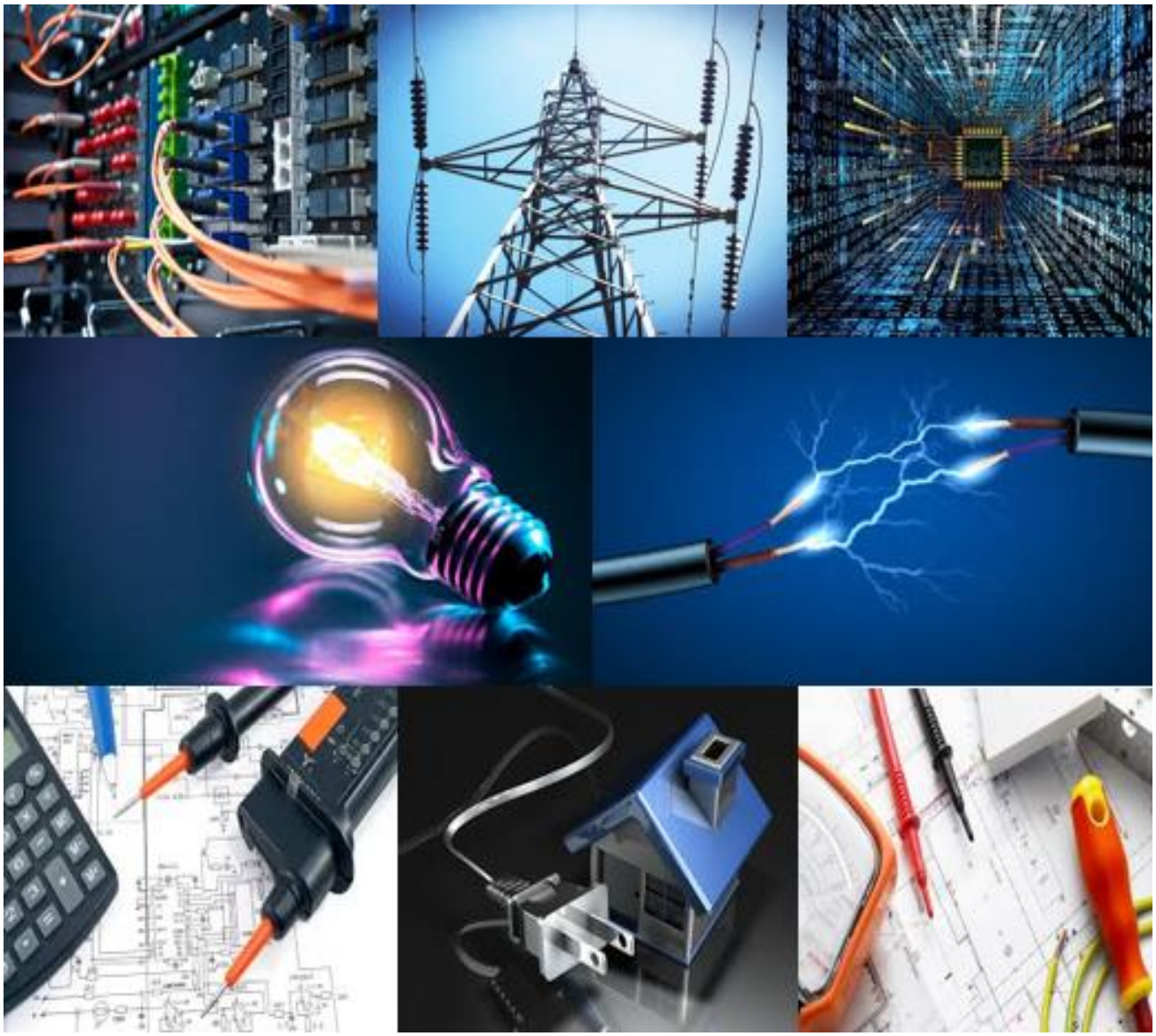
National Competency Standards Level 5 for "Electrical Technology"



National Vocational and Technical Training Commission (NAVTTC)

Government of Pakistan

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- 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 especially to Syed Javed Hassan Chairman NAVTTC and Raja Saad Khan, Deputy Team Lead TSSP-GIZ who made it happened in this challenging time.

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Introduction

The Technical and Vocational is a profession that is increasingly getting attention in Pakistan, not only among the youth seeking to enter the industry but also among adults who wish to polish their skills to develop a career out of it. Scope and demand of Electrical engineers, supervisors, operator, and technician is very high in Pakistan due to fast growing economic zone like CPEC. There are more job opportunities for electrical technician and supervisors in Pakistan than any other field of engineering. Pakistan is still facing energy crises, for need for more power houses, renewable energy sources is being felt which will definitely result in more demand of electrical engineers.

CBT based level 5 course in Electrical Technology with updated concepts, not only allows students to equip with growing Industrial trends but will be beneficial in capturing the job market across the globe. The course is divided into sub fields like electronics, computer engineering, power engineering, telecommunications, control systems, and microelectronics. Many of these sub disciplines overlap with other engineering branches, spanning a huge number of specializations such as hardware engineering, power electronics, avionics, mechatronics and nanotechnology.

Pakistan can boost economic growth and job creation by overcoming inefficiencies in its power sector, "Reforms that address these distortions can make better use of existing facilities. These need to focus on eliminating waste, promoting the shift towards cleaner energy and attracting private investments."

"Power sector reform should be a top priority, as few other reforms could yield economic gains of a similar magnitude so quickly, based on findings from this report," says Fan Zhang, Senior Economist at the World Bank. *"If well designed, these reforms will directly benefit the poor by increasing access, improving reliability, and reducing cost and pollution."*

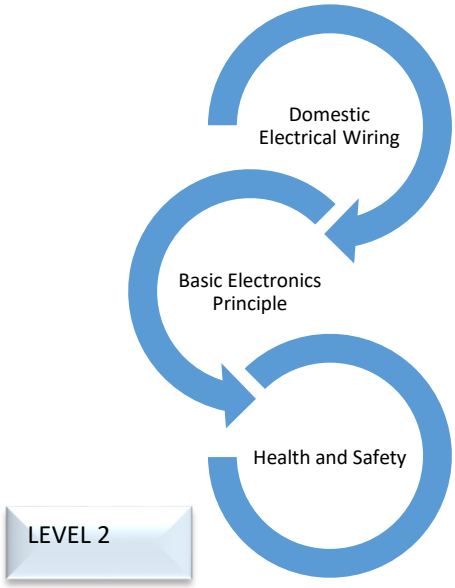
Purpose of the Qualification

Based upon this demand of industry these competency-based qualifications for Electrical Technology are developed under National Vocational Qualification Framework (Level 1 to 5). The qualifications mainly cover competencies along with related knowledge and professional attitude which is essential for getting a job or self-employed.

The qualifications are also in line with the vision of Pakistan's National Skills Strategy (NSS), National TVET Policy and National Vocational Qualification Framework (NVQF). This provides policy directions, support and an enabling environment to the public and private sectors to impart training for skills development to enhance social and economic profile. The National Vocational & Technical Training Commission (NAVTTC) has approved the Qualification Development Committee (QDC) for Electrical Technology.The QDC consists experts from the relevant industries from different geographical locations across Pakistan and academicians who were consulted during the development process to ensure input and ownership of all the stakeholders. The National Competency Standards could be used as a referral document for the development of curricula to be used by training institutions.

The purpose of the training is to provide skilled manpower to improve the quality of value added products of industrial sector. This training will provide the basic skills to the trainees in the field of Electrical and convert it into value added product which is acceptable by International market reducing the line losses and fit-in a skilled graduate into National Vocational Qualification Framework for his / her vertical career progression and qualification equivalencies at par with acceptable international standards.

Common Courses with respective levels



LEVEL 2

Digital Skills

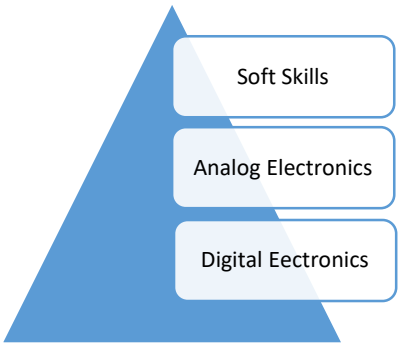
Basic Engineering Drawings

Metrology

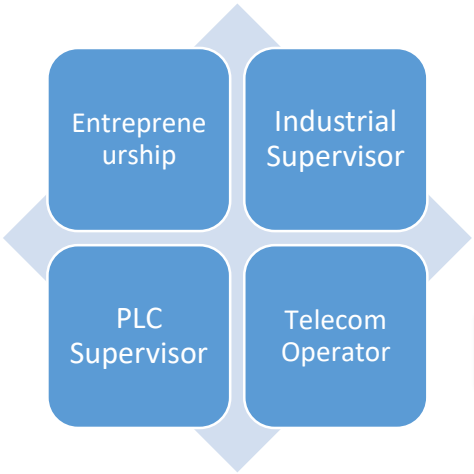
Electronics Devices

LEVEL 3

Basic Electrical Engineering



LEVEL 4



LEVEL 5

Levelling of Core Competencies of the Qualification along with the Occupations

Following is the description and structure of the course

Sr No	Competency Standards	Occupations	NVQF Level	Category	Estimated Contact Hours			Cr Hr
					Th	Pr	Total	
	Level-2							
	Health & Safety	**Safety Supervisor**						
1	Maintain Occupational Health and Safety		Level 2	Generic	10	30	40	4
2	Adopt Safety Regulations, Labour Protection Laws, Environmental Protection Laws at Workplace		Level 3	Functional	10	30	40	4
	Occupation Total Hours				**20**	**60**	**80**	**8**
	Basic Electrical Engineering	**Electrical Lab Technician**						
1	Operate Measuring Instruments.		Level 4	Technical	5	15	20	2
2	Verify Ohm's Law & Kirchhoff's Law by Implementing Series/Parallel Circuits.		Level 4	Technical	7	23	30	3
3	Measure Electrical Power, Energy, Power Factor & Determine Phase Sequence		Level 2	Technical	9	21	30	3
4	Operate Oscilloscope		Level 5	Technical	9	21	30	3
5	Implement Electromagnet to See Various Effects & Verify Faradays Laws.		Level 5	Technical	7	23	30	3
6	Verify Law of Combination of Capacitor and Determine Break down voltage of Capacitor.		Level 5	Technical	6	14	20	2
	Occupation Total Hours				**43**	**117**	**160**	**16**
	Basic Electrical Wiring (Single Phase)	**Domestic Electrician**						
1	Maintain Tools & Equipment.		Level 2	Technical	5	15	20	2
2	Make Cable/Wire Joints		Level 2	Technical	5	15	20	2
3	Prepare and Install Main Distribution Boards (Single Phase)		Level 2	Technical	8	12	20	2
4	Carryout Basic Electrical Installation		Level 2	Technical	7	23	30	3
5	Install Simple Single Phase Electrical Wiring		Level 2	Technical	7	33	40	4

6	Install Single Phase Complex Electrical Wiring		Level 2	Technical	10	40	50	5
7	Perform Testing of Electrical Wiring		Level 2	Technical	10	30	40	4
8	Repair/ Maintenance of Single Phase Electrical Installations		Level 2	Technical	5	15	20	2
9	Repair/ Maintenance and Service of Home Appliances		Level 2	Technical	8	32	40	4
	Occupation Total Hours				**65**	**215**	**280**	**28**
	Complex Electrical Wiring (Three Phase)	**Industrial Electrician**						
1	Maintain Tools & Equipment for 3 Phase Wiring		Level 3	Technical	5	15	20	2
2	Make Cable/Wire Joints (Heavy Cable Joints)		Level 3	Technical	5	15	20	2
3	Prepare and Install Distribution Boards for 3 Phase.		Level 3	Technical	5	15	20	2
4	Install Three Phase Electrical Wiring		Level 3	Technical	7	33	40	4
5	Install Three Phase Complex Electrical Wiring		Level 3	Technical	12	48	60	6
6	Perform Testing of 3 Phase Electrical Wiring.		Level 3	Technical	10	40	50	5
7	Diagnose Electrical Fault in Generator		Level 3	Technical	7	13	20	2
8	Repair/ Maintenance of 3 Phase Electrical Installations.		Level 3	Technical	5	15	20	2
9	Carry Out Manual Electrical Planning and Estimation for 3 Phase		Level 3	Technical	6	24	30	3
	Occupation Total Hours				**62**	**218**	**280**	**28**
	LEVEL-2 TOTAL HOURS				**190**	**610**	**800**	**80**
	Level-3							
	Manage Digital Skills	**Digital Skills**						
1	Install Computer Operating Systems And Hardware		Level 5	Technical	3	17	20	2
2	Operate Word-Processing Applications		Level 5	Technical	6	14	20	2
3	Operate Spreadsheet Applications		Level 5	Technical	5	15	20	2
4	Operate Presentation Packages		Level 5	Technical	5	15	20	2
5	Perform Writing And Editing Tasks		Level 5	Technical	4	16	20	2
6	Perform Computer Operations		Level 5	Technical	5	15	20	2

7	Use Computer Applications		Level 5	Technical	5	15	20	2
8	Create User Documentation		Level 5	Technical	3	17	20	2
9	Create Technical Documentation		Level 5	Technical	5	15	20	2
10	Create Basic Databases		Level 5	Technical	4	16	20	2
11	Operate Digital Media Technology		Level 5	Technical	2	8	10	1
12	Use Social Media Tools For Collaboration And Engagement		Level 5	Technical	3	17	20	2
13	E-Commerce		Level 5	Technical	4	16	20	2
14	Use Digital Devices		Level 5	Technical	2	8	10	1
	Occupation Total Hours				**56**	**204**	**260**	**26**
	Electrical Instruments and Calibration							
1	Measure Current, Voltage and Make Multiplier for Galvanometer Range Extension		Level 5	Technical	5	15	20	2
2	Measure Temperature, Earth Resistance, Light Intensity		Level 5	Technical	6	24	30	3
3	Measure the Resistance, Measure High Dc Current by Using Shunt.		Level 5	Technical	4	16	20	2
4	Measure Voltage, Frequency, Capacitance & Inductance by CRO	**Calibration Technician**	Level 5	Technical	4	26	30	3
5	Measure Capacitance and Inductance by RLC Meter, Dismantle and Assemble the Instruments		Level 5	Technical	6	24	30	3
6	Identify The Parts and Connection of Energy Meter(Single/3-Phase), Factor(Pf) Meter, MDI Meter, Megger		Level 5	Technical	8	32	40	4
7	Calibrate Electrical Equipment's		Level 5	Technical	10	40	50	5
	Occupation Total Hours				**43**	**177**	**220**	**22**
	Machine Shop Supervisor							
1	Perform Cleaning, Oiling and Centering the Job.		Level 5	Technical	6	24	30	3
2	Perform Facing, Straight Turning, Centre Drilling	**Machine Shop Technician**	Level 5	Technical	6	14	20	2
3	Perform Drilling, Step Turning, Knurling and Boring a Straight Hole On Lathe.		Level 5	Technical	4	26	30	3

