate, drain and Sources) whit the Help of Datasheet **P2.** Select the components for Common Drain (CD) amplifier **P3.** Implement the circuit of Common Drain (CD) amplifier **P4.** Analyze the different parameter of Common Drain (CD) amplifier **P5.** Monitor the Output waveform on oscilloscope

	P6. Draw the characteristic curves of Common Drain (CD) amplifier **P7.** Generate the Lab report
CU5. Design the circuit of Common Gate (CG) amplifier	**P1.** Identify the FET and there terminal (gate, drain and Sources) whit the Help of Datasheet **P2.** Select the components for Common Gate (CG) amplifier **P3.** Implement the circuit of Common Gate (CG) amplifier **P4.** Analyze the different parameter of Common Gate (CG) amplifier **P5.** Monitor the Output waveform on oscilloscope **P6.** Draw the characteristic curves of Common Gate (CG)amplifier **P7.** Generate the Lab report
CU6. Design a switching Circuit Using MOSFET	**P1.** Identify the MOSFET and there terminal (gate, drain and Sources) whit the Help of Datasheet **P2.** Select the components for Switching Circuit **P3.** Implement Switching Circuit using MOSFET **P4.** Perform the operation of switching **P5.** Monitor the Output **P6.** Generate the Lab report
CU7. Design a Low voltage transistor based regulated power supply	**P1.** Draw the Schematic of power supply **P2.** Select the components for power supply **P3.** Implement the circuit of power supply **P4.** Perform individual operationsondifferent sections of power supply **P5.** Measure Output Voltage **P6.** Generate the Lab report

Knowledge & understanding

- Learn the basics of FET
- Learn the concept of FET Biasing.
- Learn the power rating of FET
- Study The datasheet of FET
- Learn the basics of FET
- Learn the concept of
- FET Biasing.
- Learn the power rating of FET
- Study The datasheet of FET
- Learn the Switching theory
- Learn the behavior of current and voltage in FET's
- Learn biasing mechanism and basic formulae of FET's
- Learn the vgs, VDs, Idss&Rds as per datasheet.
- Study the basic of FETs, & their applications in circuits
- Knowledge of basic
- electronics
- Understand Multimeter & power Supply
- Understand the data sheets
- Study the basic of FETs, & their applications in circuits
- Knowledge of basic electronics
- Understand Multimeter & power Supply
- Understand the data sheets
- Study the basic of FETs, & their applications in circuits
- Knowledge of basic electronics
- Understand Multimeter & power Supply
- Understand the data sheets
- Study the basic of BJTs, ICs & their applications in circuits
- Knowledge of basic electronics and amplifier
- Understand Multimeter, Oscilloscope
- & power Supply
- Understand the data sheets

Tools & Equipment

SN	Tools

1	FET Transistors
2	Multimeter
3	Capacitors
4	Resistors
5	Power Supplies
6	Trainer
7	Simple FET
8	Digital
9	MOSFET

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

0714-E&A-56. Implement (Uni Junction Transistor, Silicon Control Rectifier,Diac and Triac) in Various Application

Overview:

This competency standard covers the skills and knowledge required to Implement the UJT in electronic circuits as switch, Implement the SCR in electronic circuits as switch and Construct the dimmer circuit using Diac & Triac**.** After the completion of this standard the candidate will be able to install Uni junction Transistor (UJT), Silicon-controlled rectifier (SCR) in power Control Application.

Competency Units	Performance Criteria
CU1. Implement the UJT in electronic circuits as switch	**P1.** Identify the UJT **P2.** Draw the circuit of switch using UJT. **P3.** Select the components for the relaxation oscillator circuits **P4.** Construct the relaxation oscillator circuits using UJT **P5.** Measure the input and output voltage **P6.** Generate the lab report
CU2. Implement the SCR in electronic circuits as switch	Identify the SCR terminals **P1.** Draw the circuit of switch using SCR. **P2.** Select the components for SC switching circuits. **P3.** Construct the SC switching circuit. **P4.** Apply the trigger Pulse and Check out the desired outputs
CU3. Construct the dimmer circuit using Diac&Triac.	Identify the Diac&Triac. **P1.** Draw the dimmer circuit using Dias& Trial. **P2.** Select the components for the dimmer circuit. **P3.** Construct the dimmer circuits. **P4.** Control the load using dimmer Generate the lab report

Knowledge & understanding

- Learn the basics of UJT
- Learn the uses of oscilloscope and power Supply
- Understand the data sheets
- Learn adequate knowledge of hand tools
- Learn basics of SCR

- Understand the data sheets
- Learn adequate knowledge of hand tools
- Learn the uses of oscilloscope, power Supply& Multimeter
- Learn the basics of diac&triac
- Understand the data sheets
- Learn adequate knowledge of hand tools

Tools & Equipment

SN	Tools
1	Oscilloscope
2	UJT,
3	Resistor
4	Variable DC power supply,
5	Multimeter
6	Soldering iron, wire
7	Breadboard or trainer
8	Supply
9	Trainer/Breadboard
10	Multimeter
11	SCR, Diodes, Resistors, Inductors, Capacitors & connecting wire

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

0714-E&A-57. Design Operational Amplifier

Overview:

This competency standard identifies the competencies required to Construct a Non-inverting amplifier using operational amplifier, construct an Inverting amplifier using and Construct a differentiator circuit using operational amplifier. Construct Operation Amplifier.

Competency Units	Performance Criteria
CU1. Construct a Non-inverting amplifier using operational amplifier	**P1.** Identify the Operational amplifier and its terminals (Inverting, Non-inverting Inputs &Outputs) with the Help of Datasheet **P2.** Identify different parameters (Current, Voltage, and power rating) of Op-Amp using datasheet. **P3.** Draw the Schematic diagram of non-Inverting Op-Amp. **P4.** Select the components for Non-Inverting Op-Amp. **P5.** Implement Non-Inverting Op-Amp circuit. **P6.** Perform the operations of Non-Inverting Op-Amp circuit. **P7.** Measure the output frequency response & gain **P8.** Draw the characteristic curves of Op-Amp. **P9.** Generate the Output report
CU2. Construct an Inverting amplifier using operational amplifier	**P1.** Identify the Operational amplifier and its terminals (Inverting, Non-inverting Inputs &Outputs) with the Help of Datasheet **P2.** Identify different parameters (Current, Voltage, and power rating) of Op-Amp using datasheet. **P3.** Draw the Schematic diagram of Inverting Op-Amp. **P4.** Select the components for Inverting Op-Amp. **P5.** Implement Non-Inverting Op-Amp circuit. **P6.** Perform the operations of Inverting Op-Amp circuit. **P7.** Measure the output frequency response & gain **P8.** Draw the characteristic curves of Op-Amp. **P9.** Generate the Output report
CU3. Construct a differentiator circuit using operational amplifier	**P1.** Draw the Schematic diagram of differentiator circuit using Op-Amp. **P2.** Select the components for differentiator circuit. **P3.** Implement differentiator circuit. **P4.** Perform the operations of differentiator circuit. **P5.** Measure the output, frequency response & gain

	P6. Draw the characteristic curves of differentiator circuit. **P7.** Generate the Output report

Knowledge and understanding

- Study the basics of Transistors, ICs, Capacitors, Resistors, Op-Amp & their applications in circuits
- Explain the basics of electronics & its applications
- Understand Multimeter, Oscilloscope
- & power Supply& their applications
- Understand the data sheets
- Study the basics of Transistors, ICs, Capacitors, Resistors, Op-Amp & their applications in circuits
- Explain the basics of electronics& its applications
- Understand Multimeter, Oscilloscope
- power Supply& their applications
- Understand the data sheets
- Study the basics of Transistors, ICs, Capacitors, Resistors, Op-Amp & their applications in
- circuits
- Explain the basics of electronics, Differentiator and their applications
- Understand Multimeter, Oscilloscope
- & power Supply& their applications
- Understand the data sheets

Tools & Equipment

SN	Tools
1	Functions Generator
2	Datasheets
3	Digital Oscilloscope
4	Capacitors
5	Inductors
6	Op-Amp
7	Power supply
8	Trainer
9	Multimeter
10	Resistors

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

0714-E&A-58. Implement Diode and Thyristor in Power Control Application.

Overview:

This competency standard covers the skills and knowledge required toBuild forward bias circuit of diode and observe its behavior, Build reverse bias circuit of diode and observe its behavior, Use SCR to build Phase control rectifier, Build force commutated circuit for SCR and Build full wave converter and observe natural commutation. Build forward bias and reverse bias circuit of diode and observe its behavior.

Competency Units	Performance Criteria
CU1. Build forward bias circuit of diode and observe its behavior.	**P1.** Draw forward bias circuit diagram of diode. **P2.** Make connection as per diagram. **P3.** Connect volt meter parallel to diode and ampere meter in series **P4.** Turn on the supply and take readings of ampere meter as well as voltmeter. **P5.** Note the behavior of diode
CU2. Build reverse bias circuit of diode and observe its behavior.	**P1.** Draw reverse bias circuit diagram of diode. **P2.** Make connection as per diagram. **P3.** Connect volt meter parallel to diode and ampere meter in series **P4.** Turn on the supply and take readings of ampere meter as well as voltmeter. **P5.** Note the behavior of diode.
CU3. Use SCR to build Phase control rectifier.	**P1.** Draw circuit diagram of phase control rectifier. **P2.** Make connection as per diagram. **P3.** Switch on the power supply. **P4.** Vary the value of potentiometer to set the trigger level for the SCR **P5.** Recode the output signal wave shape from oscilloscope.
CU4. Build force commutated circuit for SCR.	**P1.** Draw circuit diagram of force commutated circuit for SCR. **P2.** Make connection as per diagram. **P3.** Switch on the power supply and apply triggering pulse at the gate of SCR. **P4.** Connect oscilloscope across the load resistor and record the output wave shape
CU5. Build full wave converter and observe natural	**P1.** Draw circuit diagram of full wave converter. **P2.** Make connection as per diagram. **P3.** Switch on the power supply and apply triggering pulse at the

commutation.	gate of SCR. **P4.** Connect oscilloscope across the load resistor and record the output wave shape

Knowledge & Understanding

- Define forward biasing
- Define reverse biasing
- Define Reverse breakdown voltage
- Define junction potential
- Define SCR
- Describe the operation of SCR
- Define phase control rectifier
- Define triggering of SCR
- Describe the use of SCR
- Define V_{AK}
- Define commutation and its types
- Define natural commutation.
- Define force commutation
- Name the methods of force commutation.
- Describe the use of force commutation

Tool and Equipment

SN	Tools
1	Power diode
2	Resistor of 1 K ohms
3	Volt meter
4	Ampere meter
5	DC supply
6	Connecting leads
7	Power supply
8	Centre tapped transformer
9	Bread Board
10	Oscilloscope
11	Connecting leads
12	Resistor of 10 K ohms
13	Capacitor 10uF
14	SCR
15	Connecting leads

16	Power supply
17	Bread Board
18	Oscilloscope Dual
19	Potentiometer 500 o
20	Resistor of 10 K & 100 K ohms
21	Inductor 2mH
22	Diode
23	SCR
24	Bread Board

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

0714-E&A-59. Measure Current, Voltage and Make Multiplier for Galvanometer Range Extension

Overview:

This competency standard covers the skills and knowledge required to measure current with Galvanometer and Voltage with Galvanometer and make multiplier for galvanometer range extension.