4	Perform Step or Counter Boring, Reaming, Tool Grinding, Taper Turning and Cutting		Level 5	Technical	5	25	30	3
	Basic Workshops							
5	Perform Basic Metal Work.		Level 5	Technical	11	69	80	8
6	Perform Wood Work.		Level 5	Technical	9	41	50	5
7	Perform Oxy Acetylene Welding.		Level 5	Technical	8	32	40	4
8	Perform Arc Welding.		Level 5	Technical	9	31	40	4
	Occupation Total Hours				**58**	**262**	**320**	**32**
	LEVEL-3 TOTAL HOURS				**157**	**643**	**800**	**80**
	Level-4							
	Application of Computor in Electrical Drawing	**Computer Operator Electrical**						
1	Select Computer Specification and Work with Windows.		Level 5	Technical	6	24	30	3
2	Process Data (Files, Documents & Presentations) with MS Office.		Level 5	Technical	6	24	30	3
3	Carryout Basic Programming		Level 5	Technical	8	22	30	3
4	Perform Internet Browsing		Level 5	Technical	7	13	20	2
5	Construct The Different Engineering Curves Used in Various Mechanism.		Level 5	Technical	10	20	30	3
6	Perform Multi-View Drawings.		Level 5	Technical	8	22	30	3
7	Draw Production Drawing.		Level 5	Technical	4	16	20	2
8	Design and Simulate the Electronic Circuit by Using Computer-Aided Design (Cad) Software		Level 5	Technical	4	16	20	2
	Occupation Total Hours				**53**	**157**	**210**	**21**
	DC Machines (Motror and Generator)	**DC Machine Operator**						
1	Verify Basic Laws of Electrical Machines		Level 5	Technical	10	30	40	4
2	Analyze DC Generators		Level 5	Technical	10	30	40	4
3	Perform Tests On DC Generators		Level 5	Technical	7	43	50	5
4	Analyze Dc Motors		Level 5	Technical	6	24	30	3
5	Perform Tests On Dc Motors		Level 5	Technical	20	60	80	8
6	Repair/ Maintenance and Service of Dc Motors and Dc Generators.		Level 5	Technical	8	32	40	4

	Occupation Total Hours				**61**	**219**	**280**	**28**
	AC Machines (Transformer)	**Transformer Winding Supervisor**						
1	Verify Basic Laws of Electrical Machines		Level 5	Technical	10	30	40	4
2	Operate Single Phase Transformer		Level 5	Technical	10	40	50	5
3	Perform Tests On Single Phase Transformer.		Level 5	Technical	10	40	50	5
4	Operate Auto Transformer.		Level 5	Technical	3	27	30	3
5	Perform Tests On Auto Transformer.		Level 5	Technical	3	27	30	3
6	Operate Three Phase Transformer.		Level 5	Technical	14	66	80	8
7	Identify Vector Group of Three Phase Transformer		Level 5	Technical	6	24	30	3
8	Repair/ Maintenance and Service of Transformer		Level 5	Technical	9	41	50	5
	Occupation Total Hours				**65**	**295**	**360**	**36**
	Manage Soft Skills	**Soft Skills**						
1	Develop Workplace Policy and Procedures for Sustainability		Level 5	Functional	4	26	30	3
2	Maintain Professionalism in the Workplace		Level 5	Functional	4	26	30	3
3	Manage Personal Work Priorities and Professional Development		Level 5	Functional	3	26	30	3
4	Manage Workforce Planning		Level 5	Functional	4	26	30	3
5	Undertake Project Work		Level 5	Functional	4	26	30	3
6	Prepare and Implement Negotiation		Level 5	Functional	5	26	30	3
7	Manage Meetings		Level 5	Functional	3	26	30	3
8	Organize Schedules		Level 5	Functional	2	18	20	2
9	Identify and Communicate Trends in Career Development		Level 5	Functional	3	17	20	2
10	Apply Specialist Interpersonal and Counseling Interview Skills		Level 5	Functional	3	17	20	2
	Occupation Total Hours				**35**	**234**	**270**	**27**

	Electroplating	**Electroplating Supervisor**						
1	Perform Pre-Electroplating Activities		Level 5	Technical	6	24	30	3
2	Perform Electroplating		Level 5	Technical	4	26	30	3
3	Perform Post-Electroplating Activities and Tests		Level 5	Technical	4	26	30	3
4	Plan an Electroplating Shop		Level 5	Technical	10	30	40	4
	Occupation Total Hours				**24**	**106**	**130**	**13**
	Industrial Supervisor (Electrical)	**Jr. Electronics Technician**						
1	Identify Basic Electronics Components		Level 4	Technical	5	25	30	3
2	Design A Rectifier Using Diode		Level 5	Technical	6	24	30	3
3	Carry Out Diode Application		Level 5	Technical	6	24	30	3
4	Implement Bipolar Junction Transistor (BJTs) In Different Applications		Level 5	Technical	6	24	30	3
5	Implement Field Effect Transistor (FETs) In Different Application		Level 5	Technical	6	24	30	3
6	Implement Thyristor Family (Uni-Junction Transistor, Silicon Control Rectifier, DIAC and TRIAC) In Various Application.		Level 5	Technical	6	24	30	3
7	Applications of Operational Amplifier.		Level 5	Technical	6	24	30	3
8	Verify Truth Tables of Digital Gates.		Level 4	Technical	7	23	30	3
9	Construct & Verify Combinational Logic Circuit.		Level 4	Technical	9	31	40	4
10	Construct and Verify Function of Flip Flops.		Level 5	Technical	6	24	30	3
11	Use 555 IC as Multi-vibrator.		Level 5	Technical	6	14	20	2
12	Construct Shift Registers and Counters With the help of Flip Flops		Level 5	Technical	4	16	20	2
	Occupation Total Hours				**73**	**277**	**350**	**35**
	LEVEL-4 TOTAL HOURS				**311**	**1288**	**1600**	**160**
	Level-5							
	Applications of Computer in Electrical Technology	**Jr. Computer Programmer**						
1	Perform Basic Mathematics Calculations in C++		Level 5	Technical	13	47	60	6
2	Perform Basic Circuit Analysis Calculations in C++		Level 5	Technical	8	12	20	2

3	Perform Electrical Analysis in C++		Level 5	Technical	6	24	30	3
4	Develop and Analyze Electrical Circuit with Multisim		Level 5	Technical	10	30	40	4
5	Develop and Analyze Electrical Circuit with PSPICE Software		Level 5	Technical	7	23	30	3
6	Carry Out in Computer Electrical Planning and Estimation		Level 5	Technical	4	26	30	3
7	Carry out Industrial Automation and PLC Installation		Level 5	Technical	3	17	20	2
	Occupation Total Hours				**51**	**179**	**230**	**23**
	AC Machines (Motor and Alternator)	**Motor Winding Supervisor**						
1	Verify Basic Laws of Electrical Machines		Level 5	Technical	6	24	30	3
2	Analyze an Alternator.		Level 5	Technical	7	23	30	3
3	Analyze Single Phase Motors		Level 5	Technical	6	24	30	3
4	Analyze Special Purpose Motors		Level 5	Technical	8	22	30	3
5	Analyze Three Phase Motors		Level 5	Technical	15	55	70	7
6	Repair/ Maintenance and Service of Ac Electric Motors and Generators.		Level 5	Technical	4	16	20	2
	Occupation Total Hours				**46**	**164**	**210**	**21**
	Industrial Supervisor (Electrical)	**Industrial Supervisor**						
1	Implement Diode and Thyristor in Power Control Application.		Level 5	Technical	10	40	50	5
2	Implement Single Phase and Three Phase Inverter		Level 5	Technical	6	24	30	3
3	Control Speed of AC/DC Motors.		Level 5	Technical	12	48	60	6
4	Program PLC using Ladder Logic.		Level 4	Technical	4	16	20	2
5	Carry out Industrial Automation and PLC Installation		Level 4	Technical	14	56	70	7
6	Install PLC Software and Simulator		Level 4	Technical	4	16	20	2
7	Design and Test the PLC		Level 4	Technical	6	24	30	3
8	Installation, Commissioning and Maintenance of PLC.		Level 4	Technical	6	24	30	3
	Occupation Total Hours				**62**	**248**	**310**	**31**
	Telecom Operator (Power)	**Telecom Operator (Power)**						
1	Identify The Parts of Analog & Digital Telephone Set & Verify		Level 5	Technical	6	14	20	2

	Their Function							
2	Carryout Modulation, Demodulation, Multiplexing & Demulti-plexing.		Level 5	Technical	8	32	40	4
3	Install Cord Less Telephone, PABX & Satellite Dish System.		Level 5	Technical	7	23	30	3
4	Install Power Supply		Level 5	Technical	11	19	30	3
5	Maintain Lead Acid Batteries and Implement Their Series Parallel Combination.		Level 5	Technical	6	14	20	2
	Occupation Total Hours				**38**	**102**	**140**	**14**
	Power Plant And Energy Conservation	**Power Plant Operator**						
1	Operate Hydro Power Plant		Level 5	Technical	5	25	30	3
2	Operate Thermal Power Plant		Level 5	Technical	8	22	30	3
3	Operate Diesel Power Plant		Level 5	Technical	8	22	30	3
4	Operate Nuclear Power Plant		Level 5	Technical	6	14	20	2
5	Design A Solar Power Plant		Level 5	Technical	8	22	30	3
6	Operate Solar Power Plant		Level 5	Technical	6	14	20	2
7	Operate Wind Power Plant		Level 5	Technical	5	15	20	2
8	Utilize Electrical Energy in Building		Level 5	Technical	5	15	20	2
9	Utilize Natural Energy in Building		Level 5	Technical	8	12	20	2
10	Calculate Tariffs and Economics		Level 5	Technical	15	15	30	3
	Occupation Total Hours				**74**	**176**	**250**	**25**
	Power System Transmission, Distribution and Protection	**Sr. Lineman**						
1	Carryout Transmission of Electrical Power		Level 5	Technical	12	28	40	4
2	Carryout Distribution of Power System.		Level 5	Technical	17	53	70	7
3	Carryout Protection of Distribution and Transmission System		Level 5	Technical	13	57	70	7
	Occupation Total Hours				**42**	**138**	**180**	**18**
	Develop Enterpreneure Skills	**Enterpreneur**						
1	Investigate Microbusiness Opportunities		Level 5	Generic	3	17	20	2
2	Develop A Micro Business Proposal		Level 5	Functional	3	27	30	3

3	Develop A marketing Plan		Level 5	Functional	3	27	30	3
4	Develop And Review A Business Plan		Level 5	Functional	3	27	30	3
5	Organize Finances For The Micro Business		Level 5	Generic	3	17	20	2
6	Manage Human Resources		Level 5	Generic	3	17	20	2
7	Market Products And Services		Level 5	Functional	6	24	30	3
8	Monitor And Review Business Performance		Level 5	Functional	6	24	20	2
9	Negotiate For Resolving Business Issues		Level 5	Functional	3	17	20	2
10	Manage Personal Finances		Level 5	Functional	6	24	20	2
11	Coordinate A Work Team		Level 5	Functional	6	24	20	2
12	Lead Small Teams		Level 5	Functional	3	17	20	2
	Occupation Total Hours				**48**	**262**	**280**	**28**
	LEVEL-5 TOTAL HOUR				**361**	**1269**	**1600**	**160**
	GRAND TOTAL HOURS OF ALL LEVELS (2-5).				**1019**	**3810**	**4800**	**480**
	Overall (Level-5 Diploma) % Ratio of Theory and Practical				**21.2**	**79.4**		

Occupations and Level Descriptor					
SR.NO	**OCCUPATIONS**	**NO OF MODULES**	**LEVEL**	**OCCUPATION HOURS**	**G. TOTAL (LEVEL HOURS)**
1	*Safety Supervisor*	2	**2**	80	800
2	*Electrical Lab Technician*	6		160	
3	*Domestic Electrician*	9		280	
4	*Industrial Electrician*	9		280	
3	*Digital Skills*	14	**3**	260	800
4	*Calibration Technician*	7		220	
5	*Machine Shop Technician*	8		320	
8	*Computer Operator-Electrical*	8	**4**	210	1600
9	*DC Machine Operator*	6		280	
10	*Transformer Winding Supervisor*	8		360	
11	*Soft Skills*	10		270	
12	*Electroplating Supervisor*	4		130	
15	*Jr.Electronics Technician*	12		350	
13	*Jr. Computer Programmer*	7	**5**	230	1600
14	*Motor Winding Supervisor*	6		210	
16	*Industrial Supervisor*	8		310	
17	*Telecom Operator (Power)*	5		140	
18	*Power Plant Operator*	10		250	
19	*Sr. Lineman*	3		180	
20	*Entrepreneur*	12		280	

Packaging of Occupations

The National Vocational Qualifications have been packaged as detailed below:

Level 2

(Safety Supervisor, Electrical Lab Technician, Domestic Wiring Electrician, Industrial Electrician)

Safety Supervisor

1. Maintain Occupational Health and Safety
2. Adopt Safety Regulations, Labor Protection Laws, Environmental Protection Laws at Workplace

Electrical Lab Technician

1. Operate Measuring Instruments.
2. Verify Ohm's Law & Kirchhoff's Law by Implementing Series/Parallel Circuits.
3. Measure Electrical Power, Energy, Power Factor & Determine Phase Sequence
4. Operate Oscilloscope
5. Implement Electromagnet to See Various Effects & Verify Faradays Laws.
6. Verify Law of Combination of Capacitor and Determine Break down voltage of Capacitor.

Domestic Wiring Electrician

1. Maintain Tools & Equipment.
2. Make Cable/Wire Joints
3. Prepare and Install Main Distribution Boards (Single Phase)
4. Carryout Basic Electrical Installation
5. Install Simple Electrical Wiring
6. Install Single Phase Complex Electrical Wiring
7. Perform Testing of Electrical Wiring
8. Repair/ Maintenance of Electrical Installations
9. Repair/ Maintenance and Service of Home Appliances.

Industrial Electrician

1. Maintain Tools & Equipment.
2. Make Cable/Wire Joints
3. Prepare and Install Distribution Boards.
4. Install Three Phase Electrical Wiring
5. Install Three Phase Complex Electrical Wiring
6. Perform Testing of Electrical Wiring
7. Diagnose Electrical Fault in Generator
8. Repair/ Maintenance of Electrical Installations
9. Carry Out Manual Electrical Planning and Estimation

Level 3

(Digital Skills, Calibration Technician, Machine Shop Technician,)

Digital Skills

1. Install Computer Operating Systems and Hardware
2. Operate Word-Processing Applications
3. Operate Spreadsheet Applications
4. Operate Presentation Packages
5. Perform Writing and Editing Tasks
6. Perform Computer Operations
7. Use Computer Applications
8. Create User Documentation
9. Create Technical Documentation
10. Create Basic Databases
11. Operate Digital Media Technology
12. Use Social Media Tools for Collaboration and Engagement
13. E-Commerce
14. Use Digital Devices

Calibration Technician

1. Measure Current, Voltage and Make Multiplier for Galvanometer Range Extension
2. Measure Temperature, Earth Resistance, Light Intensity
3. Measure the Resistance, Measure High Dc Current by Using Shunt.
4. Measure Voltage, Frequency, Capacitance & Inductance by CRO
5. Measure Capacitance and Inductance by RLC Meter, Dismantle and Assemble the Instruments
6. Identify The Parts and Connection of Energy Meter(Single/3-Phase), Factor(Pf) Meter, MDI Meter, Megger
7. Calibrate Electrical Equipment's

Machine Shop Technician

1. Perform Cleaning, Oiling and Centering the Job.
2. Perform Facing, Straight Turning, Centre Drilling
3. Perform Drilling, Step Turning, Knurling and Boring a Straight Hole On Lathe.
4. Perform Step or Counter Boring, Reaming, Tool Grinding, Taper Turning and Cutting
5. Perform Basic Metal Work.
6. Perform Wood Work.
7. Perform Oxy Acetylene Welding.
8. Perform Arc Welding.

Level 4

(Computer Operator-Electrical, DC Machine Operator, Transformer Winding Supervisor, Soft Skills, Electroplating Supervisor, Jr. Electronics Technician)

Computer Operator-Electrical

1. Select Computer Specification and Work with Windows.
2. Process Data with MS Office.
3. Carryout Basic Programming
4. Explore Electrical
5. Perform The Different Engineering Curves Used in Various Mechanism.
6. Perform Multi-View Drawings.
7. Draw Production Drawing.
8. Design and Simulate the Electronic Circuit by Using Computer-Aided Design (Cad) Software

DC Machine Operator

1. Verify Basic Laws of Electrical Machines
2. Analyze Dc Generators
3. Perform Tests On Dc Generators
4. Analyze Dc Motors
5. Perform Tests On Dc Motors
6. Repair/ Maintenance and Service of Dc Motors and Dc Generators.

Transformer Winding Supervisor

1. Verify Basic Laws of Electrical Machines
2. Operate Single Phase Transformer
3. Perform Tests On Single Phase Transformer.
4. Operate Auto Transformer.
5. Perform Tests On Auto Transformer.
6. Operate Three Phase Transformer.
7. Identify Vector Group of Three Phase Transformer
8. Repair/ Maintenance and Service of Transformer

Soft Skills

1. Develop Workplace Policy and Procedures for Sustainability
2. Maintain Professionalism in the Workplace
3. Manage Personal Work Priorities and Professional Development
4. Manage Workforce Planning
5. Undertake Project Work
6. Prepare and Implement Negotiation
7. Manage Meetings
8. Organize Schedules
9. Identify and Communicate Trends in Career Development
10. Apply Specialist Interpersonal and Counseling Interview Skills.

Electroplating Supervisor

1. Perform Pre-Electroplating Activities
2. Perform Electroplating
3. Perform Post-Electroplating Activities and Tests

4. Plan an Electroplating Shop

Jr. Electronics Technician

1. Identify Basic Electronics Components
2. Design A Rectifier Using Diode
3. Carry Out Diode Application
4. Implement Bipolar Junction Transistor (BJTs) In Different Applications
5. Implement Field Effect Transistor (FETs) In Different Application
6. Implement (Uni-Junction Transistor, Silicon Control Rectifier, DIAC and TRIAC) In Various Application.
7. Design Operation Amplifier.
8. Verify Truth Tables of Digital Gates.
9. Construct & Verify Combinational Logic Circuit.
10. Construct and Verify Function of Flip Flops.
11. Use 555 IC as Multi-vibrator.
12. Construct Shift Registers and Counters Used Flip Flops

Level 5

(Jr. Computer Programmer, Motor Winding Supervisor, Industrial Supervisor, Telecom Operator (Power), Power Plant Operator, Sr. Lineman, Entrepreneur)

Jr. Computer Programmer

1. Perform Basic Mathematics Calculations in C++
2. Perform Basic Circuit Analysis Calculations in C++
3. Perform Electrical Analysis in C++
4. Develop and Analyze Electrical Circuit with Multisim
5. Develop and Analyze Electrical Circuit with PSPICE Software
6. Carry Out in Computer Electrical Planning and Estimation
7. Carry out Industrial Automation and PLC Installation

Motor Winding Supervisor

1. Verify Basic Laws of Electrical Machines
2. Analyze an Alternator.
3. Analyze Single Phase Motors
4. Analyze Special Purpose Motors
5. Analyze Three Phase Motors
6. Repair/ Maintenance and Service of Ac Electric Motors and Generators.

Industrial Supervisor

1. Implement Diode and Thyristor in Power Control Application.
2. Implement Single Phase and Three Phase Inverter
3. Control Speed of Dc/Ac Motors.
4. Program PLC using Ladder Logic.
5. Carry out Industrial Automation and PLC Installation
6. Install PLC Software and Simulator
7. Design and Test the PLC
8. Installation, Commissioning and Maintenance of PLC.

Telecom Operator (Power)

1. Identify The Parts of Analog & Digital Telephone Set & Verify Their Function
2. Demonstrate Modulation, Demodulation, Multiplexing & Demulti-plexing.
3. Install Cord Less Telephone, PABX & Satellite Dish System.
4. Install Power Supply
5. Maintain Lead Acid Batteries and Implement Their Series Parallel Combination.

Power Plant Operator

1. Operate Hydro Power Plant
2. Operate Thermal Power Plant
3. Operate Diesel Power Plant
4. Operate Nuclear Power Plant
5. Design A Solar Power Plant
6. Operate Solar Power Plant
7. Operate Wind Power Plant
8. Calculate Tariffs and Economics
9. Utilize Electrical Energy in Building
10. Utilize Natural Energy in Building

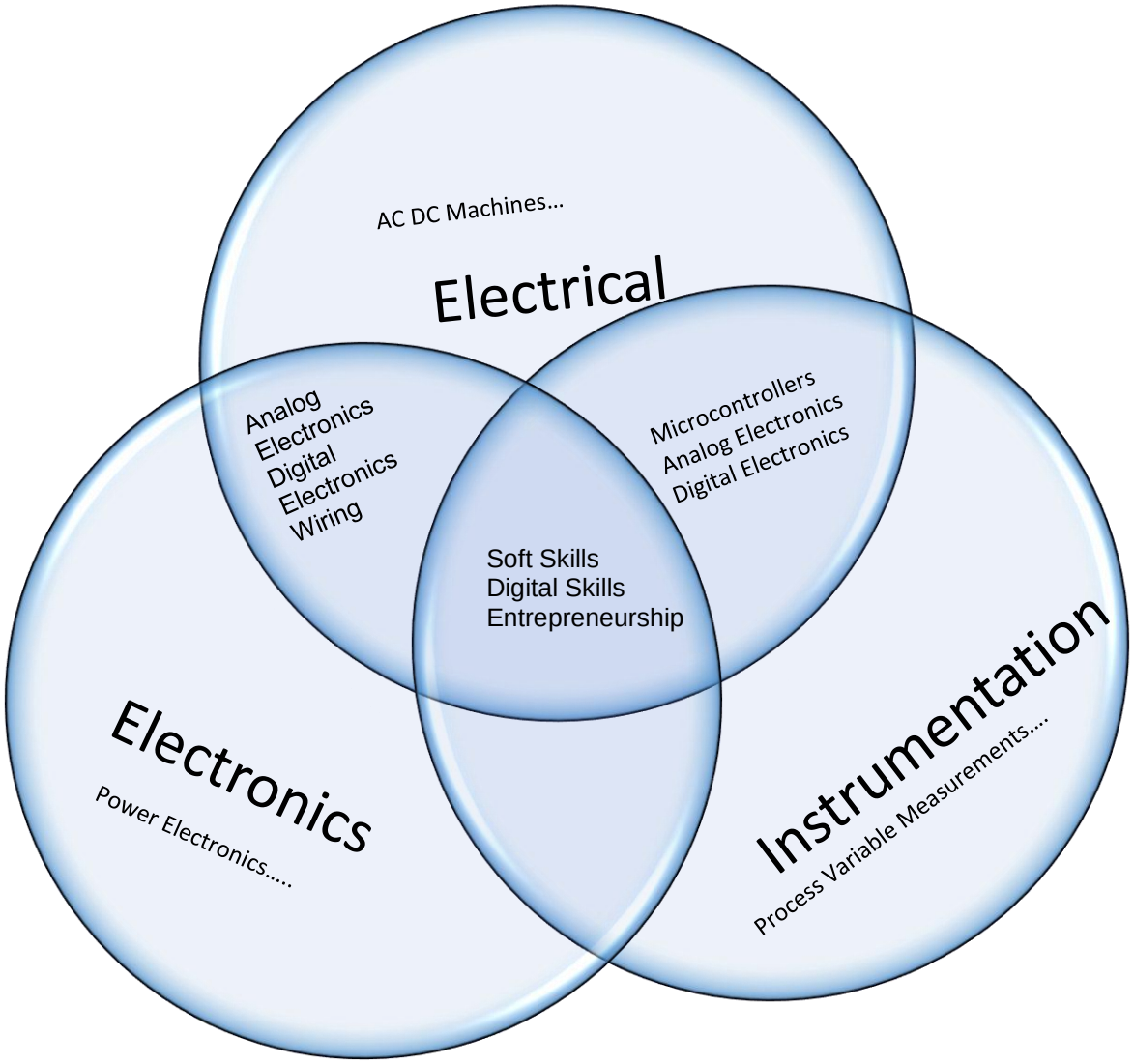
Sr. Lineman

1. Carryout Transmission of Electrical Power
2. Carryout Distribution of Power System.
3. Carryout Protection of Distribution and Transmission System

Entrepreneur

1. Investigate Microbusiness Opportunities
2. Develop A Micro Business Proposal
3. Develop A Marketing Plan
4. Develop and Review a Business Plan
5. Organize Finances for The Micro Business
6. Manage Human Resources
7. Market Products and Services
8. Monitor and Review Business Performance
9. Negotiate for Resolving Business Issues\
10. Manage Personal Finances
11. Coordinate A Work Team
12. Lead Small Teams

Mapping of the Qualifications



Date of Validation

The level 5 of National DAE qualification on Electrical has been validated by the Qualifications Validation Committee (QVC) members on 23-25 May, 2019 and will remain valid for ten years i.e **25 May, 2029**

Date of Review

The level 5 of National DAE qualification on Electrical has been validated by the Qualifications Validation Committee (QVC) members on 23-25 May, 2019 and shall be reviewed after three years i.e **26 May, 2022**

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

Members of Qualifications Development Committee

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

S #	Name	Designation	Organization
1	Muhammad Faheem Anjum	Chief Instructor Electrical DACUM Facilitator	P-TEVTA
2	Amir Amin	HOD Electrical, Research Associate LUMS	City Polytechnic
3	Aijaz Ahmed Zia	Design & Application Engineer	INTECH Process Automation. Lahore
4	Muhammad Asad	Instructor Electrical	P-TEVTA
5	Tahreem Javaid	Lab Engineer	The University of Lahore
6	Huma Naeem	Research Associate	COMSATS Lahore
7	Engr.Inayat Ur Rehman	DACUM Facilitator	KPK-TEVTA
8	Muhammad Yasir	NAVTTC Coordinator	NAVTTC HQ Islamabad

Members of Qualification Validation Committee

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

S #	Name	Designation	Organization
1	Israr Ahmad	DD Academia	KP-TEVTA
2	Muhammad Yasir	NAVTTC Coordinator	NAVTTC HQ Islamabad
3	Sayeda Fatima Iqbal	System Analyst	PBTE Lahore
4	Danish Khan	Calibration Engineer	NPSL(PCSIR) Islamabad
5	Ghulam Rasool Maka	Vice Principal	S TEVTA
6	Muhammad Mehboob butt	Associate Professor	P TEVTA
7	Inayat Ur Rehman	EX Professor/ Ex-Director Academics	KP-TEVTA
8	Muhammad Asad	Instructor Electrical	P-TEVTA
9	Muhammad Faheem Anjum	Chief Instructor Electrical. DACUM Facilitator	P-TEVTA

Entry Requirements

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

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

Detail of Competency Standards

0713E&E1Maintain 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 use of personal protective equipment (PPE)	**P1.** Arrange the required personal protective equipment **P2.** Check functional condition of PPE's **P3.** Wear personal protective equipment **P4.** 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

Tools 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.

0713E&E2 Adopt Safety Regulations, Labor 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. **P7.** 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 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

Knowledge & Understanding

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

- Explain Emergency equipment, supplies and their operation
- Explain Methods of communication during emergency
- Explain Factors affecting Health & Safety in the workplace.

Tools 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)

0713E&E3 Maintain Tools & Equipment for Single Phase Wiring

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.** Identify damaged insulated tools and equipment **P2.** Apply insulation on tools and equipment as per standards **P3.** Check the insulation is working.
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
- Explain storage methods of tools and equipment
- Explain insulation procedure
- Explain types of insulation
- Explain methods of insulated tools and equipment.
- Explain types of calibration
- Explain methods of equipment calibration
- Explain methods of tools and equipment inventory
- Explain 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

0713E&E4 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 upto 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 upto 75mm. **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. **P7.** Insulate 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.** Solder the joint. **P5.** Insulate the joint.

CU5. Make Britannia joint	**P1.** Select the cable. **P2.** Strip both cables upto 75mm. **P3.** Bend the tips of both cable right angle about 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

Tools 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

0713E&E5 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.** Prepare a list of material used according to drawing **P3.** Perform Estimation of Materials **P4.** Calculate Labor Cost
CU2. Prepare Distribution Board	**P1.** Select Distribution board w.r.t. size, current rating, voltage, No. of CBs 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 in DB 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 on appropriate place. **P2.** Take wire from DB to load without joint. **P3.** Distribute load equally depend upon the size of wire.

Knowledge & Understanding

- Define distribution board.
- Describe D.B. w.r.t. size, current rating, voltage, No. of CBs 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).

0713E&E6 Carryout Basic Electrical Installation for Single phase

Overview:

This Competency standard deals with the skills and knowledge required to lay cables, perform single phase connections, basic electric wiring and wiring test for carrying out basic electrical appliances installation. The trainee will be required to follow company guidelines as well as the procedure for carrying out basic electrical appliances 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
- Explain types of joints
- Define conductor and insulator
- Define three phase connection
- Explain Knowledge about cable gauging
- Explain Knowledge about color code of cables / phase sequence.
- Explain Methods of Wiring
- Explain Types of wiring
- Explain Types of connections
- Explain Types of wiring tests
- Describe various wiring test
- Explain Color of cables
- Distinguish between different wiring systems
- Give name of necessary materials required for each type of wiring.
- Explain the uses of each type of wiring.

Tools 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

0713E&E7 Install Simple Single Phase 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.
- Describe socket.
- Define intermediate switch.
- Explain intermediate switch circuit and its use.
- Explain tunnel circuit and its use
- Define impulse switch.
- Define push button.

Tools and Equipment

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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**:** Make series/test lamp circuit.

0713E&E8 Install Single Phase Complex Electrical Wiring

Overview: This Competency Standard covers the skills and knowledge required to Install kitchen circuit, Install Drawing room circuit, Install Sleeping room circuit, install hall wiring, install impulse switch, Install Bell indicator circuit, install timer/time switch circuit, prepare fluorescent tube circuit and install.

Competency Units	Performance Criteria
CU1. Install kitchen circuit	**P1.** Draw wiring diagram of kitchen circuit. **P2.** Draw Current path diagram of kitchen circuit **P3.** Draw layout diagram of kitchen 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. Install Drawing room circuit	**P1.** Draw wiring diagram of drawing room. **P2.** Draw Current path diagram of drawing room. **P3.** Draw layout diagram of drawing room. **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. Install Sleeping room circuit	**P1.** Draw wiring diagram of sleeping room. **P2.** Draw Current path diagram of sleeping room. **P3.** Draw layout diagram of sleeping room. **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. Install hall wiring.	**P1.** Draw wiring diagram of hall. **P2.** Draw Current path diagram of hall. **P3.** Draw layout diagram of hall **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. Install two impulse switch in a 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
CU6. Install Bell indicator circuit.	**P1.** Draw wiring diagram of bell with bell button circuit. **P2.** Draw Current path diagram of bell with bell button circuit. **P3.** Draw layout diagram of bell with bell button 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. Install timer/time switch circuit.	**P1.** Draw wiring diagram of a circuit having timer/time switch. **P2.** Draw Current path diagram of a circuit having timer/time switch. **P3.** Draw layout diagram of a circuit having timer/time switch. **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
CU8. Make fluorescent tube circuit and install.	**P1.** Draw wiring diagram of fluorescent tube circuit and its installation circuit. **P2.** Draw Current path diagram of fluorescent tube circuit and its installation circuit. **P3.** Draw layout diagram of fluorescent tube circuit and its installation 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
CU9. Perform Domestic Electrical Work	**P1.** Install wire for grounding **P2.** Perform pre Installation module based Tests. **P3.** Install conduits or Trunks in the building as per drawing **P4.** Install electrical wiring, as per drawing and standard. **P5.** Install main box and distribution box. **P6.** Install Electric Breakers in main box, as per load for safety measures **P7.** Install the appliances used in electric work as per drawing **P8.** Install emergency light system in main box, as per standard color scheme **P9.** Install Main Distribution Board. **P10.** Test the Installation and obtain test certificate.