Competency Units	Performance Criteria
CU1. Measure current with Galvanometer	**P1.** Select tools and equipment. **P2.** Make connections as per standard **P3.** Measure current with galvanometer **P4.** Show the results on galvanometer **P5.** Obtain readings and interpret the results.
CU2. Measure voltage with Galvanometer	**P1.** Select tools and equipment. **P2.** Make connections as per standard **P3.** Measure current with galvanometer **P4.** Show the results on galvanometer **P5.** Obtain readings and interpret the results.
CU3. Make multiplier for Galvanometer range extension	**P1.** Select tools and equipment. **P2.** Connect a large multiplier resistance in series with the galvanometer **P3.** Calculate the range of voltmeter **P4.** Insert different multiplier resistances for different ranges. **P5.** Measure voltage with galvanometer **P6.** Obtain readings and interpret the results.

Knowledge & Understanding

- Explain different types of electrical measuring instruments
- Define absolute and secondary instruments.
- Operating principle of tangent galvanometer.
- Define various effects used as forces in electrical instruments
- Define the physical parameter due to various forces (thermal, magnetic and electromagnetic
- electrostatic, induction effects)
- Explain indicating, integrating and recording instruments.
- Explain the methods of Damping forces(Air friction, Fluid friction, Eddy current) in instruments

Tool and Equipment

SN	Tools
1	Galvanometer
2	Connecting cables
3	Test Bench
4	Resistance decade box
5	DC Power supply
6	Plier

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

0714-E&A-60. Measure Temperature, Earth Resistance, Light Intensity

Overview:

This competency standard covers the skills and knowledge required to Measure temperature with thermocouple by voltage method, measure the Earth resistance by using earth resistance tester, measure light intensity with lux meter.

Competency Units	Performance Criteria
CU1. Measure temperature with thermocouple by voltage method	**P1.** Pick K-type thermocouple **P2.** Put the Sensor tip in temperature source. **P3.** Connect the Multimeter on the other end of thermocouple. **P4.** Apply temperature by source and measure the voltage generated on multi meter **P5.** Record the readings. **P6.** Compare the measured value of voltage against temperature with ITS-90 table for K-typeTC.
CU2. Measure the earth resistance by using earth resistance tester	**P1.** Short P1 and C1 terminals on the instrument (four terminal tester) and connected to the earth electrode under test **P2.** Drive C2 reference rod into the earth straight-out as far from the electrode under test as possible. **P3.**Potential reference P2 is then driven into the earth**,** at a set number of points, roughly on a straight line between C1 and C2**.** **P4.** Resistance readings are logged for each P2 point **P5.** Plot Measurements on **a** curve of resistance vs. distance. **P6.** Correct earth resistance is read from the curve for the distance that is roughly 62% of the total distance between C1 and C2. **P7.** Report the result.
CU3.Measure the light intensity with lux meter	**P1.** Locate three or more points at same height apart from each other. **P2.** Turn on the Lux meter and let it stabilize. **P3.** Take reading on each selected point. **P4.** Calculate the average of measurements and report the result.

Knowledge & Understanding

- Describe different types of thermocouple, construction and temperature ranges.
- Explain the working principle of thermocouple

- Explain different shapes of thermocouples and its colors.
- Describe the industrial application of thermocouple and its advantages.
- Differentiate between thermocouple and thermistor.
- Explain thermoelectric voltage
- Define working principle of thermistor.
- Define types of thermistor
- Define the use of thermistor for current control.
- Describe different methods of earth resistance testing
- Explain the procedure for selection of test points and safety considerations.
- Define the operating procedure of earth resistance tester
- Describe light and its intensity
- Explain the working principle of lux meter.
- Explain the standard ranges of light intensity for different environments

Tool and Equipment

SN	Tools
1	Multimeter
2	Oven (Temperature source)
3	**Earth resistance tester**
4	**Connecting cables**
5	Lux meter
6	**Electrodes**
7	Light source
8	Test probes
9	Thermocouples

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

0714-E&A-61. Measure the Resistance and High DC Current by Using Shunt.

Overview:

This competency standard covers the skills and knowledge required to Measure the resistance by using wheat stone bridge, Measure the resistance by ohm meter, Measure the resistance by AVO meter and Measure high DC current by using shuntmeasure resistance with wheat stone bridge, ohmmeter and AVO meter and measure high DC current by using shunt.

Competency Units	Performance Criteria
CU1. Measure the resistance by using wheat stone bridge	**P1.** Select the unknown resistor Rx **P2.** Connect it in a bridge circuit. **P3.** Balance the wheat stone bridge circuit **P4.** Calculate unknown resistance Rx. **P5.** Record the result.
CU2. Measure the resistance by ohm meter	**P1.** Select the unknown resistor Rx **P2.** Connect the probes of ohmmeter across resistor. **P3.** Read the value from the display
CU3. Measure the resistance by AVO meter	**P1.** Select the unknown resistor Rx **P2.** Move the knob of AVO meter and set it on ohm. **P3.** Connect the probes of ohmmeter across resistor. **P4.** Read the value from the display
CU4. Measure high DC current by using shunt	**P1.** Select the appropriate shunt **P2.** Connect it in parallel with the Ammeter within a circuit. **P3.** Apply high current and find voltage drop against shunt. **P4.** Measure the reading and interpret result **P5.** Record the result.

Knowledge & Understanding

- Describe and draw the wheat stone bridge circuit
- Working principle of Wheat Stone Bridge circuit
- Working principle of ohmmeter
- Working of AVO meter
- Describe the working principle of ammeter and shunt.
- Define the effects of multiplier and shunt resistances.

Tool and Equipment

SN	Tools
1	Power supply
2	Shunts

3	Test probes
4	Multimeter
5	Load
6	Test bench
7	AVO meter
8	Power supply
9	Resistors
10	Wheat stone bridge circuit
11	Multimeter
12	Ohmmeter
13	Test probes

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

0714-E&A-62. Measure Voltage, Frequency, Capacitance &Inductance by CRO

Overview:

This competency standard covers the skills and knowledge required toMeasure voltage using CRO, Measure frequency using CRO, Measure capacitance using CRO and Measure inductance using CRO.measure voltage, frequency, capacitance & inductance using CRO (Cathode Ray Oscilloscope).

Competency Units	Performance Criteria
CU1. Measure voltage using CRO	**P1.** Shut off the internal horizontal sweep generator **P2.** Calibrate the CRO against known voltage and adjust the vertical gain. **P3.** Keep the vertical gain unchanged, apply the unknown voltage to be measured, to the vertical input terminals of the oscilloscope **P4.** Measure the length of the vertical line obtained **P5.** Calculate the voltage and record the result. **OR** **P1.** Set the trigger button to auto. **P2.** Adjust the Vertical and horizontal controls to get sine wave clear and stable image. **P3.** Now take measurements along the center vertical line which has the smallest divisions. **P4.** Take Reading of the voltage signal by vertical control. **P5.** Record the reading.
CU2. Measure frequency using CRO	**P1.** Identify the inputs of CRO for frequency (vertical /horizontal) **P2.** Adjust various controls as per input frequency. **P3.** Apply frequency input and read the pattern obtained. **P4.** Interpret the pattern obtained to calculate frequency. **P5.** Record the result.
CU3. Measure capacitance using CRO	**P1.** Connect 1kohm resistor in series with standard capacitor **P2.** Set the function generator to output a 1.9 V amplitude, 100 Hz sine wave. **P3.** Set the voltage and frequency. **P4.** Adjust the vertical scale setting of the oscilloscope to use as much of the display as possible to improve the accuracy of voltage measurements. **P5.** Connect probes of oscilloscope across capacitor. **P6.** Set the oscilloscope to measure the channel 1 frequency, phase between channel 2 and channel 1, channel 1

	amplitude, and channel 2 amplitude. **P7.** Calculate the impedance and capacitance from available data. **P8.** Record the result.
CU4. Measure inductance using CRO	**P1.** Connect 1kohm resistor in series with standard capacitor **P2.** Set the function generator to output a 1.9 V amplitude, 10kHz sine wave. **P3.** Set the voltage and frequency. **P4.** Adjust the vertical scale setting of the oscilloscope to use as much of the display as possible to improve the accuracy of voltage measurements. **P5.** Connect probes of oscilloscope across inductor. **P6.** Set the oscilloscope to measure the channel 1 frequency, phase between channel 2 and channel 1, channel 1 amplitude, and channel 2 amplitude. **P7.** Calculate the impedance and inductance from available data. **P8.** Record the result.

Knowledge & Understanding

- Explain the control knobs for electrical /electronic signals.
- Explain the instrument measurement principle from time and amplitude screen.
- Describe the instrument's functional range.
- Explain Testing techniques of circuit.
- Describe reading and measuring techniques for the circuit through oscilloscope/function generator.

Tool and Equipment

SN	Tools
1	10 kohm resistor
2	Voltage probes
3	Power supply
4	Standard Inductor
5	Function generator
6	Standard capacitor
7	100 Ohm resistor
8	Test bench
9	Oscilloscope
	Multimeter

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

0714-E&A-63. Identify the Parts and Connection of Energy Meter (Single/3-Phase), Factor(PF) Meter, MDI Meter, Meagre.

Overview:

This competency standard covers the skills and knowledge required to identify parts of Energy meter, identify different types of PF meter, its parts and connect it in circuit, identify and implement MDI meter and measure insulation resistance by Meagre

Competency Units	Performance Criteria
CU1. Identify parts and connection of Energy meter(Single/3-phase)	**P1.** Identify the Energy meter(Single/3-phase) **P2.** Differentiate between driving, moving, braking and recording system **P3.** Identify aluminum disc, series and shunt electromagnet, copper shading ring, magnetic brake, pressure and current coil, permanent magnet and cyclometer **P4.** Connect Single Phase Energy meter in a load circuit **P5.** Connect 3phase Energy meter in a load circuit **P6.** Take the measurements and record.
CU2. Identify different types of PF meter, its parts and connect it in circuit.	**P1.** Identify the PF meters (Electrodynamometer type/ Moving Iron type) **P2.** Differentiate between pressure coil and current coil **P3.** Identify inductive and resistive part of pressure coil in electrodynamometer type PF meter **P4.** Connect Single phase PF meter in a load circuit **P5.** Connect 3phase PF meter in a load circuit **P6.** Take the measurements and record.
CU3. Identify MDI meter parts and use it on line	**P1.** Identify the parts of MDI meter **P2.** Select the MDI meter according to load. **P3.** Identify the connections and insert it on line as per procedure **P4.** Note down the reading and interpret it.

CU4. Measure insulation resistance by Meager	**P1.** Isolate the unit under test **P2.** Connect the meager with cable of unknown insulation resistance as per standard **P3.** Hand crank the meager to generate voltage **P4.** Analyze the reading and note it down. **P5.** Interpret the measurements

Knowledge & Understanding

- Explain the types of Energy meters and its working principles.
- Draw single phase/3 phase energy meter connection diagram
- Describe single phase/3 phase energy meter theory and phase diagram
- Explain single phase/3 phase energy meter specifications
- Explain the types of PF meters and its working principles.
- Describe Power factor and conditions of leading and lagging power factor
- Explain the resistive, capacitive and inductive load.
- Explain phase angle and conditions in which voltage/current leads/lags
- Differentiate between Apparent, True and Reactive power.
- Describe formulas for calculation of PF while having resistive, capacitive, inductive and mixed loads.
- Explain the construction of MDI meter
- Explain working principle of MDI meter
- Explain Apparent, true and reactive power
- Explain the construction of meager
- Explain the working principle of meager
- Describe the standard insulation resistances for different systems

Tool and Equipment

SN	Tools
1	Wattmeter
2	Multimeter
3	Nose plier
4	Wire Cutter
5	Tweezers
6	Electrical test bench
7	Power source Single/3-phase

8	Single/3-phase Load circuit
9	Test probes
10	Precision screw driver set
11	Static hand gloves

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

0714-E&A-64. Calibrate Electrical Equipment

Overview:

After this Competency Standard, the Trainee will be able to Calibrate digital ammeter, calibrate analog ammeter, calibrate capacitor, Calibrate inducator, calibrate voltmeter, Calibrate Multimeter, calibrate 2- standard resistor r by direct method and Calibrate 4 terminal standard resistor by indirect method develop skill and competence required to Calibrate ammeter equipment's The Trainee will be able to calibrate electrical measuring/sources equipment's.

Competency Units	Performance Criteria
CU1. Calibrate digital ammeter	**P1.** Placed test ammeter in the suitable place in respective laboratory. **P2.** Examined / checked through incoming Unit under Test carefully. **P3.** Recorded UUT in respective register. **P4.** Undetected digital ammeter is checked physically for any damage or abnormality. **P5.** Check digital ammeter power on / OFF system and necessary display. **P6.** Select re proper reference standard / source against which it is to be calibrated **P7.** Proper stabilization circuit before putting may be provided to it accordingly. **P8.** Review the entire procedure before starting a calibration process. **P9.** Verify that the UUT line current selector switches are set to the correct setting. **P10.** Connect the UUT to the line current and then, turn on the power switch. **P11.** Enter the particulars of UUT in the work and record the environmental conditions of the lab. I.e. temperature, relative humidity, pressure etc. Make sure through appropriate monitoring that environmental conditions are within the calibration of UUT. **P12.** Calibrator appropriate to the requirement of UUT Connect the UUT in circuit according to the requirement of method selected or to the instructions given in its manual. **P13.** Connect the current terminals **P14.** Select desired ranges on the UUT and apply appropriate magnitude of current and test frequency coupled with current according to the range (s) selected for calibration from the calibrator or the reference source. **P15.** Keep on increasing the applied magnitude of current from the source and note the corresponding readings given by the UUT.

	P16. Repeat every observation five times for each value of parameters
CU2. Calibrate analog ammeter	**P1.** Placed test analog ammeter in the suitable place in respective laboratory. **P2.** Examined / checked through incoming UUT carefully. **P3.** Recorded UUT in respective register. **P4.** Under test digital ammeter is checked physically for any damage or abnormality. **P5.** Check physically analog Ammeter of its electrodynamics system, needle position performance **P6.** Select re proper reference standard / source against which it is to be calibrated **P7.** Proper stabilization circuit before putting may be provided to it accordingly. **P8.** Review the entire procedure before starting a calibration process. **P9.** Verify that the UUT line current selector switches are set to the correct setting. **P10.** Connect the UUT to the line current and then, turn on the power switch. **P11.** Enter the particulars of UUT in the work and record the environmental conditions of the lab. I.e. temperature, relative humidity, pressure etc. Make sure through appropriate monitoring that environmental conditions are within the calibration of UUT. **P12.** Calibrator appropriate to the requirement of UUT Connect the UUT in circuit according to the requirement of method selected or to the instructions given in its manual. **P13.** Connect the current terminals **P14.** Select desired ranges on the UUT and apply appropriate magnitude of current and test frequency coupled with current according to the range (s) selected for calibration from the calibrator or the reference source. **P15.** Keep on increasing the applied magnitude of current from the source and note the corresponding readings given by the UUT. **P16.** Repeat every observation five times for each value of parameters
CU3. Calibrate capacitor	**P1.** Ensure that the capacitance meter is connected to the 9100 according to diagram and both instruments are powered on and warmed up. **P2.** Turn capacitance meter in Capacitance mode and then select the Capacitance function on 9100. **P3.** Set the capacitance meter to the appropriate measurement range. **P4.** For fix capacitor measurement directly connect the capacitance meter / LCR meter to the standard capacitor and note its reading according to diagram.

	P5. Record the observed data as per format given in the associated document. **P6.** Repeat the observation three times at least for value of each inductor selected. **P1.** Compute the standard deviation and evaluate the uncertainty of measurement according to the procedure given in NPSL **P2.** Report the results of test / calibration.
CU4. Calibrate inducator	**P1.** Ensure that the Inductance meter is connected to the Fix Standard Inductor. **P2.** Ensure that the Inductance meter is powered on and warmed up **P3.** Set the Inductance Meter to the appropriate measurement range. **P4.** Connect the LCR meter to the standard Inductors and note its reading according to diagram. **P5.** Record the observed data and create report. **P6.** Repeat the observation three times at least for value of each inductor selected. **P7.** Compute the standard deviation and evaluate the uncertainty of measurement according to the procedure given in NPSL. **P8.** Report the results of test / calibration according to the format given in the NPSL. **P9.** Ensure that the Inductance meter powered on and warmed up. **P10.** Set the Inductance meter to the appropriate measurement range. **P11.** For standard Inductors measurement directly connect the Inductance meter / LCR meter to the standard Inductors and note its reading.
CU5. Calibrate voltmeter	**P1.** Enter the particulars of UUT in the work / data sheet and record the environmental conditions of the lab. I.e. temperature, relative humidity, pressure etc. Make sure through appropriate monitoring that environmental conditions are within the range required. **P2.** Select calibration method and reference source appropriate to the requirement of UUT. **P3.** Connect circuit according to the requirement of method selected or given in its manual. **P4.** Select desired ranges given in the table on the UUT and apply corresponding magnitude of voltage and test frequency coupled with voltage according to the range (s) selected for calibration from the calibrator or the reference source. Note the readings observed on the UUT. **P5.** Keep on increasing the applied magnitude of voltage from the source and note the corresponding readings given by the UUT. **P6.** Repeat every observation five times for each value of parameters. **P7.** Record the observed data and Compute the standard deviation and

	evaluate the uncertainty of measurement. **P8.** Report the results of test
CU6. Calibrate Multimeter	**P1.** Under test Multimeter, received through CSS is placed on the suitable place in respective laboratory. **P2.** Checked UUT carefully. **P3.** The under test instrument may be checked physically for any damage or abnormality if any. If it is digital multi-meter, please check its power on / OFF system and necessary display. And if it is analog multi-meter go through for Physical checking of its electrodynamics system, needle position performance etc. **P4.** Select relevant / proper reference standard / source against which it is to be calibrated **P5.** Before putting the UUT in Test acclimatization time may be provided to it accordingly. **P6.** Review the entire procedure before starting a calibration process. **P7.** Verify that the UUT line voltage selector switches are set to the correct setting. **P8.** Connect the UUT to the line voltage and then, turn on the power switch. **P9.** Zero offset calibration (Following the under test calibration manual) **P10.** Apply a 4-wire short (copper) across Input HI-LO and Sense HI-LO terminals. **P11.** Select each function and range according to the order **P12.** DC V, Resistance and DCI calibration. **P13.** Select different function and range. Compare measurement result to an accuracy of UUT. Be certain to allow for an appropriate Calibrator setting
CU7. Calibrate 2- standard resistor r by direct method	**P1.** Place the under test resistor, at a suitable place in the laboratory. **P2.** Record the description of the UUT in the relevant record register. **P3.** Check the under test instrument (UUT) physically for any damage or abnormality if any. Select appropriate reference resistance standard against which the UUT is to be calibrated. **P4.** Give proper warm up stabilization time to the UUT before putting into the calibration setup. **P5.** Enter the particulars of UUT in the work and record the environmental conditions of the lab. I.e. temperature, relative humidity, pressure etc. Make sure through appropriate monitoring that environmental conditions are within the range required calibration of UUT.

		P6. Connect the UUT in circuit according to the requirement of method selected. **P7.** Be sure that measuring leads are tightly connected to the terminals of the UUT.
CU8.	**Calibrate 4 terminal standard resistor by indirect method**	**P1.** Place the under test resistor, at a suitable place in the laboratory. **P2.** Record the description of the UUT in the relevant record register. **P3.** Check the under test instrument (UUT) physically for any damage or abnormality if any. Select appropriate reference resistance standard against which the UUT is to be calibrated. **P4.** Give proper warm up stabilization time to the UUT before putting into the calibration setup. **P5.** Select rated current be applied to UUT and note the corresponding value of voltage drop at the voltage terminals. **P6.** Put the applied values of current and measured value of voltage drop in Ohm's Law i.e. (V = I x R) and calculate the corresponding resistance. **P7.** Repeat every observation five times for each value of resistor selected. **P8.** Record the observed data. **P9.** Compute the standard deviation and evaluate the uncertainty of measurement **P10.** Report the results of test.