Knowledge & Understanding

- Define single pole switch.
- What is lamp?
- Explain single pole switch circuit and its use.
- Define current, voltage, power and resistance.
- Describe socket.
- Define series circuit.
- Define parallel circuit.
- Define impulse switch.
- Define power plug.
- Explain the function of exhaust
- Explain the function of AC and Heater.
- Explain bell circuit
- Explain fluorescent tube circuit
- Describe the safety of installation
- Explain the Protective measures against too high a contact voltage and conduct electrical accidents.
- Describe Fundamentals of installation engineering
- Describe the Power overhead-line systems.
- Describe Low-voltage switchgear and distribution systems.
- Explain Mounting and connection of motor testing of installed plant.

Tools and Equipment

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SN	Tools
1	Electrician Tool kit.
2	Single pole switch.
3	Lamp holder
4	Lamp
5	Woden/PVC board.
6	PVC Pipe/Duct.
7	PVC clamp.
8	Screw
9	PVC wire according to load.

10	Circuit Breaker.
11	AVO meter.
12	Test Indicator.
13	Exhaust
14	Fan
15	Series board.
16	Impulse switch.
17	Power plug

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard**:** Install timer/time switch circuit in a complete house wiring.

0713E&E9 Perform Testing of Electrical Wiring

Overview: This Competency Standard covers the skills and knowledge required to Perform Earth leakage Test, Perform Open Circuit Test, Perform Short Circuit Test, Perform Continuity/Loop Test, Perform Visual Test, Perform Insulation Test, Perform Polarity Test, Perform Earth Resistance Test, Perform Murray Loop Test, and Perform BLAVIER & Earth Loop Test

Competency Units	Performance Criteria
CU1. Perform Earth leakage Test.	**P1.** Ensure the socket must be at least 13A for RCD plug in. **P2.** Adjust the sensitivity of RCD. **P3.** Ensure tripping time must not exceed than 200msec. **P4.** Plug the RCD in socket and switch on socket outlet. **P5.** Ensure P-N and P-E light up. **P6.** Press the test button. **P7.** Ensure that RCD will trip and reading must be shown less than 200msec. **P8.** Move the selection switch to 180^{o}. **P9.** Press the test button. **P10.** Ensure that RCD will trip and reading must be shown less than 200msec. **P11.** Move selection switch to 0^{0}. **P12.** Press the test button. **P13.** Ensure that RCD will trip and reading must be shown less than 200msec.
CU2. Perform Open Circuit Test	**P1.** Disconnect the supply source, neutral conductor and earth conductor from distribution fuse box. **P2.** Connect ohmmeter between starting and ending terminals of live conductor. **P3.** Ensure the reading must be near to 0 ohm. **P4.** Repeat P2 to P3 for neutral and earth conductor.

CU3.	Perform Short Circuit Test	**P1.** Disconnect the supply source, neutral conductor and earth conductor from distribution fuse box. **P2.** Connect one terminal of ohmmeter with live conductor. **P3.** Connect the other terminals of ohmmeter with neutral conductor. **P4.** Ensure the reading must be infinity (No reading). **P5.** Connect ohmmeter between live conductor and earth conductor. **P6.** Ensure the reading must be infinity (No reading)
CU4.	Perform Continuity/Loop Test	**P1.** Connect all metal clad switches, metal parts, conduits with earth. **P2.** Open the main switch. **P3.** Turn on all the switches. **P4.** Connect earth continuity tester with conduit and independent earth. **P5.** Measure the resistance value with tester which must not be more than 1 ohm.
CU5.	Perform Visual Test	**P1.** Check the wires joints. **P2.** Check if there is any spark. **P3.** Check over heating of wires. **P4.** Check all the appliances are on or fluctuating. **P5.** Check all indications of meters. **P6.** Check Voltages on all phases. **P7.** Check the DB and Breakers. **P8.** Check the main supply is coming properly.
CU6.	Perform Insulation Test	**P1.** Switch off the main breaker. **P2.** Short circuit all lighting connections. **P3.** Connect merger between line and earth. **P4.** Rotate the merger to generate the voltage. **P5.** Read the merger dial and ensure that the insulation resistance should not be less than 50M ohm of any single circuit.
CU7.	Perform Polarity Test	**P1.** Switch off the main switch. **P2.** Disconnect all loads. **P3.** Switch on all circuit control switches. **P4.** Connect ohm meter between main line and all the terminal of

	sockets and load points one by one. **P5.** Ensure meter reading value must be less than 1 ohm.
CU8. Perform Earth Resistance Test	**P1.** Place 3 electrodes in earth at distance of 10m apart between every electrode. **P2.** Connect terminal E of earth resistance tester to first electrode. **P3.** Connect terminal P of earth resistance tester to the second electrode. **P4.** Connect terminal C of the earth resistance tester with third electrode. **P5.** Measure the resistances after applying specific voltage. **P6.** Repeat P1 to P5 by interacting earthling regions. **P7.** Ensure 3 readings must be equal.
CU9. Perform Murray Loop Test	**P1.** Connect galvanometer with Wheatstone bridge. **P2.** Connect positive terminal of DC source with Wheatstone bridge. **P3.** Connect negative terminal of DC source with ground. **P4.** Connect remaining two terminal of Wheatstone bridge with two cores of the cable. **P5.** Short the other end of these two cores of cable. **P6.** Note the reading of galvanometer. **P7.** Calculate Rx. **P8.** Repeat the P1 to P7 for other cores of the cable.
CU10. Perform BLAVIER & Earth Loop Test	**P1.** Connect galvanometer with Wheatstone bridge. **P2.** Connect positive terminal of DC source with Wheatstone bridge. **P3.** Connect negative terminal of DC source with ground. **P4.** Connect remaining two terminal of Wheatstone bridge with two cores of the cable. **P5.** Short the other end of these two cores of cable. **P6.** Note the reading of galvanometer. **P7.** Calculate Rx. **P8.** Repeat the P1 to P7 for other cores of the cable.

Knowledge & Understanding

- Define RCD
- Define sensitivity
- Explain P-E and P-N
- Explain the function of RCD.
- Explain the function of distribution box.
- Explain the function of fuse.
- Explain which meters are used for open circuit and short circuits test.
- What does it mean by 0 ohm reading in open circuit test?
- What does it mean by no reading
- In short circuit test?
- Explain the purpose of continuity test.
- Explain the purpose of polarity test.
- Explain the purpose of insulation resistance test.
- Explain the purpose of Murray loop test.
- Explain the purpose of BLAVIER's loop test.
- Describe why Wheatstone bridge is attached in Murray loop test.
- What is the purpose of DC supply in Murray loop test?
- Explain the purpose of Galvanometer.

Tools and Equipment

SN	Tools
1	Sockets
2	RCD
3	Loads
4	Supply source
5	Distribution Box
6	Ohmmeter
7	Earth resistance tester
8	Continuity
9	Tester.
10	Breakers
11	Magger

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard**:** Perform Murray Loop Test.

0713E&E10 Repair/ Maintenance of Single Phase Electrical Installations.

Overview:

This Competency Standard identifies the competencies required to Analyze Fault in Electrical Installations, troubleshooting of electrical equipment's and Carry out Preventive Maintenance. Carry out repair and maintenance of electrical installations at workplace in accordance with the manufacturer's instructions and organizational requirements.

Competency Units	Performance Criteria
CU1. Analyze Fault in electrical Installations	**P1.** Inspect visually the electrical wiring, fixtures, equipment, soldering, connection, appliances and machinery for discovering the faults and defects **P2.** Check the installation for consistency with the electrical drawing **P3.** Draw the layout of equipment's before disassembling of electrical components **P4.** Check the faulty components with scope or meter **P5.** Re assembled the components as per drawing and the installation **P6.** Check the fault indication at relay for HT installation **P7.** Test electrical equipment as specified in the manufacturer's manual and record the results

CU2. Troubleshoot the electrical equipment's	**P1.** Prepare a list of items/material(s) required for repair /replacement as per specifications **P2.** Draw circuit diagram of electrical equipment be disassembling **P3.** Make necessary adjustments in the control and protective switchgear **P4.** Replace defective control & protective switch gear, cables and accessories with standard items **P5.** Replace defective earth electrode & faulty/damaged earthling conductors **P6.** Test installed electrical equipment for safe and optimum performance according to standards & regulations **P7.** Record the results of the test performed on a standard format
CU3. Carry out Preventive Maintenance	**P1.** Perform Preventive maintenance as specified by the manufacturers or SOP **P2.** Check out the equipment logging sheet and updates logging **P3.** Update Maintenance/service records as per requirement

Knowledge & Understanding

- The candidate must be able to demonstrate underpinning Knowledge and understanding: required to carry out the tasks covered in this competency standard.
- Explain layout diagrams, technical sketches, graphic symbols and wiring diagrams, and manufacturer's specifications etc.
- Explain types of electrical tools used for troubleshooting and preventive maintenance purposes
- Explain types of electrical measuring instruments used in testing electrical installations.
- Explain types of electrical wiring systems for domestic& industrial purposes methods of tracing the fault.
- Explain types of electrical control and protective switchgear and accessories used in electrical circuits

- Explain types and principles of operation of circuit breakers used in electrical installations and their applications
- Explain types of electrical wires and cables and their ratings
- Explain types of electrical accessories and their application on electrical installations
- Explain types of earthling systems used in domestic& industrial electrical installations
- Explain Importance of testing electrical installations Importance of corrective & preventive maintenance

Tools and Equipment

SN	Tools
1	Specific Gravity Chart
2	Splicing Machine
3	Spring tension checking meter
4	Tachometer
5	Soldering Lead
6	Soldering Iron
7	Set of Screw Drivers
8	Set of Nose Pliers
9	Safety Shoes
10	Ring Spanner Set
11	RPM Meter
12	Safety Helm
13	Safety Goggles
14	Safety Belt
15	IR Temperature Gun
16	Mini Hydraulic Press Machine
17	OTDR Mete
18	Multimeter
19	Overall Combination
20	Phase Sequence Meter
21	Philips Screw drivers Set
22	L Scale
23	Lux Meter
24	Lugs Punching Machine (Hydraulic and Manual)
25	Medgar (Insulation Tester)

26	Micron Meter
27	Magnetic Conductor
28	Ammeter
29	Hydrometer
30	Hole saw
31	Handsaw
332	Hammer
33	Hacksaw
34	Grinder
35	Battery Charger
36	Gloves
37	Generator
38	Flux
39	Filler gauge
40	Files (set)
41	Earth Tester
42	Battery Cleaning Ki
43	Duct Rod
44	Disk Grinder
45	Combination Plier Set
46	Clamp Meter
47	Circuit Boards
48	Bearing Puller
49	Bench Vice
50	Chisel
51	Cells tester
52	Cable Knife
53	Cable / Wire Gauge

Critical Evidence(s) Required

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

- Trace out the fault and take corrective action

- Carry out the preventive maintenance
- Update the service/repair record

0713E&E11 Repair/ Maintenance and Service of Home Appliance

Overview:

This Competency Standard identifies the competencies required to diagnose fault and repair electric iron, Repair/ maintenance of Pedestal Fan and Ceiling Fan, Repair/ maintenance of Juicer and grinder, Repair/ maintenance Refrigerator /Air conditioner. Carry out repair and maintenance of electrical home appliances in accordance with the manufacturer's instructions.

Competency Units	Performance Criteria
CU1. Diagnose fault and repair electric iron	**P1.** Dismantle the electric Iron for internal tests/servicing/repairs according to manufacturer's instructions **P2.** Check the continuity of wire/switch/protective device by using specified test **P3.** Inspect visual mechanical defect such as, loose connection, short circuit, insulation and temperatures. **P4.** Check the thermostats by using specified test instruments to detect defects. **P5.** Diagnose the faulty area **P6.** Clean the parts of the iron with specified cleaning material **P7.** Repair/replace the faulty parts of iron as per diagnosed fault. **P8.** Re assembled the iron and check iron in test bench as per standard.
CU2. Repair/ maintenance of Pedestal Fan and Ceiling Fan.	**P1.** Dismantle the fan for internal tests/servicing/repairs according to manufacturer's instructions **P2.** Check the continuity of wire/switch/protective device by using specified test **P3.** Inspect visual mechanical defect such as, loose connection, short circuit, insulation and temperatures. **P4.** Check the speed and capacitor **P5.** Check the winding by using specified test instruments to detect defects. **P6.** Diagnose the faulty parts **P7.** Clean the parts of the fan with specified cleaning material

	P8. Repair/replace the faulty parts of fan as per diagnosed fault. **P9.** Rewind the winding **P10.** Assembled and test fan as per standard.
CU3. Repair/ maintenance of Juicer/grinder and Kitchen	**P1.** Dismantle the juicer/grinder for internal tests/servicing/repairs according to manufacturer's instructions **P2.** Check the continuity of wire/switch/protective device by using specified test **P3.** Inspect visual mechanical defect such as, loose connection, short circuit, insulation and temperatures. **P4.** Check the winding by using specified test instruments to detect defects. **P5.** Diagnose the faulty components Clean the parts of the fan with specified cleaning material **P6.** Repair/replace the faulty parts as per diagnosed fault. **P7.** Rewind the winding if wind is burnt **P8.** Re assembled the juicer/grinder and check juicer in test bench as per standard.
CU4. Repair/ maintenance Refrigerator /Air conditioner	**P1.** Turn off the Refrigerator /Air conditioner **P2.** Dismantle the Refrigerator /Air conditioner for internal tests/servicing/repairs according to manufacturer's instructions. **P3.** Inspect visual mechanical defect such as, loose connection, short circuit, insulation and Check the cooling system of air conditioner. **P4.** Check the thermostat glitches **P5.** check the temperature/heat or condenser coil and identify the problems **P6.** Check the gas pressure with pressure gauge **P7.** check the leaking or dirty ducts **P8.** Check the drainage of water **P9.** replace dirty filters **P10.** check ducts and thermostat with specified test equipment's **P11.** Diagnose the faulty components Clean the parts of the fan with specified cleaning material **P12.** Repair/replace the faulty parts as per diagnosed fault. **P13.** Refill the gas up to required standard (10 to 20 psi)

	P14. Before refilling gas create vacuum in compressor or zero gas pressure **P15.** Assembled Refrigerator /Air conditioner and performed test bench as per standard.
CU5. **Repair/ Maintenance of sandwich maker/toaster**	Trainee will be able to **P1.** Dismantle the sandwich maker/toaster for internal tests/servicing/repairs according to manufacturer's instructions **P2.** Check the continuity of wire/switch/protective device by using specified test **P3.** Inspect visual mechanical defect such as, loose connection, short circuit, insulation and temperatures. **P4.** Check the element by using specified test instruments to detect defects. **P5.** Diagnose the faulty components Clean the parts of the sandwich maker/toaster with specified cleaning material **P6.** Repair/replace the faulty parts as per diagnosed fault. **P7.** Replace the heating element if that is burnt **P8.** Re assembled the sandwich maker/toaster and check sandwich maker/toaster in test bench as per standard.
CU6. **Repair/ Maintenance of washing machine/dryer.**	Trainee will be able to **P1.** Dismantle the washing machine/dryer for internal tests/servicing/repairs according to manufacturer's instructions **P2.** Check the continuity of wire/switch/protective device by using specified test **P3.** Inspect visual mechanical defect such as, loose connection, short circuit, insulation and temperatures. **P4.** Check the speed and capacitor **P5.** Check the winding by using specified test instruments to detect defects. **P6.** Diagnose the faulty parts **P7.** Clean the parts of the washing machine/dryer with specified cleaning material **P8.** Repair/replace the faulty parts of fan as per diagnosed fault. **P9.** Rewind the winding if required. **P10.** Assembled and test washing machine/dryer as per standard.