Knowledge & Understanding

- Define digital ammeter function and working
- Explain UUT function and working.
- Define reference standard of UUT
- Define knowledge of circuit calibration
- Define calibration of digital ammeter
- Explain resolution of ammeter
- Define uncertainty of digital ammeter
- Explain calculation method of error off error and uncertainty budget
- Explain precision and accuracy of ammeter.
- Define analog ammeter function and working
- Explain UUT function and working.
- Define reference standard of UUT
- Define knowledge of circuit calibration
- Define calibration of digital ammeter
- Explain resolution of ammeter
- Define uncertainty of digital ammeter
- Explain calculation method of error and uncertainty budget

- Explain precision and accuracy of ammeter.
- Explain factor of coverage factor values changing.
- Define 9100 wavelets and working.
- Define knowledge of LCR meter
- Define uncertainty.
- Explain UUT function and working.
- Define reference standard of UUT
- Define knowledge of circuit calibration
- Define calibration of capacitor
- Explain resolution of capacitor.
- Define uncertainty of digital capacitor
- Explain calculation method of error and uncertainty budget
- Explain precision and accuracy of capacitor.
- Explain factor of coverage factor values changing
- Define fix standard inductor.
- Define basic knowledge of appropriate measurement range.
- Explain UUT function and working.
- Define reference standard of UUT
- Define knowledge of circuit calibration
- Define calibration of indicator
- Explain resolution of indicator
- Define uncertainty of indicator
- Explain calculation method of error and uncertainty budget
- Explain precision and accuracy.
- Explain factor of coverage factor values changing
- Define UUT and data sheet
- Define basic knowledge of voltmeter.
- Explain UUT function and working.
- Define reference standard of UUT
- Define knowledge of circuit calibration
- Define calibration of voltmeter
- Explain resolution of voltmeter
- Define uncertainty of digital voltmeter
- Explain calculation method of error and uncertainty budget
- Explain precision and accuracy of voltmeter.
- Explain factor of coverage factor values changing.
- Define css rules
- Define UUT function

- Define 4-wire ohm
- Define ac voltage and dc current.
- Define reference standard of UUT
- Define knowledge of circuit calibration
- Define calibration of Multimeter
- Explain resolution of Multimeter.
- Define uncertainty of Multimeter
- Explain calculation method of error and uncertainty budget
- Explain precision and accuracy of Multimeter.
- Explain factor of coverage factor values changing
- Define UUT and data sheet.
- Define basic knowledge of 4-standardresistor.
- Explain UUT function and working.
- Define reference standard of UUT
- Define knowledge of circuit calibration
- Explain resolution of circuit.
- Define uncertainty of 2-standard resistor
- Explain calculation method of error and uncertainty budget
- explain precision and accuracy of
- Circuit.
- Explain factor of coverage factor values changing
- Define UUT and data sheet.
- Define basic knowledge of4 standard resistor.
- Explain UUT function and working.
- Define reference standard of UUT
- Define knowledge of circuit calibration
- Explain resolution of circuit.
- Define uncertainty of 2-standard resistor
- Explain calculation method of error and uncertainty budget
- Explain precision and accuracy of circuit.
- Explain factor of coverage factor values changing

Tool and Equipment

SN	Tools
1	Digital ammeter
2	UUT scale
3	Datasheet

4	Wires
5	9100wavelete,
6	capacitor meter
7	4wire ohm meter
8	Calibrator

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

:

- Types of hazards that are most likely to cause harm to health and safety
- Health and safety precautions
- Health and safety signs and symbols
- Techniques and methods to identify the risks of hazards at workplace
- Dealing with hazards to avoid any accident or injury
- Safety reporting procedures and documentation
- Describe fire-fighting methods
- Demonstrate use of appropriate Personal Protective Equipment (PPE) for the assigned job

Demonstrate removal and disposal of PPE

0714-E&A-65. Operate Oscilloscope

Overview:

This competency standard covers the skills and knowledge required to Measure AC voltage, current, frequency, time period with oscilloscope, RMS value and average value of AC signal with oscilloscope

Competency Units	Performance Criteria
CU1. Measure AC voltage with oscilloscope	**P1.** Select a proper volt/division and give AC voltage to oscilloscope. **P2.** Read number of divisions between the +ve and -ve peaks of the signal. **P3.** Apply the formula to calculate the actual amplitude of AC voltage.
CU2. Measure current with oscilloscope	**P1.** Select the proper load to measure the current. **P2.** Connect the low value of resistance in series with the load. **P3.** Connect the oscilloscope across low value of resistor and measure the voltage. **P4.** Apply ohms law by using value of low value of resistor and voltage across it and find out current.
CU3. Measure frequency of AC signal with oscilloscope	**P1.** Select a proper time/division and give AC voltage to oscilloscope. **P2.** Calculate number of divisions between the one AC cycles of the AC signal. **P3.** Apply the formula to calculate the actual frequency of AC voltage.
CU4. Measure time period of AC signal with oscilloscope	**P1.** Select a proper time/division and give AC voltage to oscilloscope. **P2.** Calculate number of divisions between the one AC cycles of the signal. **P3.** Apply the formula to calculate the actual frequency of AC voltage
CU5. Measure RMS value of AC signal with oscilloscope	**P1.** Select a proper volt/division and give AC voltage to oscilloscope. **P2.** Read number of divisions between the +ve and -ve peaks of the signal. **P3.** Apply the formula to calculate V_{p-p} of AC voltage. **P4.** Calculate peak value form V_{p-p}

	P5.	Calculate rams value form peak voltage of AC
CU6. Measure average value of AC signal with oscilloscope	**P1.**	Select a proper volt/division and give AC voltage to oscilloscope.
	P2.	Read number of divisions between the +ve and -ve peaks of the signal.
	P3.	Apply the formula to calculate V_{p-p} of AC voltage.
	P4.	Calculate peak value form V_{p-p}
	P5.	Calculate average value form peak voltage of AC.

Knowledge & Understanding

- What are different controls of an oscilloscope?
- Describe volt/division control.
- Describe time/division control
- What is trigger?
- What is channel?
- Define frequency.
- Define time period
- Define RMS value of ac signal.
- Define average value of ac signal.

Tool and Equipment

SN	Tools
1	Cathode-ray oscilloscope
2	Multimeter
3	Oscillator/signal generator

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Measure average value of AC signal with oscilloscope

0714-E&A-66. Perform Measurement and Calibration of Instruments

Overview: This standard will provide the basic knowledge and skills about the use of basic instruments and how to calibrate the instruments used in telecom sector. Also, the student will know how to calculate uncertainties according to ISO 17025 while doing measurement.

Competency Units	Performance Criteria
1. **Measurement of unknown resistance with Wheatstone Bridge**	**-** **P1**. Make Wheatstone bridge **P2**. Insert galvanometer between the terminals of the bridge **P3**. Switch the power. **P4**. Adjust the value of variable resistor so that Galvanometer shows 0 value. **P5**. Note down the value of resister
D2. **Measure the current with Ammeters**	**-** **P1.** Check the Instrument physically for any damage or abnormality. **P2.** Switch on the instrument and give proper time to stabilize the instrument. **P3.** Connect the two terminals of the voltage source to either side of the 1 k Ohm resistor. **P4.** Connect the two terminals of the ammeter across the resistor, or in parallel. This will allow the current flowing the resistor to be determined. **P5.** Switch on the voltage supply, and set it to 1 V. **P6.** Note the value of current on Ammeter. **P7.** Cross check the accuracy of calculated current by Ammeter using Ohm's law (I=V/R).
D3. **Calibrate Voltmeters**	**-** **P1**. Check the voltmeter physically for any abnormality. Check the power on / Off and necessary display in case of DVM Check physically electro dynamic or needle movement, in case of AVM. **P4.** Select relevant appropriate reference voltage standard / source against which the voltmeter is to be calibrated. **P5.** Connect the voltage meter in the test / calibration set up / circuit according to the requirement of method selected or to the instructions given in its manual. **P6**. Synchronize ranges of voltage coupler and calibrator. **P7**. Note the readings observed on the voltmeter. **P8**. Keep on increasing the applied magnitude of current from the source and note the corresponding readings given by the voltmeter. **P9**. Repeat every observation at least three times for each value of parameter selected. **P10**. Find standard deviation and uncertainty. **P11**. Prepare calibration report.
D4. **Test Ethernet cable**	**-** P1. Turn on Ethernet tester. P2. Put the ends of Ethernet cable RJ45terminated cable into the tester's two ports.

	P3. Push the button and note two separate bars of indicators, each with 8 lights. P4. Observe whether lights are bright, dim or no light to indicate good, bad or no connection respectively.
D5. **Calibrate Frequency Generator**	**-** **P1**. Maintain the room Temperature (23±2) °C & (50±15) % R.H. **P2**. Check the Instrument physically for any damage or abnormality **P3**. Switch on the instrument and give Proper time to stabilize the instrument. **P4**. Check the Time Base of Instrument under calibration on the standard reference Signal analysers. **P5**. Take different signals from low to high frequency with suitable gap and proper amplitude from the reference frequency Generator (EUC) on the standard reference frequency Counter/Analyser. **P6**. Take at least five readings of same frequency giving suitable interval between the readings. **P7**. Take average of above five values and compare it with the specific value. **P8**. Find standard deviation and uncertainty. **P9**. Prepare calibration report. **P10**. Observe the average value within tolerance limit (provided by the manufacturer) and specification of international standard.
D6. **Calibrate Frequency Counters**	**P1.** Maintain the room Temperature (23±2) °C & (50±15) % R.H. **P2.** Check the Instrument physically for any damage or abnormality. **P3.** Switch on the instrument and give proper time to stabilize the instrument. **P4.** After warming up the oven of reference oscillator of EUC for the specified time, depress the Power. Switch to turn the Power ON. (Switch On reference oscillator). **P5.** Switch ON the reference generator, counter and other allied equipment's for the warm-up for the specified time (normally 1-hour). **P6.** Check the Time Base of EUC on the reference standard counter, taking at least five readings giving suitable interval between the readings. **P7.** Apply different signals from low to high frequency with proper gap and amplitude levels from the reference Frequency Generator to the EUC. **P8.** Note the observed values as measured by the measuring equipment / set up in the system. **P9.** Repeat the observations at least five times for the signal selected resetting the EUC each time. **P10.** Take average of above five values and compare it with the specific value.
D7. **Operate OTDR**	**P1**. Inspect OTDR instrument **P2**. Set test range, OTDR test pulse width, wavelength for fiber cable testing. **P3.** Attach fibre cable to test loss and fault length P4. Acquire traces

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- Working Principle of Wheatstone bridge
- Working principle of Ammeter.
- Working principle of digital Multimeter
- Calculation standard deviation, Average, Uncertainty A, Uncertainty
- Calibration of Ammeter, Voltmeter, Multimeter
- Working principle of frequency generator and counter
- . the networking cable, RJ 45 connector and working of cable tester.
- Working principles of Optical Fiber system
- Use of OTDR

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Finding of current, voltages, resistance by using voltage meter, ammeter etc.
- Calibration of GSM, CDMA and WiMAX band frequency.
- Measuring and Calibration of oscilloscope, Function Generator, Frequency counter at 1000 MHz, 1 GHz and 10 GHz etc.
- Finding signal loss/ attenuation of optical while using OTDR.

Tools and Equipment	
• Wheatstone bridge • Digital Multimeter • Resistance of different values • Tool kit • Ammeters, • precision digital Multimeter, • Wave tech • Reference Voltage Source, • Voltage Calibrator, • Heating and cooling controlled system	• RJ45 Cable, • Ethernet tester, • frequency counter, • Audio Signal generator, • Thermohydrometer, • Universal Counter, • Electronic Counter, • Radio Frequency Generator, • Portable OTDR,

0714-E&A-67. Install OLT and ONU

Overview:
This competency standard will provide skill and knowledge required to install and perform testing of OLT (Optical Line Transmission). You will be able to configure OLT and ONU

Competency Units	Performance Criteria
1. Check Room DesignRequirements for OLT	P1. Ensure that equipment install in the normal temperature environment as per vendor specifications. P2. Check Cable and optical cable wiring (including fiber splicing work) as per design and plan. P3. Check dust particles density with more than 5μm in diameter≤3.0*104/m3. P4. Place equipment in the dry, cool place, at least have 10 centimetres at both sides for the ventilation space P5. Ensure that OLT have the necessary mounting screws and nuts and necessary tools if install inside the rack.
2. Open Package to Inspect Hardware	P1. Check packing list or supply contract, and verify the goods, if any component is loss, wrong or damaged, please contact with your customer manager
3. Access Power & Earth requirement for system	P1. Ensure input voltage must be stable, no EMI noise and distortion P2. use DC power supply, the input voltage is -48VDC, the allowed range is -36 ~ -72 VDC P3. use AC power supply, the input voltage is 110/220VAC, the allowed range is 90 ~264VAC P4. Follow all security specification and the rule about the electricity in the locality or the building. All power supply must be legal P5. Connect grounding body of machine to the grounding resistance value is less than 1Ω.
4. Install OLT	P1. Ensure the worktable is strong enough to support the weight of the device and cables. P2. Ensure no obstacles on the worktable and the surroundings affecting the installation of the device exist. P3. Prepare the OLT device to be installed and move the device to the place where near the worktable and facilitates the handling. P4. Lift the OLT device and slowly move to the front of the worktable. P5. Move the OLT device to the location slightly higher than the worktable and then place the OLT device to the specified location on the worktable. P6. Install OLT equipment inside 19'' rack which is compliance with ETSI standard
5. Connect Ports and power connections	P1. Connect Uplink Port as per design P2. Connect PON Port as per specification P3. Install Ground Cable as per plan

	P4. Connect Management Port P5. Get the supplied AC power cords from the OLT's shipment kit. P6. Connect one end of each AC power cord into the AC power inlet connectors located at the rear of the OLT. P7. Connect the other ends of the power cords into AC wall outlets. P8. Connect each AC power cord to a different AC power source if you want AC line input power redundancy
6. Connect DC Input Power Cable	P1. Assemble the DC input power cable as per design. P2. Turn off power from the DC power source through the circuit breakers. P3. Get a DC input plug from the ship kit. 4 P4. Locate the four wires coming from the DC power source that will be used in the connection to your unit: -48V (negative terminal) (two wires) -48V Return (positive terminal) (two wires) P5. Strip 5/16 inches (8 mm) of insulation from each of the wires coming from the DC power source. P6. Feed the exposed section of the appropriate wire into the rectangular plug hole in the DC input plug. P7. Connect the DC input power cables to the DC connectors
7. Check power supply	P1. Double check the power supply it is accord with the power supply requirements, P2. Check each module and card are installed correctly P3. Check the equipment is in reliable grounding. P4. Turn on the power supply sources.
8. Check OLT working status	**-** P1. Check the power LED. The power LED will be on. P2. The SYS LED will flash per second If the uplink equipment is connected to the uplink port, the relevant connection LED is on P3. Connect a PC with an ONU UNI port and check if the network is running well by means of ping LAN (in the same IP address) or by PING package tools P4. Use the RJ45/DB9 Serial Port cable (in package) to link management PC with 8 PON OLT CONSOLE port. Management computer can access to OLT equipment from Super terminal interface of the PC for configuration P5. Use PC which has installed EMS network management software to connect in band or out band port of 8 PON OLT

Knowledge & Understanding
This competency standard will provide knowledge related to:

- Environment temperature required for hardware as per specifications
- Room layout and design
- BOQ of plan
- Knowledge of AC and DC power sources

- Power connection standards
- Installation plan reading skill
- Connection skills
- Hardware interfaces know how.
- Configuration manual of hardware
- Knowledge of DC voltage and rectifier
- Configuration of hardware
- Knowledge of DC voltage and rectifier
- Configuration of deceive

Critical Evidence(s) Required
The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Verify hardware requirement as per plan.
- Check power and grounding of system as per specifications
- Install OLT as per plan.
- Check out OLT’s working status using standard tests.

0714-E&A-68. Deploy Cloud Infrastructure

Overview:
This competency standard will provide skills and knowledge related to Cloud Infrastructure. You will be able to install the Virtual machines in cloud base infrastructure. You can demonstrate your skills about bare-metal service, Server cabling, Hypervisors and virtual machines

Competency Units	Performance Criteria
1. **Mount Bare-Metal Server**	P1. Mount the server into rack P2. Connect the Server/Machine to LCD P3. Check the server/machine specification for compatibility issues
2. **Lay Server Cables**	P1. Connect Server to power Cable P2. Power up the Server P3. Connect the server to Intranet via Ethernet/Fiber cable
3. **Install Hypervisor**	P1. Check the server/machine specification for compatibility P2. Enable the virtualization from BIOS P3. Install the Hypervisor (Xen Citrix, VMware, KVM, Open Stack) P4. Configure the IP Address in Server P5. Connect server to admin machine for virtual machines configuration

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes:

- Server/machines
- OS
- Bootable USB
- Server/machines
- Ethernet & Fiber cables
- SFP
- Single mode and multimode
- BIOS
- Virtualization Software
- Linux/ Ubuntu/ RedHat
- Admin portal Hypervisor
- Virtual machines and OS

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Mount the server into rack & also power up the server

- Install the Hypervisor in Bare-metal
- Create the Virtual machine as per Software required

Tools and Equipment
• Server • LCD • Keyboard • Mouse • Power Cable • Internet cable • Fiber • SFP • Virtualization Software • Laptop • USB

0714-E&A-69. Install CCTV

Overview:

This competency standard will provide skills and knowledge related to CCTV. You will be able to install the CCTV. You can demonstrate your skills about CCTV

Competency Units	Performance Criteria
1 **Install up a Camera**	- P1. Select the location of camera P2. Lay the camera cables P3. Install the camera P4. Connect the camera through cables
2. **Set up a Monitor**	- P1. Established the control room P2. Set the monitor P3. Connect cameras to monitor via switch, multiplexer and switches
3. **Set up Switches**	- P1. Place the switches in control room P2. Connect all camera to recording device via switches P3. Configure the switch
4. **Set up Multiplexers**	- P1. Connect all cameras to Recoding Device via multiplexer P2. Connect multiplexer to recording device via switch.
5. **Set up Recording Devices**	- P1. Connect Recoding device to LCD for monitoring P2. Connect multiplexer to recording device
6. **Test the CCTV System**	- P1. Connect Recoding device to LCD for monitoring P2. Check the video quality of camera

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes:

- Multiplexer
- Cables
- Switches
- Cameras
- Cables installation
- Safety location of cameras
- Control room
- Switches
- CCTV systems
- Video quality
- Recording devices

- Hard drive

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Connect the cables to camera
- Connect cameras to switch
- connect switches to multiplexer

Tools and Equipment
• Camera • Connectors • Cables • Monitors • Multiplexer • LCD • Recording Device

0714-E&A-70. Install mount of RF antenna and RRU (Remote Radio Unit) on tower

Overview:

This competency standard will provide skills and Construction Practices and Installation of field equipment, Mounting and Installation of antennas and RRU (Remote Radio Unit).

Competency Units	Performance Criteria
C1. Mount Antennas on a Telecom Tower.	**-** **P11.** Ensure all line items required for installation are available on the site. **P12.** Check the installation plan **P13.** Fix the installation bracket to the back of the antenna with the nuts, spring washers, and flat washers. **P14.** Fix the elevation adjustable bracket to the installation bracket. **P15.** Fix the antenna support to the pole. **P16.** Mount the antenna on tower using fixed-pulley mechanism and rope. **P17.** Fix the antenna to antenna support on the tower. **P18.** Apply thread bolts through the antenna support and elevation adjustable bracket. **P19.** Put on flat washers, spring washers, and nuts to fix the bolts. **P20.** Adjust the antenna angle and tighten all of the four nuts.
C2. Mount Remote Radio Unit (RRU) on pole	**P6.** Determine a position for installing the mounting bracket as per Installation Plan. **P7.** Mount bracket hoisted onto the tower. **P8.** Adjust the position of the nut and remove one end of the square-neck bolt from the slot on the auxiliary bracket. **P9.** slide the mounting brackets onto the pole horizontally and insert the square-neck bolt into the slot **P10.** Install the RRU onto the main bracket
C3. Lay and install Cabling of RRU	**-** **P7.** Route the cable according to the specified cabling requirements to prevent signalinterference. **P8.** Route Cables neatly along the specified cabling direction and secured with cable clips. **P9.** Make power cable connector. **P10.** Install Power cables must be in the position specified in engineering design documents. **P11.** Connect PGND cables for the base station to the same ground bar. **P12.** Check E1 cables are straight and bound neatly with cable ties.
C4. **Install RF Jumper from RRU to Antenna**	**-** **P5.** Connect the male connector at one end of the RRU RF jumper to the ANT port on the RRU and use a torque wrench to tighten the connector. **P6.** Connect the other end of the RF jumper to the external antenna system.

	P7. Waterproof the connectors of the RF jumper. **P8.** Verify that dustproof caps are not removed.

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- Types of RF antenna
- RF Antenna bands
- RRU bands
- Basic knowledge of optical fibre cable

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Mount and Install RF Antenna as per given installation plan.
- Install RRU alongside the installed RF Antenna and connect RF Fiber Cable.
- Install Power Cable and PGND from RRU to Rectifier Unit.

0714-E&A-71. Install GPS antenna and Rack

Overview:

This competency standard will provide skills and Construction Practices and Installation of field equipment installation of GPS antenna and Rack.

Competency Units	Performance Criteria
C1. Install GPS Antenna.	**-** **P1.** Install the GPS antenna on the GPS antenna and use four screws to secure it **P2.** Install the mounting bracket according to the direction. **P3.** Lead the hose clamps through the holes in the multi-functional accessory. **P4.** Wear the hose clamps around the pole body and tighten the hose clamps. **P5.** Remove the rubber plug and connect the GPS feeder. **P6.** Connect the other end of the feeder to the GPS antenna and secure the joint. **P7.** Install surge arrester to protect interface lightning.
C2. Install Rack	**-** **P1.** Mark points for drilling as per given plan. **P2.** Drill holes onto the marked points. **P3.** Fix Ravel Bolts into the holes. **P4.** Place Rack onto the bolts. **P5.** Tighten Nuts on the bolts

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- Reading layout plan
- Drilling
- Use of compass
- Hose clamp
- Earthing

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Install GPS Antenna as per given installation plan.
- Install Rack as per given layout plan

0714-E&A-72. Perform 2G Drive/Walk Test

Overview:
In this competency standard the student will provide knowledge pertinent to 2G network and related software used to monitor and record performance data and perform 2G Drive and Walk test.

Competency Units	Performance Criteria
1. Plotting site data for Navigation	P1. Map site coordinates in Navigation software P2. Plot site sectors according to data sheet provided. P3. Ensure sector's azimuth as per plan. P4. Move to site location
2. Verify Site Data	P1. Verify physical sector azimuth with site data provided. P2. Connect cell phone with data collection software to Confirm sector identities are serving as per plan. P3. Confirm Electrical and Mechanical tilts are perfectly matched with plan. P4. Escalate if there is any discrepancy found in previous steps. P5. Make changes if required.
3. Perform 2G Drive test	P1. Make sure cell phones are connected with data collection software. P2. Confirm cell ID is serving corresponding to your current location. P3. Initiate call from cell phone. P4. Run call setup script for short calls. P5. Start drive test. P6. Stop drive test when successfully handover to neighbouring site
4. Perform 2G Walk test	P1. Load building plan into data collection software. P2. Connect cell phone. P3. Initiate call setup. P4. Confirm sector coverage map. P5. Escalate if any discrepancy found. P6. Start log recording and proceed for walk test. P7. Stop recording when you finished walk test. P8. Make report and submit to concern
R5. Perform 2G Performance Test	P1. Connect cell phone with monitoring software. P2. Move to near point as per define. P3. Start log recording and execute short call setup and take screenshot of CSSR stop log recording. P4. Perform handovers intra/inter. P5. Perform throughput test. P6. Perform cell reselection test. P7. Perform P3-P6 test on mid and far points as defined. P8. Make performance test report.