Knowledge & Understanding

- Understand Type, Construction and working principal of iron
- Explain Types of electrical measuring instruments used in testing electric iron
- Explain Working principal of thermostat Fundamentals of transformer.
- Understand Type, Construction and working principal of fan
- Explain Types of electrical measuring instruments used in testing electric iron
- Explain Working principal of capacitor
- Understand Type, Construction and working principal of fan
- Explain Types of electrical measuring instruments used in testing electric iron
- Explain Working principal of capacitor
- Understand Construction and working principal of Refrigerator /Air conditioner fan
- Explain Working principal of electrical measuring instruments used in testing Refrigerator /Air conditioner.
- Study and working principal of condenser and compressor
- Study about helium gas
- Study about pressure gauges
- Explain winding.
- Explain bearing.
- Explain timer.
- Explain Type, Construction and working principal of washing machine/dryer.
- Explain Types of electrical measuring instruments used in testing electric washing machine/dryer
- Explain Type, Construction and working principal of sandwich maker/toaster.
- Explain types of electrical measuring instruments used in testing electric grinder/juicer.
- Working principal of element.
- Explain heating principle.
- Define induction

Tools and Equipment

SN	Tools
1	Electric iron
2	Fan
3	Juicer/grinder
4	Kitchen
5	Refrigerator
6	Air conditioner
7	Ammeter
8	Battery Charger
9	Battery Cleaning Kit
10	Bearing Puller
11	Clamp Meter
12	Disk Grinder
13	Combination Plier Set
14	Bench Vice
15	Duct Rod
16	Cable / Wire Gauge
17	Cable Cutter
18	Cells tester
19	Cable Knife
20	Chisel
21	Circuit Boards
22	Earth Tester
23	Files (set
24	Filler gauge
25	Flux
26	Gloves
27	Grinder
28	Hydrometer
29	Philips Screw Drivers Set
30	Phase Sequence Meter

31	Overall Combination
32	IR Temperature Gun
33	OTDR Meter
34	Ring Spanner Set
35	RPM Meter
36	All related Safety tools
37	Set of Nose Pliers
38	Set of Screw Drivers
39	Soldering Iron
40	Washing machine/Dryer
41	Sandwich maker/toaster

Critical Evidence(s) Required

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

- Troubleshooting of starting system of Refrigerator /Air conditioner
- Replacement of capacitor and bearings of fan

0713E&E12 Install Computer Operating Systems and Hardware

Overview:

This unit describes the performance outcomes, skills and knowledge required to select, configure and use computer operating systems and basic computer hardware.

Unit of Competency		Performance Criteria
CU1.	Identify operating system and hardware components	**P1.** Determine ICT organizational requirements and specifications **P2.** Identify and select operating system **P3.** Identify appropriate external hardware components **P4.** Identify internal hardware components
CU2.	Install and configure operating system and application software with hardware components	**P1.** Install and configure operating system to meet organizational requirements **P2.** Identify the functions associated with the operating system and associated boot process **P3.** Configure power-management settings to minimize power consumption as an environmentally sustainable measure **P4.** Use both the graphical user interface and the command line interface to perform basic tasks **P5.** Install or upgrade application software onto the operating system and hardware configuration **P6.** Determine the relationship between an application program, the operating system and hardware **P7.** Identify general differences between the different computer platforms and their respective operating systems
CU3.	Optimize operating system and hardware components	**P1.** Optimize operating system using included tools or third-party utilities **P2.** Customize the graphical user interface **P3.** Use techniques unique to the command line interface

	P4. Set up and configure external hardware components and check functionality **P5.** Install drivers as appropriate and check functionality

Knowledge and Understanding:

- Basic knowledge of current industry-accepted operating system, hardware and software products
- Compatibility of an operating system, in respect to other versions
- Function of single-user and multi-user operating systems
- Interoperability between operating systems
- OHS principles and responsibilities, including ergonomic principles to avoid injury associated with using computer systems.

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to select, configure and use computer operating systems and basic computer hardware. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to**:**

- Use an operating system in a variety of scenarios and across functions, including**:**
  - scheduling, loading, initiating, and supervising the execution of programs
  - allocating storage
  - initiating and controlling input and output operations
  - handling errors
- Identify and install suitable hardware components

- Install and upgrade application software.

0713E&E13-Operate Word-Processing Applications

Overview:

This unit describes the skills and knowledge required to operate word- processing applications and perform basic operations, including creating and formatting documents, creating tables and printing labels. It applies to individuals in the workplace using fundamental knowledge of word-processing under direct supervision or with limited responsibility.

Unit of Competency	Performance Criteria
CU1. Create documents	**P1.** Open word-processing application, create document and add data according to information requirements **P2.** Use document templates as required **P3.** Use simple formatting tools when creating the document **P4.** Save document to directory
CU2. Customize basic settings to meet page layout conventions	**P1.** Adjust page layout to meet information requirements **P2.** Open and view different toolbars **P3.** Change font format to suit document purpose **P4.** Change alignment and line spacing according to document information requirements **P5.** Modify margins to suit the document purpose **P6.** Open and switch between several documents
CU3. Format documents	**P1.** Use formatting features and styles as required **P2.** Highlight and copy text from another area in the document or from another active document **P3.** insert headers and footers to incorporate necessary data **P4.** have document in another file format **P5.** have and close document to a storage device
CU4. Create tables	**P1.** Insert standard table into document

	P2. Change cells to meet information requirements **P3.** Insert and delete columns and rows as necessary **P4.** Use formatting tools according to style requirements
CU5. Add images	**P1.** Insert appropriate images into document and customize as necessary **P2.** Position and resize images to meet document formatting needs
CU6. Print documents	**P1.** Preview document in print preview mode **P2.** Select basic print settings **P3.** Print document or part of document from printer

Knowledge and Understanding:

- Describe formatting styles and their effect on formatting, readability and appearance of documents.
- Identify organizational requirements for ergonomics, including work periods and breaks
- Select organizational style guide to use
- Outline purpose, use and function of word-processing software.

Critical Evidence(s) Required

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

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to**:**

- follow organizational ergonomic work health and safety (WHS) requirements and practices
- create, open and retrieve documents using customized basic settings
- format documents by creating tables and adding text, objects and images
- Save and prints documents.

0713E&E14 Operate Spreadsheet Applications

Overview:

This unit describes the skills and knowledge required to operate word- processing applications and perform basic operations, including creating and formatting documents, creating tables and printing labels. It applies to individuals in the workplace using fundamental knowledge of word-processing under direct supervision or with limited responsibility.

Unit of Competency	Performance Criteria
CU1. Create presentations	**P1.** Open presentation package and create a simple design for a presentation according to organizational requirements **P2.** Open blank presentation and add text and graphics **P3.** Apply existing styles within a presentation **P4.** Use presentation template and slides to create a presentation **P5.** Use various tools to improve the look of the presentation **P6.** Save presentation to the appropriate storage device and folder
CU2. Customize basic settings	**P1.** Adjust display to meet user requirements **P2.** Open and view different toolbars to view options **P3.** Ensure font settings are appropriate for the presentation purpose **P4.** View multiple slides at once
CU3. Format presentations	**P1.** Use and incorporate organizational charts and bulleted lists, and modify as required **P2.** Add objects and manipulate to meet presentation purposes **P3.** Import objects and modify for presentation purposes **P4.** Modify slide layout, including text and colors, to meet presentation requirements **P5.** Use formatting tools as required within the presentation **P6.** Duplicate slides within and across a presentation **P7.** Reorder sequence of slides and delete slides for presentation purposes **P8.** Save presentation in another format

	P9. Save to storage device and close presentation
CU4. Add slide show effects	**P1.** Incorporate pre-set animation and multimedia effects into presentation as required to enhance the presentation **P2.** Add slide transition effects to presentation to ensure smooth progression through the presentation **P3.** Test presentation for overall effect **P4.** Use onscreen navigation tools to start and stop slide show or move between different slides as required
CU5. Print presentation and notes	**P1.** Select appropriate print format for presentation **P2.** Select preferred slide orientation **P3.** Add notes and slide numbers **P4.** Preview slides and run spell check before presentation **P5.** Print selected slides and submit presentation to appropriate person for feedback

Knowledge and Understanding:

- list basic technical terminology to read help files and prompts
- outline the different types of**:**
- formal and informal presentations
- audience
- explain the effect of design and formatting on the readability and usability of presentations
- outline presentation pitfalls
- Identify suitable presentation effects for different audiences.

Critical Evidence(s) Required

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

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to**:**

- create, format and prepare presentations for distribution and display
- customize basic settings
- Add slide show effects.

0713E&E15 Operate Presentation Packages

Overview: This unit describes the skills and knowledge required to operate word- processing applications and perform basic operations, including creating and formatting documents, creating tables and printing labels. It applies to individuals in the workplace using fundamental knowledge of word-processing under direct supervision or with limited responsibility.

Unit of Competency	Performance Criteria
CU1. Create spreadsheets	**P1.** Open the spreadsheet application, create spreadsheet files and enter numbers, text and symbols into cells according to information requirements **P2.** Enter simple formulas and functions using cell referencing when required **P3.** Correct formulas when error messages occur **P4.** Use a range of common tools during spreadsheet development **P5.** Edit columns and rows within the spreadsheet **P6.** Use the auto-fill function to increment data where required **P7.** Save the spreadsheet to a folder on a storage device
CU2. Customize basic settings	**P1.** Adjust page layout to meet user requirements or special needs **P2.** Open and view different toolbars **P3.** Change font settings so they are appropriate for the document purpose **P4.** Change alignment options and line spacing according to spreadsheet formatting features **P5.** Format cell to display different styles as required **P6.** Modify margin sizes to suit the purpose of the spreadsheets **P7.** View multiple spreadsheets concurrently
CU3. Format spreadsheet	**P1.** Use formatting features as required **P2.** Copy selected formatting features from another cell in the spreadsheet or from another active spreadsheet

	P3. Use formatting tools as required within the spreadsheet **P4.** Align information in a selected cell as required **P5.** Insert headers and footers using formatting features **P6.** Save spreadsheet as another file type **P7.** Save to storage device and close spreadsheet
CU4. Incorporate object and chart in spreadsheet	**P1.** Import an object into an active spreadsheet **P2.** Manipulate imported object by using formatting features **P3.** Create a chart using selected data in the spreadsheet **P4.** Display selected data in a different chart **P5.** Modify chart using formatting features
CU5. Print spreadsheet	**P1.** Preview spreadsheet in print preview mode **P2.** Select basic printer options **P3.** Print spreadsheet or selected part of spreadsheet **P4.** Submit the spreadsheet to appropriate person for approval or feedback

Knowledge and Understanding:

- List basic technical terminology related to reading help files and prompts
- Explain the effect of formatting and appearance on the readability and usability of spreadsheets
- Outline log-in procedures relating to accessing a personal computer (PC)
- Describe the purpose, use and function of spreadsheet applications

Critical Evidence(s) Required

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

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to**:**

- create spreadsheets
- customize basic settings
- format spreadsheets
- create basic formulas

0713E&E16-Perform Writing and Editing Tasks

Overview: This unit describes the skills and knowledge required to apply the conventions of plain English to writing and editing tasks of different forms. It also includes editing and proofreading techniques. It applies to individuals in various writing contexts who write and edit texts using appropriate language, style, grammar, spelling, and standard conventions for editing and proofreading.

Unit of Competency	Performance Criteria
CU1. Apply clear and appropriate language and style to writing and editing tasks	**P1.** Use safe work practices including addressing ergonomic requirements when undertaking writing tasks **P2.** Use clear, concise and plain English in writing and editing tasks **P3.** Apply appropriate paragraph structure to written material to ensure clarity of meaning and ease of reading **P4.** Make clear and logical connections between sentences, paragraphs and sections **P5.** Determine and incorporate the language and style of the audience
CU2. Apply the appropriate voice, tone and tense	**P1.** Determine appropriate voice, tone and tense of the written materials according to audience requirements **P2.** Maintain consistent voice, tone and tense throughout written material
CU3. Apply appropriate grammar, spelling and punctuation	**P1.** Apply appropriate grammar conventions to a range of written contexts including use of numbers, quotations, and tables **P2.** Apply appropriate spelling and punctuation conventions in writing and editing tasks.
CU4. Perform editing and proof reading tasks to meet requirements	**P1.** Edit written material to ensure clear meaning through language and paragraphs, consistent voice, tone and tense **P2.** Copyedit written material by checking grammar, spelling and punctuation using standard editing conventions **P3.** Proofreading using style guides and by monitoring written material for errors

Knowledge and Understanding:

- Main features of clear, concise and plain English language for written material
- Grammar, punctuation and spelling conventions that meet the task requirements
- Editing conventions used in substantive editing and copyediting of written material
- Basic software used to write and collect feedback

Critical Evidence(s) Required

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

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to**:**

- write and edit at least one written material (2500-4000 words) and edit another material written by another author (2500-4000 words), of different forms (e.g. blog, journal, book) that demonstrate use of**:**
  - clear and concise language
  - clear and logical paragraph structures
  - appropriate voice, tone, tense and language
  - plain English grammar, spelling and punctuation
  - accepted grammar conventions for a range of written contexts including use of numbers, quotation and tables
  - standard editing conventions
- complete editing and proofreading tasks using handwritten and digital methods
- Accurately follow a style guide where required.

0713E&E17 Perform Computer Operations

Overview:

This unit covers the knowledge, skills and attitudes and values needed to perform computer operations which include inputting, accessing, producing and transferring data using the appropriate hardware and software.

Unit of Competency		Performance Criteria	
CU1	**Plan and prepare for task to be undertaken**	**P1**	Requirements of task are determined as per standard
		P2	operating procedures
		P3	Appropriate hardware and software is selected according to task assigned and required outcome
		P4	Task is planned to ensure
CU2	**Input data into Computer**	**P1**	Data are entered into the computer using appropriate program/application in accordance with company procedures
		P2	Accuracy of information is checked and information is saved in accordance with standard operating procedures
		P3	Inputted data are stored in storage media according to requirements
		P4	Work is performed within ergonomic guidelines
CU3	**Access information using computer**	**P1**	Correct program/application is selected based on job requirements
		P2	Program/application containing the information required is accessed according to company procedures
		P3	Desktop icons are correctly selected, opened and
		P4	closed for navigation purposes
		P5	Keyboard techniques are carried out in line with OH &S requirements for safe use of keyboards

CU4	Produce/output data using computer system	**P1**	Entered data are processed using appropriate software commands
		P2	Data are printed out as required using computer hardware/peripheral devices in accordance with standard operating procedures
		P3	Files and data are transferred between compatible
		P4	systems using computer software, hardware/ peripheral
		P5	devices in accordance with standard operating
		P6	procedures
CU5	Maintain computer equipment and systems	**P1**	Systems for cleaning, minor maintenance and replacement of consumables are implemented
		P2	Procedures for ensuring security of data, including regular back-ups and virus checks are implemented in accordance with standard operating procedures
		P3	Basic file maintenance procedures are implemented in line with the standard operating procedures

Knowledge and Understanding:

- Basic ergonomics of keyboard and computer use
- Main types of computers and basic features of different operating systems
- Main parts of a computer
- Storage devices and basic categories of memory
- Relevant types of software
- General security
- Viruses
- OH & S principles and responsibilities
- Calculating computer capacity

Critical Evidence(s) Required

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

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to**:**

- Selected and used hardware components correctly and according to the task requirement
- Identified and explain the functions of both hardware and software used, their general features and capabilities
- Produced accurate and complete data in accordance with the requirements
- Used appropriate devices and procedures to transfer files/data accurately
- Maintained computer system

0713E&E18 Use Computer Applications

Overview:

This unit describes the performance outcomes, skills and knowledge required to identify, select and operate three commercial software packages, including a word-processing, a spreadsheet and presentation application package.