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes:

- Basic Knowledge of 2G networks, coordinate system, GPS and mapping software (MapInfo).
- Knowledge of cellular network Sectors, concept of Electrical and mechanical tilts and sector identities.

- Drive test techniques and Handovers inter/intra.
- Walk test techniques, AutoCAD software and sector coverage Map.
- Functions of 2G & 2.5G Technologies, MS office.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Plot site ID and sector information in MapInfo software.
- Create Tab file to show location of Site and sector information in data collection software.
- Create script of 10 calls for duration of 10 seconds each.
- Execute previously created script.
- Perform 2G Drive/Walk test on provided site.
- Make Drive/Walk test report

Tools and Equipment
• Laptop/Tab • Compass • Data collection software, • MapInfo Data collection software supported cell phones. • MS office.

0714-E&A-73. Install Connector on Optical Fiber Cable

Overview: This competency standard will provide skills and the fundamentals of Optical Fiber cable. You will be able to install the optical fiber connector with optical fiber cables.

C1. **Install Optical Fiber Connectors for Direct Termination where Required**	P11. Select Connector to match terminating frame to suit design specifications P12. Expose Cable end and remove sheath. P13. Use Optical fiber in accordance with connector type. P14. Remove Coatings from exposed optical fiber to eliminate all possible contaminants P15. Fit Connector and crimped without causing damage to fiber or thread P16. Hold Fiber firm within connector using adhesive P17. Direct termination for signal strength to manufacturers design and requirements. P18. Utilize Strain relief boots/sleeve to protect connector and fiber cord cable. P19. Utilize Protection boots/sleeve are to protect connector and fiber from exposure to contaminants P20. Ensure Connection end polished to a smooth flat surface for no optical path redirection after connection is made

Knowledge & Understanding

The candidate must be able to demonstrate below given knowledge and understanding required carrying out the tasks covered in this competency standard:

1. Optical Fiber cable
2. Types of Optical fiber connectors
3. Usage of Crimping Tool

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

1. Install Optical Fiber Connectors according to given specification of optical fiber cable

0714-E&A-74. Handle Customer's Call

Overview: This competency standard will provide skills and the fundamentals of Communication and management skills. You will be able to handle calls and write report on problems.

C1. **Handle a Customer's Call**	**-** **P1.** Maintain call handling time while handling calls for inbound and outbound **P2.** categorize customer's interaction as a query, request or a complaint **P3.** Verify customer's details for any account related information **P4.** Obtain sufficient information from the customers to login their query, request or complaint **P5.** Address customer's query, request or complaint on the basis of categorization **P6.** Provide estimate of resolution time to the customer, if an immediate solution cannot be found on-call **P7.** Record the customer's interaction as a query, request or a complaint **P8.** Refer problem to a supervisor/floor support/manager, if unable to resolve on call **P9.** Resolve at least 80% of first level complaints at front end, without any further escalations

Knowledge & Understanding

The candidate must be able to demonstrate below given knowledge and understanding required carrying out the tasks covered in this competency standard:

1. Communication skills
2. Management skills
3. Report writing

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

1. Handle a customer call and report the problems to supervisor

0714-E&A-75. Manage Store

Overview: This competency standard will provide skills related to store management and organisation of store items.

7. Manage Store	**-** **P1.** Adhere to specified uniform/dress code and grooming guidelines **P2.** Wear name badges as per organizational guidelines **P3.** Organize inventory, stationery, pantry stock and display products at the store/showroom/outlet **P4.** Maintain basic hygiene and infrastructure upkeep in the store **P5.** Attend daily morning briefing before store opening **P6.** Review previous day's performance during morning meeting **P7.** Obtain product/process changes, new schemes/offers and target & task distribution from store manager **P8.** Maintain transparency with customer in sharing resolution timelines

Knowledge & Understanding
This competency standard will provide knowledge related to:

- Differentiate between accessories.
- Basic working of a computer
- Process of store management, organizing inventory, stationery, pantry stock and product displayed

Critical Evidence(s) Required
The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Receive extra martial in store
- Organise Inventory
- Maintain stock register.

0714-E&A-76. Perform 3G Drive/Walk Test

Overview:
In this competency standard the student will provide knowledge pertinent to 3G network and related software used to monitor and record performance data and perform 3G Drive and Walk test

Competency Units	Performance Criteria
1. Plotting Site Data for Navigation	P1. Map site coordinates in Navigation software P2. Design site sectors according to data sheet provided. P3. Ensure sector's azimuth as per plan. P4. Move to site location
2. Verify site data	P1. Verify physical sector azimuth with site data provided. P2. Connect cell phone with data collection software to Confirm sector identities are serving as per plan. P3. Confirm Electrical and Mechanical tilts are perfectly matched with plan. P4. Escalate if there is any discrepancy found in previous steps. Make changes if required
3. Perform 3G Drive Test	P1. Make sure cell phones relate to data collection software. P2. Confirm scrambling code is serving corresponding to your current location. P3. Lock Cell phone to 3G band. P4. Initiate call from cell phone. P5. Run call setup script for short calls. P6. Initiate Download and Upload script. P7. Start drive test. P8. Stop drive test when successfully handover to neighbouring site
4. Perform 3G Walk test	P1. Load building plan into data collection software. P2. Connect cell phone. P3. Lock phone to 3G band. P4. Initiate call setup. P5. Initiate download / upload script. P6. Confirm sector coverage map. P7. Escalate if any discrepancy found. P8. Proceed for walk test
5. Perform 3G Performance test	P1. Connect cell phone with monitoring software. P2. Move to near point as per define. P3. Start log recording and execute short call setup and take screenshot of CSSR. P4. Perform handovers intra/inter. P5. Perform throughput test (HSPA + HSDPA). P6. Perform cell reselection. P7. Perform IRAT test. P8. Make performance test report.

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding

required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- Basic Knowledge of 2G/3G/LTE networks,
- Coordinate system, GPS and mapping software (MapInfo).
- Knowledge of cellular network Sectors, concept of Electrical and mechanical tilts and sector identities.
- 3G Technology, scrambling codes and band locking techniques.
- Walk test techniques, AutoCAD software and sector coverage Map.
- 3G performance criteria

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Plot site ID and sector information in MapInfo software.
- Create Tab file to show location of Site and sector information in data collection software.
- Create script of 10 calls for duration of 10 seconds each.
- Execute previously created script.
- Perform throughput test on mentioned site.
- Perform 3G Drive/Walk test on provided site.
- Make Drive/Walk test report.

Tools and Equipment
• Laptop/Tab, • Compass • Data collection software, • Data collection software supported cell phones. • Laptop/Tab supported cell phone and monitoring software.

0714-E&A-77. Perform 4G/LTE Drive/Walk test

Overview:

In this competency standard the student will learn about 4G/LTE network and related software used to monitor and record performance data and perform 4G/LTE Drive and Walk test

Competency Units	Performance Criteria
1. Plotting Site Data for Navigation	P1. Map site coordinates in Navigation software P2. Design site sectors according to data sheet provided. P3. Ensure sector's azimuth as per plan. P4. Move to site location
2. Verify Site Data	P1. Verify physical sector azimuth with site data provided. P2. Connect cell phone with data collection software to Confirm sector identities are serving as per plan. P3. Confirm Electrical and Mechanical tilts are perfectly matched with plan. P4. Escalate if there is any discrepancy found in previous steps. P5. Make changes if required.
3. Perform 4G (LTE) Drive Test	P1. Make sure cell phones are connected with data collection software. P2. Confirm PCI is serving corresponding to your current location. P3. Initiate upload command or script. P4. Initiate download command or script. P5. Start drive test. P6. Stop drive test when successfully handover to neighbouring site.
4. Perform 4G (LTE) Walk Test	P1. Load building plan into data collection software. P2. Connect cell phone. P3. Initiate Upload command or script. P4. Initiate download command or script. P5. Confirm sector coverage map. P6. Escalate if any discrepancy found. Proceed for walk test
5. Perform VOLTE Drive Test	P1. Make sure cell phones relate to data collection software. P2. Lock cell phone on LTE band. P3. Confirm PCI is serving corresponding to your current location. P4. Initiate Call setup. P5. Start drive test. P6. Stop drive test when successfully handover to neighbouring site.
6. Perform VOLTE Walk Test	P1. Load building plan into data collection software. P2. Connect cell phone. P3. Lock cell phone on LTE band. P4. Initiate call setup. P5. Confirm sector coverage map. P6. Escalate if any discrepancy found. P7. Proceed for walk test.

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes:

- Basic Knowledge of 2G/3G/LTE networks
- Coordinate system
- GIS software (MapInfo).
- Knowledge of cellular network Sectors
- Concept of Electrical and mechanical tilts
- Sector identities.
- Command line interface
- TCP and UDP protocols

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Plot site ID and sector information in MapInfo software.
- Create Tab file to show location of Site and sector information in data collection software.
- Create script of 20 calls for duration of 10 seconds each.
- Execute previously created script.
- Perform throughput test on mentioned site using FTP protocol.
- Perform 4G Drive/Walk test on provided site.
- Make Drive/Walk test report.

Tools and Equipment
• Laptop/Tab • Compass • T3. MapInfo • Data collection software • Supported cell phones...

0714-E&A-78. Perform Audit of 2G, 3G and LTE Site

Overview:
In this competency standard the student will learn and perform techniques related to cellular site audit for 2G, 3G and 4G(LTE) networks and make report as per customer requirement.

Competency Units	Performance Criteria
1. **Plotting site data for Navigation**	P1. Map site coordinates in Navigation software P2. Design site sectors according to data sheet provided. P3. Ensure sector's azimuth as per plan. P4. Move to site location
2. **Observe Health and Safety Requirement**	P1. Ensure compliance with site risk control, OHS, environmental and quality requirements as per company's norms P2. Ensure that work is carried out in accordance to the level of competence and legal requirements P3. Ensure that hazards associated with the workplace that have not been previously controlled, are reported in accordance with appropriate procedures P4. Ensure compliance with all organizational security arrangements (like using valid ID cards) and approved procedures P5. Use and maintain protective equipment according to work requirements P6. Ensure availability of first aid box at site P7. Ensure escalation of safety incidents to relevant authorities as per guidelines
3. **Perform 2G Site Audit**	P1. Identify 2G antennas. P2. List Azimuths for all sectors. P3. Climb the tower. P4. Take snapshot of antenna model Tag for all sectors. P5. Take snapshot of sector view. P6. Take snapshots of Electrical and Mechanical Tilts. P7. Make audit report
4. **Perform 3G Site Audit**	P1. Identify 3G antennas. P2. List Azimuths for all sectors. P3. Climb the tower. P4. Take snapshot of antenna model Tag for all sectors. P5. Take snapshot of sector view. P6. Take snapshots of Electrical and Mechanical Tilts. P7. Make audit report.
5. **Perform 4G Site Audit**	P1. Identify 4G antennas. P2. List Azimuths for all sectors. P3. Climb the tower. P4. Take snapshot of antenna model Tag for all sectors. P5. Take snapshot of sector view. P6. Take snapshots of Electrical and Mechanical Tilts. P7. Make audit report.

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding

required to carry out the tasks covered in this competency standard. This includes:

- Basic Knowledge of 2G/3G/LTE antennas
- coordinate system
- GPS and mapping software (MapInfo).
- EHS for work at height
- 2G antenna types.
- Audit techniques
- 3G antenna types.
- 4G antenna types.
- MS Office

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Identify antennas according to their technologies
- Change Electrical and Mechanical tilts of Antennas as given and prepare report
- Verify Antenna view with actual Azimuth and geo position

Tool and Equipment
• Camera. • PPE • First Aid Box • Laptop/Tab • Compass • EHS equipment

0714-E&A-79. Verify Truth Tables of Digital Gates

Overview:

This competency standard covers the skills and knowledge required to Verify the truth table of AND gate, Verify the truth table of OR gate, Verify the truth table of NOT gate, Verify the truth table of NAND gate, Verify the truth table of NOR gate, Verify the truth table of XOR gate and Verify the truth table of XNOR gate Verify the truth table of AND gate, OR gate, NOT gate, NAND gate, NOR gate, XOR gate and XNOR gate

.

Competency Units	Performance Criteria
CU1. Verify the truth table of AND gate	**P1.** Identify the symbol of logic gate, IC & logic function. **P2.** Place (AND gate IC) on bread board. **P3.** Identify the input, output, Vcc and ground pin. **P4.** Connect LED to the output pin of IC and apply different logics ant input pins. **P5.** Record & verify the output result against each given input.
CU2. Verify the truth table of OR gate	**P1.** Identify the symbol of logic gate, IC & logic function. **P2.** Place (OR gate IC) on bread board. **P3.** Identify the input, output, Vcc and ground pin. **P4.** Connect LED to the output pin of IC and apply different logics ant input pins. **P5.** Record & verify the output result against each given input.
CU3. Verify the truth table of NOT gate	**P1.** Identify the symbol of logic gate, IC & logic function. **P2.** Place (NOT gate IC) on bread board. **P3.** Identify the input, output, Vcc and ground pin. **P4.** Connect LED to the output pin of IC and apply different logics ant input pins. **P5.** Record & verify the output result against each given input.
CU4. Verify the truth table of NAND gate	**P1.** Identify the symbol of logic gate, IC & logic function. **P2.** Place (NAND gate IC) on bread board. **P3.** Identify the input, output, Vcc and ground pin. **P4.** Connect LED to the output pin of IC and apply different logics ant input pins. **P5.** Record & verify the output result against each given input.
CU5. Verify the truth table of NOR gate	**P1.** Identify the symbol of logic gate, IC & logic function. **P2.** Place (NOR gate IC) on bread board. **P3.** Identify the input, output, Vcc and ground pin. **P4.** Connect LED to the output pin of IC and apply different logics ant input pins.

	P5. Record & verify the output result against each given input.
CU6. Verify the truth table of XOR gate	**P1.** Identify the symbol of logic gate, IC & logic function. **P2.** Place (XOR gate IC) on bread board. **P3.** Identify the input, output, Vcc and ground pin. **P4.** Connect LED to the output pin of IC and apply different logics ant input pins. **P5.** Record & verify the output result against each given input.
CU7. Verify the truth table of XNOR gate	**P1.** Identify the symbol of logic gate, IC & logic function. **P2.** Place (NOR gate IC) on bread board. **P3.** Identify the input, output, Vcc and ground pin. **P4.** Connect LED to the output pin of IC and apply different logics ant input pins. **P5.** Record & verify the output result against each given input.

Knowledge & Understanding

- Study logic gates Logic gates. AND, OR, NAND, NOR, NOT, XOR and XNOR.
- Study the Boolean expression of AND, OR, NAND, NOR, NOT, XOR and XNOR, gate and its equivalent electrical circuit
- Define Universal gate and enlist its types.

Tool and Equipment

SN	Tools
1	AND gate (7408 2-input Quad)
2	OR gate (7432 2-input Quad)
3	NOT gate (7404 Hex)
4	NAND gate (7400 2-input Quad)
5	NOR gate (7402 2-input Quad)
6	X-OR gate (7486 2-input Quad)
7	X-NOR gate (74266 2-input Quad)
8	Bread board
9	DC supply (5 V)
10	LED
11	Connecting leads

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

0714-E&A-80. Construct & Verify Combinational Logic Circuit

Overview:

This competency standard covers the skills and knowledge required to **.**Apply Karnaugh mapping & Boolean algebra to simplify logic expressions, Construct & verify the truth table of Half adder, Construct & verify the truth table of Full adder, Construct & verify the truth table of Half Subtraction, Operate seven segment display with seven segment decoder, Construct & verify the truth table of Full Subtraction, Verify Encoder, Verify Encoder and Verify multiplexer and DE- multiplexer Construct & verify the truth table of Half adder, full adder and Half Subtraction.

Competency Units	Performance Criteria
CU1. Apply Karnaugh mapping & Boolean algebra to simplify logic expressions	**P1.** Identify the SOP & POS **P2.** Apply Boolean algebra & Karnaugh mapping to simplify SOP & POS. **P3.** Construct logic circuits with simplified SOP & POS.
CU2. Construct & verify the truth table of Half adder	**P1.** Place (AND gate IC) & (XOR gate IC) on bread board. **P2.** Identify the input, output, Vcc and ground pin. **P3.** Connect LED to the output pin of IC and apply different logics at input pins. **P4.** Record & verify the output result against each given input **P5.** Design, Construct, and test a half-adder circuit using one XOR gate and two NAND gates.
CU3. Construct & verify the truth table of Full adder	**P1.** Place (AND gate IC) & (XOR gate IC) on bread board. **P2.** Identify the input, output, Vcc and ground pin. **P3.** Connect LED to the output pin of IC and apply different logics at input pins. **P4.** Record & verify the output result against each given input **P5.** Design, Construct, and test a full-adder circuit using two ICS, &7486 and &7400.

CU4. Construct & verify the truth table of Half Subtraction	**P1.** Place (AND, NOT&XOR gate IC) on bread board. **P2.** Identify the input, output, Vcc and ground pin. **P3.** Connect LED to the output pin of IC and apply different logics at input pins. **P4.** Record & verify the output result against each given input
CU5. Construct & verify the truth table of Full Subtraction	**P1.** Place (AND, NOT&XOR gate IC) on bread board. **P2.** Identify the input, output, Vcc and ground pin. **P3.** Connect LED to the output pin of IC and apply different logics at input pins. **P4.** Record & verify the output result against each given input.
CU6. Verify Decoder	**P1.** Place (Decoder IC) on bread board. **P2.** Identify the input, output, Vcc and ground pin. **P3.** Connect LED to the output pin of IC and apply different logics at input pins. **P4.** Record & verify the output result against each given input.
CU7. Operate seven segment display with seven segment decoder.	**P1.** Insert (7 segment decoder IC) and 7 segment display on bread board. **P2.** Identify the input, output, Vcc and ground pin. **P3.** Connect segment display with seven segment decoder input output pins. **P4.** Record & verify the output result against each given input.
CU8. Verify Encoder	**P5.** Place (Encoder IC) on bread board. **P6.** Identify the input, output, Vcc and ground pin. **P7.** Connect LED to the output pin of IC and apply different logics at input pins. **P8.** Record & verify the output result against each given input.
CU9. Verify multiplexer and DE- multiplexer	**P9.** Implement following function with multiplexer F(ABC)=∑ (0,2,3,4,5,6): **P10.** Implement 4-to-1 mux and one 2-to-1 mux. **P11.** Implement 1-to-4 dmux using 1-to-2 dmux.

Knowledge & Understanding

- Describe the laws and rules of Boolean algebra.

- Understanding of commutative. • And distributive expiration. That is, A • (B + C) = (A • B) + (A • C) and A + (B • C) = (A + B) • (A + C).
- Study the combinational logic circuit. **(**Half adder, Full adder, Half subtraction, Full subtraction, Binary Multiplier, Magnitude
- Comparator)
- Study the Product-of-Sums& SOP Simplification
- Knowledge of Don't-Care Conditions
- Understanding of Karnaugh Map of four Variable.
- Understanding of Decoders & Encoders& Multiplexers.
- Knowledge of Pin configuration of iCs
- Knowledge of7 segment display.
- Explain pin 7 segment display and common cathode 7 segment display.
- Define limiting resistor
- Understanding how to implement functions using multiplexers.
- To study DE multiplexer

Tool and Equipment

SN	Tools
1	AND gate (7408 2-input Quad)
2	OR gate (7432 2-input Quad)
3	NOT gate (7404 Hex)
4	NAND gate (7400 2-input Quad)
5	NOR gate (7402 2-input Quad)
6	X-OR gate (7486 2-input Quad)
7	X-NOR gate (74266 2-input Quad)
8	Bread board
9	DC supply (5 V)
10	LED
11	Connecting leads
12	Bread board
13	Resistances (1K ohm)
14	Connecting leads
15	DC supply (5 V)
16	Mux KL-33006 block e
17	Seven segment display
18	74LS47 IC
19	Mux KL-33006 block

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

0714-E&A-81. Construct and Verify Function of Flip Flops

Overview:

This competency standard covers the skills and knowledge required to Construct and verify the truth table of RS latch using NAND gate, Construct and verify the truth table of clocked RS latch using NAND gate, verify function of D flip flop, verify function of JK/T flip flop construct and verify the truth table of RS latch using NAND gate, clocked RS latch using NAND gate, D flip flop and JK flip flop.

Competency Units	Performance Criteria
CU1. Construct and verify the truth table of RS latch using NAND gate	**P1.** Place (NAND gate IC) on bread board. **P2.** Identify the input, output, Vcc and ground pin. **P3.** Connect LEDs to outputs pins. **P4.** Apply different logic inputs to Record & verify the output result against each given input.
CU2. Construct and verify the truth table of clocked RS latch using NAND gat	**P1.** Place (NAND gate IC) on bread board. **P2.** Identify the input, output, Vcc and ground pin. **P3.** Connect LEDs to outputs pins. **P4.** Apply different logic inputs to Record & verify the output result against each given input.
CU3. Verify function of D flip flop.	**P1.** Insert (D flip flop) IC on bread board. **P2.** Identify the input, output, Vcc and ground pin. **P3.** Connect LEDs\ Scope to outputs pins. **P4.** Apply different logic inputs to Record & verify the output result against each given input.
CU4. Verify function of JK/T flip flop	**P1.** Insert 74112 (JK flip flop) IC on bread board. **P2.** Identify the input, output, Vcc and ground pin. **P3.** Connect LEDs\ Scope to outputs pins. **P4.** Apply different logic inputs to Record & verify the output result against each given input.