Unit of Competency	Performance Criteria
CU1 Use appropriate OHS office work practices	**P1** Use safe work practices to ensure ergonomic, work organization, energy and resource conservation requirements are addressed **P2** Use wrist rests and document holders where appropriate **P3** Use monitor anti-glare and radiation reduction screens where appropriate
CU2 Install and remove software	**P1** Select software to be installed **P2** Follow installation instructions **P3** Delete unrequired software
CU3 Use appropriate word-processing software	**P1** Select word-processing software appropriate to perform activity **P2** Identify document purpose, audience and presentation requirements, and clarify with personnel as required **P3** Identify organizational requirements for text-based business documents and design document structure and layout to ensure consistency of style and image **P4** Match document requirements with software functions to provide efficient production of documents **P5** Use technical functions, other data and formatting to finalize documents **P6** Ensure the naming and storing of documents in appropriate directories or folders and the printing of documents to the required specifications
CU4 Use appropriate spreadsheet software	**P1** Select spreadsheet software appropriate to perform activity **P2** Identify document purpose, audience and presentation requirements, and clarify with personnel as required

	P3 Enter simple formulas and functions using cell referencing where required **P4** Customize spreadsheet settings and format documents to meet requirements **P5** Ensure the naming and storing of documents in appropriate directories or folders and the printing of documents to the required specifications
CU5 Use appropriate presentation software	**P1** Select software application package appropriate to perform activity **P2** Identify purpose, audience and presentation requirements, and clarify with personnel as required **P3** Use technical functions, other data and formatting to finalize documents **P4** Ensure documents are named and stored in appropriate directories or folders and printed to required specifications **P5** Make a presentation

Knowledge and Understanding:

- Application software packages used by the organization
- Basic technical terminology related to reading help files and responding to system help prompts
- Basic knowledge of system usage
- Current business practices related to using software to prepare reports
- Features and functions of commercial computing packages
- Import and export software functions
- Linking documents
- OHS principles and responsibilities for ergonomics, such as work periods and breaks
- Purpose, use and functions of applications
- Use of input and output devices
- Functions and uses of word processing, spreadsheet and presentation software

Critical Evidence(s) Required

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

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Evidence of the ability to**:**

- Produce workplace documents using a minimum of three different software application packages
- Open, amend and save files and documents according to organizational requirements
- Use OHS principles and responsibilities for ergonomics, such as work periods and breaks
- Use help manuals and online help.

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to**:**

- Use an operating system in a variety of scenarios and across functions, including**:**
    - scheduling, loading, initiating, and supervising the execution of programs
    - allocating storage
    - initiating and controlling input and output operations
    - handling errors
- Identify and install suitable hardware components
- Install and upgrade application software.

0713E&E19 Create User Documentation

Overview: This competency standard describes the performance outcomes, skills and knowledge required to create user documentation that is clear to the target audience and easy to navigate.

Unit of Competency	Performance Criteria
CU1 Determine documentation standards and requirements	**P1** Determine documentation requirements **P2** Investigate documentation and industry standards for requirements and determine appropriate application to user documentation **P3** Design documentation templates using appropriate software and obtain approval from appropriate person
CU2 Produce user documentation	**P1** Conduct a review of the subject system, program, network or application in order to understand its functionality **P2** Gather existing technical, design or user specifications and supporting documentation **P3** Create user documentation based on template to record the operation of the subject system, program, network or application
CU3 Review and obtain sign-off	**P1** Submit user documentation to target audience for review **P2** Gather and analyze feedback **P3** Make changes to user documentation **P4** Submit user documentation to appropriate person for approval

Knowledge and Understanding:

- Content features, including clarity and readability
- Document design, web design and usability
- Functions and features of templates and style guides
- Instructional design principles

Critical Evidence(s) Required

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

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to create user documentation that**:**

- Meets business requirements
- Caters for a diverse readership
- Is clear to the target audience
- Is easy to navigate.

0713E&E20 Create Technical Documentation

Overview:

This unit describes the performance outcomes, skills and knowledge required to create technical documentation that is clear to the target audience and easy to navigate.

Unit of Competency		Performance Criteria
CU1	**Identify and analyze documentation requirements and client needs**	**P1** Consult with client to identify documentation requirements **P2** Interpret and evaluate documentation requirements and confirm details with client **P3** Investigate industry and documentation standards for requirements **P4** Define and document the scope of work to be produced **P5** Consult with client to validate and confirm the scope of work
CU2	**Design documentation**	**P1** Identify information requirements with reference to layout and document structure **P2** Create document templates and style guides consistent with information requirements **P3** Conduct a review of the system in order to understand its functionality **P4** Extract content that meets information requirements according to copyright restrictions **P5** Develop the structure of the technical documentation giving focus to the flow of information, style, tone and content format **P6** Validate the technical documentation structure with the client
CU3	**Develop documentation**	**P1** Write technical documentation based on the template and scope of work using the information gathered **P2** Translate technical terminology into plain English where appropriate

	P3	Apply content format and style according to documentation standards and templates
CU4 Evaluate and edit documentation	**P1**	Submit technical documentation to appropriate person for review Gather and analyze feedback
	P2	Incorporate alterations into the technical documentation
	P3	Edit the technical documentation for technical and grammatical accuracy
CU5 Prepare documentation for publication	**P1**	Check that the completed technical documentation meets client requirements and scope of work
	P2	Submit the technical documentation to appropriate person for approval
	P3	Prepare the technical documentation for publication and distribution using appropriate channels

Knowledge and Understanding:

- Content features, such as clarity and readability
- Document design, web design and usability
- Functions and features of templates and style guides
- Instructional design principles
- Organizational policies, procedures and standards that cover document design.

Critical Evidence(s) Required

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

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to**:**

- Establish customer needs
- Design and develop technical documentation, such as system, procedures, training material and user guides, incorporating appropriate standards
- Update document with client feedback
- Prepare documentation for publication.

0713E&E21 Create Basic Databases

Overview:

This unit describes the skills and knowledge required to design, develop and test a database in order to meet a specification. It applies to individuals who may be either database, or web designers, required to create a simple database to store information for an online application, using a simple entity relational database.

Unit of Competency	Performance Criteria
CU1 Analyze the requirements for the database	**P1** Determine the information that the database is required to hold **P2** Develop a written requirement report for the functionality of the database **P3** Complete the documentation, and submit it to the appropriate person for approval
CU2 Use data modeling to design the database to suit requirements	**P1** Design an entity-relationship (ER) diagram to model the relationships between the entities and the attributes that the database will hold **P2** Develop primary and foreign keys to link the entities **P3** Develop a data dictionary **P4** Complete the documentation, and submit it to the appropriate person for approval
CU3 Create a database on a web or database server	**P1** Use the appropriate language on a web or database server to create one or more databases **P2** Use the appropriate language on a web or database server to create tables **P3** Populate the database fields
CU4 Test the database and debug	**P1** Test the database on the web or database server **P2** Ensure that the information represented matches the requirements

Knowledge and Understanding:

- Outline the principles of open platforms, including browsers and databases
- List the processes associated with the creation of entities, attributes, and I populating fields, using both software solutions and script- based input
- Describe data-modeling techniques to design a database
- Outline the steps in database design, modeling and implementation
- Describe the internet operation related to web servers and clients
- Identify the naming conventions appropriate to database design
- Identify security restrictions on servers, incorporating some theoretical concepts
- Describe best practice communication, and accessibility, for audiences with special needs.

Critical Evidence(s) Required

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

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to**:**

- research client requirements for a database solution
- design a database that meets client requirements
- create a database on a web hosting service or server to meet client requirements by a due date
- Test and debug the database.

0713E&E22 Operate Digital Media Technology

Overview: This unit describes the performance outcomes, skills and knowledge required to identify, select and use a digital media package and supporting technologies.

Unit of Competency		Performance Criteria	
CU1	Use appropriate OHS office work practices	**P1**	Use safe work practices to ensure ergonomic, work organization, energy and resource conservation requirements are addressed
		P2	Use wrist rests and document holders where appropriate
		P3	Use monitor anti-glare and radiation reduction screens where appropriate
CU2	Identify and select appropriate digital media package	**P1**	identify the basic requirements of a design brief, including user environment
		P2	Research and review suitable available digital media packages
		P3	Select an appropriate digital media package to meet design brief requirements
CU3	Use digital media package	**P1**	Procure or create suitable data to meet requirements of the brief
		P2	Manipulate data using digital media package tools
		P3	Ensure naming and storing of documents in appropriate file format in directories or folders
CU4	Review digital media design	**P1**	Evaluate design for creative, dramatic and technical quality, file size, and suitability to meet the brief
		P2	Test and run any incorporated graphics, video or sound as part of a digital media presentation and present designs in the appropriate format
		P3	Review final product against design brief

Knowledge and Understanding:

- Basic principles of visual design
- Functions and features of digital media packages and technologies
- Graphic design and stylistic language conventions
- OHS principles and responsibilities for ergonomics, such as work periods and breaks
- Principles of digital imaging and file formats, video and sound file formats, file management and transfer systems
- Vendor product directions in digital media hardware and software
- Visualization and interpreting creative information, scripts (text) and images

Critical Evidence(s) Required

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

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence of the ability to**:**

- Identify basic requirements of a design brief
- Use digital media package to meet organizational requirements
- Use OHS principles and responsibilities for ergonomics, such as work periods and breaks
- Use help manuals and online help when appropriate
- Use digital media technologies to support design brief requirements.

0713E&E23 Use Social Media Tools for Collaboration and Engagement

Overview:

This unit describes the performance outcomes, skills and knowledge required to establish a social networking presence using social media tools and applications. The unit specifically identifies the requirement to review, compare and use different types of social networking tools and applications.

Unit of Competency		Performance Criteria
CU1	**Describe different types of social media tools and applications**	**P1** Explain characteristics of the term social media **P2** Identify different types of social-media tools and applications **P3** Illustrate some of the issues associated with the use of social media tools and applications
CU2	**Compare different types of social media tools and applications**	**P1** Select one social media type for review **P2** Review most popular tools and applications within that social media type **P3** Itemize benefits across a range of the most popular tools and applications **P4** Select most appropriate social media tool or application
CU3	**Set up and use popular social media tools and applications**	**P1** Identify social media tools and applications for possible implementation **P2** Initiate preferred social media tools and applications for use **P3** Establish social media interface using text and file content **P4** Initiate social networking interaction **P5** Test and evaluate tools and applications for ease of use **P6** Present findings

Knowledge and Understanding:

- Basic technical terminology in relation to social networking and social media applications and tools
- Basic knowledge of uploading images, text files, pdf files, audio files, video files and link associated files
- Features and functions of social media applications
- Import and export software functions
- Linking documents
- OHS principles and responsibilities for ergonomics, including work periods and breaks
- Tagging to facilitate collaborative folksonomy
- Social media applications and procedures for connecting to social networking sites
- Use of input and output devices
- Use of RSS feeds to connect a social network.

Critical Evidence(s) Required

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

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to**:**

- Establish customer needs
- Design and develop technical documentation, such as system, procedures, training material and user guides, incorporating appropriate standards
- Update document with client feedback
- Prepare documentation for publication.

0713E&E24 E-Commerce

Overview:

The aim of this module is to develop efficient E-Marketing strategies in accordance with the Vision and Mission statement of the organization driven by Electronic means.

Unit of Competency		Performance Criteria	
CU1	**Social Media Marketing**	**P1**	Identify different Social media marketing techniques
		P2	Apply suitable Classified Advertisement techniques on social media
		P3	Perform Electronic Mail Marketing
		P4	Creation of Blogs
CU2	**SCM (Supply Chain Management)**	**P1**	2dentity potential Suppliers
		P2	Select the appropriate supplier
		P3	Place order as per requirement/inventory
		P4	inspect received order
		P5	Maintain Inventory as per Inventory Control / store keeping techniques
		P6	Identity different available transportation mode
		P7	identify steps of reverse SCM i-e from consumer to organization
CU3	**SEO (Search Engine Optimization)**	**P1**	Apply SEO techniques
		P2	Employ SEO key words
		P3	Demonstrate SEO techniques to priorities their site or web application using automated tools

Knowledge and Understanding:

- K1: Describe Knowledge of different social media sites that is Facebook, Twitter, LinkedIn, Google+ etc., Comparative Statement, Award of Contract, Maintenance)
- K2**:** Explain Brand page creation on social media sites.
- K3**:** Evaluate familiarity of banner ads integration on different web sites like newspaper site in any demographic region.
- K4**:** Mention skills to regularly update brand/product/service blogs.
- K5**:** Information about electronic Data Interchange methodologies and format
- K6**:** Elaborate direct marketing techniques e.g. Email, SMS (Mobile- Commerce) for the projection of company newsletters

- Explain different SEO Methods including but not limited to Getting Indexed, Preventing Crawling, and Increasing Prominence.
- Elaborate White-hat, Black-hat SEO techniques for web application
- Knowledge of SEO key words for web page translation.
- Application of SEO tools usage
- Elaborate knowledge of procurement Cycle (Launch of RFP/RFQ, Tender, Bidding, Comparative Statement, Award of Contract, Maintenance)
- Explain different techniques to manage
- Explain product delivery and their traceability
- Knowledge of Incorporation of Outsourcing in logistics.
- Information about electronic Data Interchange methodologies and format

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability.

0713E&E25 Use Digital Devices

Overview:

This unit describes the skills and knowledge required to use a range of digital devices, such as a digital camera, video camera, or personal digital assistant (PDA) device. It applies to individuals who require entry level information and communications technology (ICT) knowledge and literacy skills to support their work in a home office or small office environment.

Unit of Competency		Performance Criteria
CU1	Prepare to use the digital device	**P1** Review the instruction manual and ensure identified components are available **P2** Identify the physical components of the digital device **P3** Turn on and follow access procedures to activate the digital device **P4** Alter the digital device settings to best suit intended use **P5** 1Configure power management settings where appropriate to minimize power consumption, as an environmentally sustainable measure
CU2	Set up and use the digital device	**P1** Identify and set the basic operating, security and menu settings **P2** Navigate and manipulate the screen environment **P3** Customize screen icons and access to applications where applicable **P4** Use the digital device, and save and edit output where applicable **P5** Identify more advanced features available and use as required
CU3	Access and use basic connectivity devices	**P1** Connect to external digital devices, such as computer devices or storage devices, to retrieve, copy, move and save information **P2** Check physical connectivity of computer devices or storage devices to ensure operation and performance **P3** Connect to a printer either through a computer device or directly, and use printer settings and print data

		P4 Access audio-visual devices to view and play a multimedia file
CU4	Shut down digital device	**P1** Save current work and back up important data **P2** Close open programs on the digital device and any computer device or storage device **P3** Shut down digital devices, according to manufacturer instructions

Knowledge and Understanding:

- Outline the capabilities and connectivity requirements of relevant**:**
  - audio-visual devices
  - peripheral devices
  - storage devices
- List basic security functions
- Explain basic software operation and associated applications
- Explain digital device functions
- Explain digital device settings.