Knowledge & Understanding

- Define Latch
- How many inputs are given to SR Latch?
- Which IC is used for NAND and NOR gate?
- What is clocked RS flip flop.

- What is difference between Latch and flip flop?
- Symbols for Combinational Elements (Symbols for Flip-Flops.)
- Define D flip flop.
- Define clock pulse.
- What is difference between synchronous & asynchronous input
- Define JK/T flip flop.
- Draw the symbol of JK flip flop
- Which IC is used for JK flip flop

Tool and Equipment

SN	Tools
1	AND gate (7408 2-input Quad)
2	OR gate (7432 2-input Quad)
3	NOT gate (7404 Hex)
4	NAND gate (7400 2-input Quad)
5	NOR gate (7402 2-input Quad)
6	X-OR gate (7486 2-input Quad)
7	X-NOR gate (74266 2-input Quad)
8	Digital clock
9	DC supply (5 V)
10	LED
11	Connecting leads
12	Bread board
13	JK Flip Flop (74112 Dual

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

0714-E&A-82. Use 555 IC as Multivibrator

Overview:

This competency standard covers the skills and knowledge required to. Construct 555 IC as Actable Multivibrator, Construct 555 IC as Mono-stable Multivibrator, and Construct 555 IC as Bi-stable Multivibrator and verify its set and reset conduction. Construct 555 IC as Actable, nonstable & beatable Multivibrator and observe their outputs.

Competency Units	Performance Criteria
CU1. Construct 555 IC as Actable Multivibrator	**P1.** Draw circuit diagram for Actable Multivibrator **P2.** Place 555 IC on bread board/trainer **P3.** Make connection as per diagram. **P4.** Apply voltage to circuit. **P5.** Recode the output signal wave shape from oscilloscope.
CU2. Construct 555 IC as Mono-stable Multivibrator	**P1.** Draw circuit diagram for Mono-stable Multivibrator **P2.** Place 555 IC on bread board/trainer. **P3.** Make connection as per diagram. **P4.** Apply voltage to circuit and give triggering pulse at input pin. **P5.** Recode the output signal wave shape from oscilloscope.
CU3. Construct 555 IC as Bi-stable Multivibrator and verify its set and reset conduction	**P1.** Draw circuit diagram for Bi-stable Multivibrator **P2.** Place 555 IC on bread board/trainer. **P3.** Make connection as per diagram. **P4.** Apply voltage to circuit and give triggering pulse at input pin. **P5.** Recode the output signal wave shape from oscilloscope.

Knowledge & Understanding

- Describe basic elements of 555 timer IC.
- Name pins of 555 timer IC.
- What is function of voltage control input?
- What is a stable Multivibrator?
- What is non stable Multivibrator?
- What is beatable Multivibrator

Tool and Equipment

SN	Tools
1	DC supply (5 V
2	Connecting leads

3	555 Timer IC
4	Capacitor 0.1µF
5	Resistors 10 KΩ
6	dual trace Oscilloscope 0-20MHZ
7	Capacitor 0.01µF
8	Bread board

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

0714-E&A-83. Construct Shift Registers and Counters with The Help of Flip Flops

Overview:

This competency standard covers the skills and knowledge required toConstruct a 4-bit shift register by Using Flip Flops, construct a 4-bit binary counter Using Flip Flops, Construct 4-bit synchronous Counter with D flip-Flops and Repair & Troubleshoot combinational logic circuits

Competency Units	Performance Criteria
CU1. Construct a 4 bit shift register by Using Flip Flops	**P1.** Draw circuit diagram 4-bit register. **P2.** Make connection of D-Flip Flop as per diagram to construct 4-bit shift register. **P3.** Apply data at the input of register and give clock pulse **P4.** Recode the output according to the input.
CU2. Construct a4-bit binary counter Using Flip Flops	**P1.** Draw circuit diagram counter. **P2.** Make connection of JK-Flip Flop as per diagram to construct 4-bit binary counter. **P3.** Connect LEDs to the outputs pins. **P4.** Apply the clock pulse and record the output.
CU3. Construct 4-bitsynchronous Counter with D flip-Flops	**P1**. Draw circuit diagram synchronous counter. **P2**. Make connection of JK-Flip Flop as per diagram to construct 4-bit synchronous counter. **P3**. Connect LEDs to the output pins. **P4**. Apply the clock pulse and record the output.
CU4. Repair & Troubleshoot combinational logic circuits	**P1.** Identify principles and operations of types of logic gates **P2.** Locate drawing and diagrams. **P3.** Check the grounding system in electronic equipment. **P4.** Locate external and internal digital IC faults

Knowledge & Understanding

- Symbols for Combinational Elements (Symbols for Registers, Counters, RAM.)
- understand the function of registers, and counters in digital circuits
- Knowledge of basic computer memories and its types.
- Explain precautions when handling components.
- Demonstrate proper use of ESD equipment.
- Explain how to distinguish hardware from software issues
- Show how pulsars are used for digital signal tracing and how logic probes are used to verify states in digital equipment.

Tool and Equipment

SN	Tools
1	Software Simulator and IDE's.
2	DLD trainer
3	Multimeter
4	IC's and Components
5	Logic tester

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

Islamabad 31st May, 2019

NOTIFICATION

No. F. 5(13)/2018-DD (TE): In pursuance of sub-section (d) of section-6" Functions of the Commission" National Vocational & Technical Training Commission (NAVTTC) Act-2011, NAVTTC is pleased to approve and notify following qualifications in twenty (20) trades for Level 1-5 under National Vocational Qualification Framework (NVQF), which have been developed in compatibility with latest global trends in the fields and fulfilling requirements of competency based training and assessment (CBT&A) system. The qualifications have been developed and validated in collaboration with TEVTAs, QABs, industry and other relevant stakeholders: -

S#	National Vocational Qualifications
1.	National Qualification Level-5 diploma in Automobile Technology
2.	National Qualification Level-5 diploma in Civil Technology
3.	National Qualification Level-5 diploma in Construction Technology
4.	National Qualification Level-5 diploma in Information & Commutation Technology (ICT)
5.	National Qualification Level-5 diploma in Garment Manufacturing Technology
6.	National Qualification Level-5 diploma in Telecommunication Technology
7.	National Qualification Level-5 diploma in Electronics Technology
8.	National Qualification Level-5 diploma in Instrumentation Technology
9.	National Qualification Level-5 diploma in Computer Aided Design & Manufacturing (CAD /CAM)
10.	National Qualification Level-5 diploma in Mechanical Technology
11.	National Qualification Level-5 diploma in Graphics Designing
12.	National Qualification Level-5 diploma in Heating, Ventilation, Air-conditioning & Refrigeration (HVACR) Technology
13.	National Qualification Level-5 diploma in Media Production
14.	National Qualification Level-5 diploma in Hotel Management
15.	National Qualification Level-5 diploma in Professional Chef
16.	National Qualification Level-5 diploma in Tourism Management
17.	National Qualification Level-5 diploma in Hair & Beauty Services
18.	National Qualification Level-5 diploma in Fashion Designing
19.	National Qualification Level-5 diploma in Ceramics Technology
20.	National Qualification Level-5 diploma in Telecom Technology

2. All the TVET related institutions / organizations are required to implement aforementioned qualifications so that a uniform and standardized TVET qualification system is established in Pakistan and efforts are made for international equivalence / recognition of these qualifications.

3. Competency Standards of the above enlisted qualifications can be accessed at NAVTTC's website **(www.navttc.org).**

(Muqeem Islam)
Director General (Skill Standards & Curricula)
Phone: 051-9215385

Distribution:

1. Federal Secretary, Ministry of Federal Education & Professional Training, Govt of Pakistan
2. Federal Secretary, Ministry of Overseas Pakistanis and Human Resource Development, Govt of Pakistan, Islamabad
3. Federal Secretary, Ministry of Industry and Production, Govt of Pakistan, Islamabad
4. Federal Secretary, Ministry of Textile Industry, Govt of Pakistan, Islamabad
5. Federal Secretary, Ministry of Commerce, Govt of Pakistan, Islamabad
6. Federal Secretary, Ministry of Railway, Govt of Pakistan, Islamabad
7. Federal Secretary, Ministry of Climate Change, Govt of Pakistan, Islamabad
8. Federal Secretary, Ministry of Religious Affairs, Govt of Pakistan, Islamabad
9. Federal Secretary, Ministry of Communication, Govt of Pakistan, Islamabad
10. Federal Secretary, Ministry of Aviation Division, Govt of Pakistan, Islamabad
11. Federal Secretary, Ministry of Science & Technology, Govt of Pakistan, Islamabad
12. Chairperson, Punjab Technical Education and Vocational Training Authority (P-TEVTA), Lahore
13. Managing Director, Khyber Pakhtunkhwa Technical Education and Vocational Training Authority (KP-TEVTA),
14. Managing Director, Sindh Technical Education and Vocational Training Authority (S-TEVTA), Karachi
15. Chairman, Azad Jammu & Kashmir, Technical Education and Vocational Training Authority (AJ&K TEVTA), Muzafarabad
16. Director TVET Cell, Gilgit Baltistan, Gilgit
17. Director General, Punjab Vocational Training Council (PVTC), Punjab
18. Managing Director, Technology Upgradation and Skill Development Company (TUSDEC) Lahore
19. Project Director, Punjab Skill Development Program (PSDP) Lahore
20. CEO, Punjab Skill Development Fund, Lahore
21. Rector, UNTECH University Islamabad
22. National Deputy Leader, GIZ Islamabad
23. PS to Minister of Federal Education & Professional Training, Govt of Pakistan
24. PS to Special Adviser to the Prime Minister on Youth Affairs, Prime Minister's Office, Islamabad

25. Chairperson, Federal of Pakistan Chamber of Commerce and Industry (FPCCI), Karachi
26. Conveyor, Sector Skills Council (Textile/ Construction/ Renewable Energy/ Hospitality and Tourism)
27. Director Technical Education and Vocational Training Authorities (TEVTA), Balochistan
28. Chairman, Pakistan Tourism Development Corporation, Lahore
29. Chairman, PCSIR Headquarters, Islamabad
30. Director General, Pakistan Forest Institute, Peshawar
31. Chairman, Wafaq ul Madaris, Multan
32. Director General, Staff Welfare, Islamabad
33. Director General, NISTE Capital Administration and Development Division, Islamabad
34. Director General, National Training Bureau, Islamabad
35. Chairmen, Provincial Technical Education Boards
36. Chairmen, Provincial Trade Testing Boards
37. Secretary, IBCC, Islamabad: *with the request that National qualifications of Level 5 diploma in the aforementioned trades may be considered equivalent to Diploma of Associate Engineer/HSSC after inclusion of compulsory courses in the light of IBCC general requirement.*

Copy for information to: -

1. DG (P&D)/(A&F)/ (A&C) (S&C) NAVTTC
2. Director General(s), NAVTTC Regional Office(s).
3. Sr. Technical Advisor, TSSP-GIZ
4. Staff Officer to Chairman, NAVTTC
5. PS to Executive Director, NAVTTC Islamabad
6. Concerned File/ Office Copy