Critical Evidence(s) Required

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

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to**:**

- turn on a digital device
- use the menu features and navigate a graphical user interface
- use device features to perform tasks

0713E&E25A Use Social Media as a Platform to Promote Your Institution Achievements

Overview:

This unit describes the performance outcomes, skills and knowledge required to promote any workplace.

Unit of Competency	Performance Criteria	
CU1. Plan your activity	**P1.**	Select the social media site you will use to promote your institution
	P2.	Compile the achievements of your institution with details in a folder, in form of pictures or MS office document
CU2. Prepare your online page/group/account.	**P1.**	Make an online page/group/account on social media site
	P2.	Give your name of institution as title.
	P3.	Write a brief history about your Institute
	P4.	Select the privacy settings as per requirement
CU3. Advertise your work	**P1.**	Share your achievements one by one
	P2.	Give the brief description of every event.

Knowledge and 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**:**
- Basic technical terminology in relation to social networking and social media applications and tools
- Basic knowledge of uploading images, text files, pdf files, audio files, video files and link associated files
- Features and functions of social media applications
- Import and export software functions
- Linking documents

- OHS principles and responsibilities for ergonomics, including work periods and breaks

Critical Evidence(s) Required

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

Prepare an online group on social media

0713E&E26 Operate Measuring Instruments

Overview: This competency standard covers the skills and knowledge required to operate ampere meter, voltmeter, ohm meter and Digital Multimeter.

Competency Units	Performance Criteria
CU1. Operate Ampere meter.	**P1.** Identify the Ampere meter amongst other measuring instruments. **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 the Voltmeter amongst other measuring instruments. **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 the Ohm meter amongst other measuring instruments. **P2.** Adjust proper range of ohm meter as per resistance value. **P3.** Connect ohm meter to resistor in circuit. **P4.** Take the reading.
CU4. Operate DMM	**P1.** Identify the DMM amongst other measuring instruments **P2.** Perform beep(continuity) test by pointing the knob towards alarm sign and connecting the probes together **P3.** Adjust the selection knob for voltage, current and resistance **P4.** Measure values with DMM for above three competency units.

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
- Describe the use of DMM.

Tools and Equipment

SN	Tools
1	Voltmeters
2	Ammeter
3	Ohmmeters
4	Digital Multimeter(DMM)
5	Resistors of different values.
6	Small pieces of copper wire.
7	Resistors

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

0713E&E27 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 up the voltage of each resistor and verify KVL(Kirchhoff's Voltage Law)
CU2. Make parallel circuit and measure current and verify KCL	**P1.** Construct parallel circuit with different resistors on bread board. **P2.** Measure the current across each resistor as well as total current. **P3.** Note the value of current against each resistor. **P4.** Sum up the reading of ampere meters and verify,(Kirchhoff's Current Law)
CU3. Verify resistance of a resistor	**P1.** Select the resistor of different values. **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 Rheostat	**P1.** Take sliding Rheostat of 17 Ω and Ohmmeter. (0 to 20 or more than 17 Ω) which is available. **P2.** Check ohm's meter(analogue) for zero error

	P3. Adjust zero with shortning the ohmmeter leads. **P4.** Take reading of rheostat when slide is full placed at end,(whole resistance of rheostat)with the ohmmeter like digram shown above. **P5.** Record the result **P6.** 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 . **P2.** Adjust zero error with shortning the ohmmeter leads. **P3.** Record the reading.
CU7. Measure resistance of incandescent lamp.	**P1.** Adjust zero error with shortning the ohmmeter leads. **P2.** Connect the ohmmeter with its terminal and note its resistance **P3.** Measure the resistance of an incandescent lamp(40 W)., **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

- State Ohms Law

Tools 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 shortening the ohmmeter leads.

0713E&E28 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 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 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 meters.
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	**P1.** Connect ampere meter as well as current coil of power factor meter in series with load

with power factor meter	**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 from 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.** Check the rotation of motor disc for correct phase sequence. **P5.** Check the rotation of motor disc for incorrect 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 difference 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?

Tools 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

0713E&E29 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.** Record 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.** Record 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.

Tools 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

0713E&E30 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.** Connect the copper rod through rheostat with DC supply. **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.** Variate Continuously 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?

Tools 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.

0713E&E31 Verify Law of Combination of Capacitor & Determine Break Down Voltage of Capacitor.

Overview:

This competency standard covers the skills and knowledge required to Implement a series circuit of capacitors, implement a parallel circuit of capacitors, and determine the breakdown voltage of low voltage capacitor.

Competency Units	Performance Criteria
CU1. Implement a series circuit of capacitors.	**P1.** Assemble a series circuit of capacitors with 3 different values. **P2.** Connect the battery and apply 10 voltages to the combination of capacitors **P3.** Measure the voltage across each capacitor connected in series **P4.** Add the voltage of each capacitor and verify is it equal to applied voltage. **P5.** Find the charge on each capacitor.
CU2. Implement a parallel circuit of capacitors.	**P1.** Assemble a parallel circuit of capacitors with 3 different values. **P2.** Connect the battery and apply 10 voltages to the combination of capacitors. **P3.** Find the charge on each capacitor. **P4.** Verify the net charge on the capacitor.
CU3. Determine the breakdown voltage of low voltage capacitor	**P1.** Take a capacitor of 6.3 rated volts. **P2.** Connect it across a 0-30 volts D.C variable supply **P3.** Increase the voltage of variable supply from zero to rated 6.3v, and then higher than the rated. **P4.** Observe carefully the voltmeter reading. **P5.** Note the voltage level (critical) at which the capacitor burns and .

Knowledge & Understanding:

- What is breakdown of capacitors?
- What is dielectric?
- What is breakdown voltage of capacitors?
- What factor can affect the life of a capacitor?
- What is charging of capacitor?
- How can we discharge capacitors before touching them to avoid electric current?

Tools and Equipment

SN	Tools
1	Capacitors, 4.7 µf
2	Capacitors, 10, 100 & 8.2 µF.
3	Voltmeter
4	D.C. power supply unit
5	Bridging plugs
6	Connecting leads
7	Multimeter. (With option of Capacitance measurement).
8	Variable D.C powers supply 0-30 Voltas.
9	Capacitor (Sanyo Operated Volts 6.3 V, SE 30)
10	D.C Analog or Preferably Digital voltmeter Range 0-50V.
11	L.E.D (3 to 9 V) Optional.
12	Connecting Leads

Critical Evidence(s) Required

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

- Determine the breakdown voltage of low voltage capacitor

0713E&E32 Perform Cleaning, Oiling and Centering the Job

Overview:

This competency standard covers the skills and knowledge required to perform cleanig and oiling of the lathe machine, perform centreing the job by tool method and perform centreing the job held in a four jaw chuck of face plate.

Competency Units	Performance Criteria
CU1. Perform Cleaning and Oiling of the Lathe Machine	**P1.** Clean spindle threads properly **P2.** Clean lead screw of machine properly **P3.** Clean oil cap and oil plug using cotton cloth **P4.** Clean cross slide and compound slide **P5.** Clean spindle bore and quill of tail stock **P6.** Lubricate oil caps of machine **P7.** Lubricate oil spindle threads **P8.** Use prescribed grade of oil for oiling and lubrication
CU2. Perform Centreing the Job By Tool Method	**P1.** Prepare a M.S Round Bar as per drawing **P2.** Mount four jaw chuck on spindle of lathe machine **P3.** Clamp work piece 100mm out of chuck from one end **P4.** Clamp cutting tool on tool post of lathe machine **P5.** Place cutting tool on surface of job and rotate chuck with hand to identify out centring **P6.** Loose the opposite side jaw, where the job is out cantered **P7.** Tighten the chuck in the direction of marked line **P8.** Repeat that step if required to centre the job
CU3. Perform Centreing The Job Held In A Four Jaw Chuck Of Face Plate	**P1.** Prepare a M.S Round Bar as per drawing **P2.** Mount four jaw chuck on spindle of lathe machine **P3.** Clamp work piece 100mm out of chuck from one end **P4.** Mount surface gauge on bed ways of lathe machine **P5.** Mark lines on surface of job with help of surface gauge to identify out centring **P6.** Loosen the opposite side jaw, where the job is out centred **P7.** Tighten the chuck in the direction of marked line **P8.** Repeat that step if required to centre the job

Knowledge & Understanding

- Discuss oil grades.
- Explain parts of lathe machine
- Define lubrication
- Define oiling
- What three jaw universal chuck?
- Define how to use surface gauge
- Describe face plate
- How to use four jaw independent chuck?
- Define how to use surface gauge
- Describe face plate

Tools and Equipment

SN	Tools
1	Mobile Oil
2	Kerosene Oil
3	Tool post key
4	Steel rule
5	Chuck key
6	Steel bar
7	Wood block
13	Cotton Glove
14	Lathe too
18	Three jaw universal chuck
19	Four jaw independent

Critical Evidence(s) Required

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

Perform Centreing The Job Held In A Four Jaw Chuck Of Face Plate

0713E&E33 Perform Facing, Straight Turning, Centre Drilling

Overview:

This competency standard covers the skills and knowledge required to perform facing, perform straight turning, perform centre drilling.

Competency Units	Performance Criteria
CU1. Perform Facing	**P1.** Prepare a M.S Round Bar as per drawing **P2.** Mount universal chuck on spindle of lathe machine **P3.** Clamp work piece 25mm out of chuck from one end **P4.** Clamp right hand side facing tool on tool post **P5.** Adjust centre height of tool nose **P6.** Set spindle speed by considering job dia and material of job **P7.** Face the work piece on both sides with help of cross slide **P8.** Measure the length of the job **P9.** Perform cleaning operation on machine
CU2. Perform Straight Turning	**P1.** Prepare a M.S Round Bar as per drawing **P2.** Mount universal chuck on spindle of lathe machine **P3.** Clamp work piece 25mm out of chuck from one end **P4.** Clamp right hand side turning tool on tool post **P5.** Check centre height of tool nose **P6.** Adjust spindle speed by considering job dia and material of job **P7.** Face the work piece on both sides with help of cross slide **P8.** Make a trial cut to straighten the job **P9.** Turn off the machine and measure diameter of work piece **P10.** Adjust the cross feed collar to zero **P11.** Set appropriate cut and turn the diameter of work piece **P12.** Adjust cutting depth of 0.5mm for finishing the job and complete the job **P13.** Measure the diameter of job **P14.** Perform cleaning operation on machine

CU3. Perform Centre Drilling	**P1.** Prepare a M.S Round Bar as per drawing **P2.** Mount universal chuck on spindle of lathe machine **P3.** Clamp work piece 25mm out of chuck from one end **P4.** Clamp right hand side facing tool on tool post **P5.** Adjust centre height of tool nose **P6.** Adjust spindle speed by considering job dia and material of job **P7.** Face the work piece from both sides **P8.** Clamp centre drill in drilling chuck and mount it in tail stock spindle **P9.** Turn on the machine and slowly feed centre drill towards work piece using tail stock hand wheel **P10.** Slide tail stock spindle Back and forth and complete centre drilling operation **P11.** Use oil during cutting operation for cooling and lubrication. **P12.** Perform cleaning operation on machine

Knowledge & Understanding

- What is four jaw independent chuck
- Define how to use surface gauge
- Define cutting speed
- Define cutting feed
- Describe angles of facing tool
- Explain types of turning
- Describe centre drilling operation
- Explain purpose of centre drilling

Tools and Equipment

SN	Tools
1	Three jaw universal chuck
2	Speed change lever
3	Centre drill
4	Drill chuck

5	Drill chuck key
6	Vernier calliper
7	Tool post key
8	Steel rule
9	Chuck key
12	Right hand Turing tool
14	Dead centre
16	Right hand side facing tool
17	Surface gauge
19	Speed change lever

Critical Evidence(s) Required

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

- Perform Facing

0713E&E34 Perform Drilling, Step Turning, Knurling and Boring a Straight Hole on lathe

Overview:

This competency standard covers the skills and knowledge required to Perform Drilling On Lathe, Perform Step Turning, Perform Knurling and Perform Boring A Straight Hole.

Competency Units	Performance Criteria
CU1. Perform Drilling On Lathe	**P1.** Prepare a M.S Round Bar as per drawing **P2.** Mount universal chuck on spindle of lathe machine **P3.** Clamp work piece 25mm out of chuck from one end **P4.** Adjust drilling speed by considering material of job **P5.** Face the work piece from both sides **P6.** Adjust the angle point of drill **P7.** Perform centre drilling operation **P8.** Clamp the drill of 5mm dia and create pilot hole **P9.** Perform drilling operation as per drawing **P10.** Unclamp the job and debar the job **P11.** Perform cleaning operation on machine
CU2. Perform Step Turning	**P1.** Prepare a M.S Round Bar as per drawing **P2.** Mount universal chuck on spindle of lathe machine **P3.** Clamp work piece 25mm out of chuck from one end **P4.** Clamp right hand side turning and facing tool on tool post **P5.** Adjust centre height of both tool nose **P6.** Adjust spindle speed by considering job dia and material of job **P7.** Face the work piece from one side **P8.** Mount centre drill in tail stock spindle **P9.** Perform centre hole drill on one side of job **P10.** Face other side of job to get required length **P11.** Clamp job as per drawing and support with dead centre **P12.** Turn dia of 12mm on the length of 47mm **P13.** Turn dia of 17mm on the length of 47mm

	P14. Unclamp the job and change the side **P15.** Turn dia of 23mm on the length of 47mm **P16.** Perform square shoulder turn operation on each step **P17.** Unclamp the job and debar the job **P18.** Perform cleaning operation on machine
CU3. Perform Knurling	**P1.** Prepare a M.S Round Bar as per drawing **P2.** Mount universal chuck on spindle of lathe machine **P3.** Clamp work piece 25mm out of chuck from one end **P4.** Clamp knurling tool on tool post **P5.** Check centre height of knurling tool **P6.** Adjust spindle speed 75% lower than turning speed **P7.** Adjust knurling tool at 90* with job axis **P8.** Adjust carriage feed at 0.38 to 0.76mm/revolution **P9.** Touch knurling tool with job surface and feed 0.63mm towards job **P10.** Start the machine and take light cut **P11.** Stop the machine, inspect the job and adjust if required **P12.** Start the machine on automatic feed and complete the job
CU4. Perform Boring A Straight Hole	**P1.** Clamp turning and facing tools in tool post **P2.** Check center height of both tools **P3.** Hold the job in chuck **P4.** Face the job on both sides and achieve the length of 48mm **P5.** Cut chamfer of 3x45* on both ends of job **P6.** Drill a through hole of 10mm **P7.** Drill a through hole of 16mm and 25mm **P8.** Clamp boring bar in tool post **P9.** Move carriage with hand to check if boring bar is not touching the sides of job P10. Adjust feed of 0.8mm to 1.2mm along longitudinal way P11. Touch boring bit point with internal circumference of job P12. Adjust appropriate depth of cut and complete the job with automatic feed

Knowledge & Understanding

- Describe job materials
- Define RPM.
- Describe drilling operation
- Explain purpose of pilot hole drill
- Define step turning
- Define cutting feed
- Describe r.p.m for step turning
- Explain types of turning
- Define types of knurling
- Describe r.p.m for knurling
- Explain purpose of knurling
- Define types of boring
- Describe r.p.m for boring
- Explain purpose of boring bar

Tools and Equipment

SN	Tools
1	Three jaw universal chuck
2	Oil can
3	Speed change lever
4	Boring bar
5	Vernier calliper
6	Dead centre
7	Steel rule
8	Surface gauge
9	Tool post key
10	Chuck key
13	Lever
15	Knurling tool
20	Drill chuck
21	Drill chuck key

22	Centre drill
23	Flat file
24	Drills of required dia
25	Speed change lever
40	Right hand side facing tool
41	Right hand Turing tool
42	Speed change lever

Critical Evidence(s) Required

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

- Perform Boring A Straight Hole

0713E&E35 Perform Step or Counter Boring, Reaming, Tool Grinding, Taper Turning and Cutting Metric Threads.

Overview:

This competency standard covers the skills and knowledge required to perform step or counter boring, perform reaming, perform tool grinding, perform taper turning by compound rest method and perform cutting metric threads on lathe machine.

Competency Units	Performance Criteria
CU1. Perform Step Or Counter Boring	**P1.** Clamp half-length of job outside chuck **P2.** Clamp facing tool in tool post **P3.** Check center height of tool **P4.** Face both ends of job as per drawing **P5.** Centre drill one side of job **P6.** Drill through hole of dia 6mm **P7.** Drill through hole of 12mm **P8.** Clamp boring bar on tool post **P9.** Move carriage with hand to check if boring bar is not touching the sides of job **P10.** Adjust feed of 0.8mm to 1.2mm along longitudinal way **P11.** Cut the bore of 16mm throughout hole **P12.** Cut the bore dia of 20mm on length of 24mm **P13.** Check bore size on both sides
CU2. Perform Reaming	**P1.** Prepare a M.S Round Bar as per drawing **P2.** Mount universal chuck on spindle of lathe machine **P3.** Clamp work piece 25mm out of chuck from one end **P4.** Adjust drilling speed by considering material of job **P5.** Face the work piece on both sides **P6.** Check the angle point of drill **P7.** Perform centre drilling operation **P8.** Clamp the drill of 5mm dia and create pilot hole **P9.** Perform drilling operation using drill of 11.8mm dia **P10.** Clamp 12mm dia reamer in drill chuck **P11.** Insert reamer in to work piece and use cutting fluid

	P12. Turn off the machine and slowly exert reamer
CU3. Perform Tool Grinding	P1. Dress the face of grinding wheel P2. Hold tool bit to grind appropriate cutting edge angle P3. Slide tool bit right to left on face of wheel P4. Grind cutting edge angle and end relief angle at same time P5. Check end relief angle P6. Produce minor radius on tool nose
CU4. Perform Taper Turning By Compound Rest Method	P1. Clamp work piece 25mm out of chuck from one end and Clamp right hand side turning tool on tool post P2. Adjust centre height of tool nose P3. Adjust spindle speed by considering job dia and material of job P4. Face the work piece on both sides with help of cross slide P5. Perform centre hole drill on one side of job P6. Face other side of job to get required length P7. Clamp job as per drawing and support with dead centre P8. Turn whole length of job on 23mm dia P9. Adjust compound slide on angle of 1*-54' P10. Adjust appropriate depth of cut P11. Control feed with compound slide knob and cut taper on job P12.Check the minor dia with help of Vernier calliper
CU5. Perform Cutting Metric Threads On Lathe Machine	P1. Clamp work piece 25mm out of chuck from one end and Clamp facing and turning tool on tool post P2. Check centre height of tool nose P3. Face the work piece on both sides with help of cross slide P4. Perform centre hole drill on one side of job P5. Clamp job as per drawing and support with dead centre P6. Turn whole length of job on 22mm dia P7. Set threading tool on 90* with axis of work piece using angle gauge P8. Touch threading tool with job surface and set cross feed collar to zero P9. Adjust gears on spindle and lead screw as per standard P10. Take appropriate cuts to complete threading

	P11. Measure the pitch of threading performed

Knowledge & Understanding

- Define types of counter boring
- Describe r.p.m for counter boring
- Explain purpose of counter boring bar.
- Define types of reamer.
- Describe r.p.m for reaming.
- Explain purpose of reaming
- Define types of wheel dresser.
- Describe r.p.m for grinding
- Explain types of grinder
- Define types of taper turning
- Describe r.p.m for taper turning
- Explain purpose of taper turning
- Explain purpose of Threading
- Describe types of Threads
- Define angle of Thread

Tools and Equipment

SN	Tools
1	Three jaw universal chuck
2	Grinding gauge
3	Tool bit
4	Oil stone
5	Wheel dresser
6	Chuck key
7	Pedestal grinder
8	Speed change lever
9	Dead centre
1	Reamer Dia 12mm
11	Oil can
12	Vernier calliper
13	Surface gauge

14	Steel rule
15	Tool post key
16	Chuck key
17	Speed change lever
18	angle gauge
20	Oil can
22	Boring bar

Critical Evidence(s) Required

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

- Perform Knurling

0713E&E36 Perform Basic Metal Work

Overview:

This competency standard covers the skills and knowledge required to Develop Name Plate manually, Carry out Sawing, Prepration of Inside Calliper, Prepration of Bottle Opener, Preparation of Dove Tail Joint, Prepration of small size Tri Square, Produce Threads on Work Piece, Prepration of Funnel, Prepration of Drawer Handle, Produce Pipe Threads, Prepration of spanner(small size).

Competency Units	Performance Criteria
CU1. Develop Name Plate manually	P1. Select marking tools P2. Cut sheet as per drawing P3. Perform surface finishing with file P4. Level the surface with tri-square P5. Mark the plate as per name requirements P6. Punch the marked area P7. Perform finishing with sand paper
CU2. Carry out Sawing	P1. Mark the job according to given drawing P2. Select appropriate blade according to job requirement P3. Set blade in frame of hacksaw as per procedure P4. Ensure the work piece is clamped firmly and properly P5. Adopt methods and techniques for sawing that is appropriate to job requirement P6. Follow marked line during sawing to ensure accuracy.
CU3. Prepare Inside Calliper	P1. Cut sheet as per drawing P2. Mark the job according to given drawing P3. Adopt appropriate methods and techniques of filing P4. Perform bending operation using hammer and bench vice. P5. Perform drilling operation using twist drill according job drawing

	P6. Perform riveting operation using cross peen hammer P7. Perform finishing with sand paper
CU4. Prepare Bottle Opener	P1. Select marking tools P2. Cut sheet as per drawing P3. Perform surface finishing with file P4. Level the surface with tri-square P5. Mark radius as per drawing P6. Develop radius as per drawing P7. Make the notch with round file P8. Perform finishing with sand paper
CU5. Prepare Dovetail Joint	P1. Select marking tools P2. Cut sheet as per drawing P3. Perform surface finishing with file P4. Level the surface of both work pieces with tri-square P5. Mark both work pieces according to drawing P6. Create outer notch on work piece using flat file and hacksaw P7. Create inner notch using hacksaw and chisel P8. Compare both pieces by inserting outer notch into inner notch P9. Perform finishing with sand paper.
CU6. Prepare small size Tri Square	P1. Select marking tools P2. Cut sheet as per drawing P3. Perform surface finishing with file P4. Level the surface of both work pieces with tri-square P5. Mark both work pieces according to drawing P6. Cut 45* on one end of both work pieces and file accordingly P7. Create a narrow cut in handle to fit blade P8. Drill a hole in handle as per drawing and rivet that hole P9. Check the firm ability of handle and blade P10. Perform finishing with sand paper.
CU7. Produce Threads	P1. Identify different kind of taps & die according to

on Work Piece	requirement P2. Identify the work piece clamping method. P3. Apply tap and die alignment. P4. Apply lubricants while threading. P5. Avoid unwanted engraving and slips. P6. Identify proper threading procedure
CU8. Prepare a Funnel	P1. Select marking tools P2. Cut sheet as per drawing P3. Perform surface finishing with file P5. Mark the sheet according to drawing P6. Cut the sheet with hand shear P7. Create radius of funnel using appropriate tools P8. Perform flat lock seam bend using bench vice P9.Perform finishing with sand paper.
CU9. Prepare Drawer Handle	P1. Select marking tools P2. Cut MS Round as per drawing P3. Mark the round bar according to drawing P4. Bend the bar using bench vice according given radius P5. Check the radius on both ends of bar P6.Perform finishing with sand paper.
CU10. Produce Pipe Threads	P1. Select marking tools P2. Cut pipe as per drawing P3. Select die as per pipe size P5. Adjust die into die holder P6. Select relevant vice for pipe clamping P7. Perform pipe threading using appropriate method P8.Perform finishing with sand paper.
CU11. Prepare spanner(small size)	P1. Select marking tools P2. Cut sheet as per drawing P3. Perform surface finishing with file P4. Level the surface with tri-square P5. Mark radius as per drawing P6. Develop radius as per drawing P7. Make the notch with round file P8. Perform finishing with sand paper

Knowledge & Understanding

- Define basic measurement
- Describe basic measuring /Marking /cutting tools
- Describe clamping/holding methods
- Describe basic measurement
- Describe types of hacksaw frames
- Describe basic measuring Marking /cutting tools
- Describe clamping/holding methods
- Define methods and techniques of sawing.
- Define types of hammers
- Describe riveting methods
- Describe the drilling procedure
- Explain drilling machine
- Describe basic measurement
- Describe basic measuring /Marking /cutting tools
- Describe clamping/holding methods
- Describe use of round file
- Describe basic measurement
- Describe basic measuring /Marking /cutting tools
- Describe types of chisels
- Understanding of chiseling process
- Understanding of types of fits
- Describe clamping/holding methods
- Understanding of chiseling process
    - Describe use of bevel protector
- Knowledge of different kind of taps & die according to requirement
- Knowledge of calculation for drill size for internal threading
- Understanding proper use of hand shear
    - knowledge of flat lock seam end in metal sheet working

- Describe clamping/holding methods
- Knowledge of inch system measurement
- Describe basic measurement
- Describe basic measuring /Marking /cutting tools
- Describe clamping/holding methods
- Knowledge of radius gauge

Tools and Equipment

SN	Tools
1	Work bench
2	Bench vice
3	Hammer
4	Tri-square
5	Hand hacksaw
6	Scriber
7	Vernier calliper
8	Flat File
9	Number/alphabet punch

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard**:** Prepare spanner of 6 inches.

0713E&E37 Perform Wood Work

Overview:

This competency standard covers the skills and knowledge required toPlanning and Squaring to dimensions, Sawing Exercise, Making Mortise and Tendon Joint, Making Dado Joint, Making Cross-lap Joint, making holes of different Diameters in Wood, Nailing and Wood Screwing Process, Making Middle Half Cross lap joint, Making Dovetail Joint.

Competency Units	Performance Criteria
CU1. Plan a square with proper dimensions	P1. Select appropriate wooden piece according to drawing P2. Select marking tools P3. Select relevant vice for wood clamping P4. Ensure the work piece is clamped properly P5. Mark work pieces according to given dimensions in drawing P6. Perform planning operation using jack plane P7. Insure squaring of work piece by using tri square P8. Perform finishing with sand paper
CU2. Implement Sawing Exercise	P1. Mark the job according to given drawing P2. Select appropriate blade according to job requirement P4. Ensure the work piece is clamped firmly and properly P5. Adopt methods and techniques for sawing that is appropriate to job requirement P6. Follow marked line during sawing to ensure accuracy.
CU3. Make Mortise and Tendon Joint	P1. Select appropriate wooden piece for mortise P2. Select appropriate wooden piece for Tendon P3. Select marking tools P4. Select relevant vice for wood clamping P5. Ensure the work piece is clamped properly P6. Mark work pieces according to given dimensions in drawing

	P7. Prepare Mortise piece using wooden saw P8. Prepare Tendon piece using Tendon machine or using wooden chisel P9. Check joint firm ability by clamping both work pieces P10. Perform finishing with sand paper
CU4. Make Dado Joint	P1. Mark the job according to given drawing P2. Select appropriate blade according to job requirement P4. Ensure the work piece is clamped firmly and properly P5. Mark width using the actual piece. P6. Make a "knife wall" with a chisel P7. Saw down the knife wall lines P8. Work the way across the waste P9. Fit and glue P10. Perform finishing with sand paper
CU5. Make Cross-lap Joint	P1. Select appropriate wooden piece for upper lap P2. Select appropriate wooden piece for lower lap P3. Select marking tools P4. Select relevant vice for wood clamping P5. Ensure the work piece is clamped properly P6. Mark work pieces according to given dimensions in drawing P7. Cut the notch using wood saw P8. Finish the notch using wood chisel P9. Check joint firm ability by clamping both work pieces P10. Perform finishing with sand paper
CU6. Make holes of different Diameters in Wood	P1. Select appropriate wooden piece according to drawing P2. Select marking tools P3. Select relevant machine vice for wood clamping P4. Ensure the work piece is clamped properly P5. Mark work piece according to given dimensions in drawing P6. Perform planning operation using jack plane if required P7. Select drills according to drawing P8. Perform drilling operation according to drawing P9. Check diameter using plug gauge P10. Perform finishing with sand paper

CU7. Implement Nailing and Wood Screwing Process	P1. Select appropriate wooden piece according to drawing P2. Select marking tools P3. Select relevant vice for wood clamping P4. Ensure the work piece is clamped properly P5. Mark work piece according to given dimensions in drawing P6. Join two pieces together with metal nail using claw hammer P7. Join two pieces together with flaw head screw using flat screw driver P8. Join two pieces together with Philip head screw using Philip screw driver P9.Perform finishing with sand paper
CU8. Make Middle Half Cross lap joint	P1. Select appropriate wooden piece for upper lap P2. Select appropriate wooden piece for lower lap P3. Select marking tools P4. Select relevant vice for wood clamping P5. Ensure the work piece is clamped properly P6. Mark work pieces according to given dimensions in drawing P7. Cut the notch in middle of work pieces using circular saw P8. Finish the notch using wood file P9. Check joint firm ability by clamping both work pieces P10. Perform finishing with sand paper
CU9. Make Dovetail Joint	P1. Select appropriate wooden piece for Tail P2. Select appropriate wooden piece for Pin P3. Select marking tools P4. Select relevant vice for wood clamping P5. Ensure the work piece is clamped properly P6. Mark work pieces according to given dimensions in drawing P7. Prepare Tail piece using hand saw and wooden chisel P8. Prepare Pin piece using hand saw and wooden chisel P9. Check joint firm ability by clamping both work pieces P10. Perform finishing with sand paper

Knowledge & Understanding

- Describe basic measurement
- Describe basic measuring /Marking /cutting tools
- Describe clamping/holding methods
- Knowledge of jackplane types
- Describe use of tri square
- Knowledge of squaring the work piece
- Describe basic measurement
- Describe types of wood working saw
- Describe basic measuring /Marking /cutting tools
- Describe clamping/holding methods
- Define methods and techniques of sawing.
- Describe basic measurement
- Describe basic measuring /Marking /cutting tools
- Describe clamping/holding methods
- Knowledge of wooden chisels
- Describe use of Tendon machine
- Knowledge of squaring the work piece
- Describe fits in joints
- Describe basic measurement
- Describe basic measuring /Marking /cutting tools
- Describe clamping/holding methods
- Knowledge of wooden chisels
- Describe application of Dado Joints
- Knowledge of glues use in wood work
- Describe fits in joints
- Describe basic measurement
- Describe clamping/holding methods
- Knowledge of wooden chisels
- Describe use of wood saw

- Describe fits in joints
- Describe basic measurement
- Describe basic measuring /Marking /cutting tools
- Describe clamping/holding methods
- Knowledge of Drill Machines
- Differentiate different types of drill
- Describe basic measurement
- Describe basic measuring /Marking /cutting tools
- Describe clamping/holding methods
- Knowledge of types of nails
- Knowledge of types of screws
- Differentiate between nail and screw
- Describe basic measurement
- Describe basic measuring /Marking /cutting tools
- Describe clamping/holding methods
- Knowledge of wooden files
- Describe use of circular saw
- Describe fits in joint
- Describe basic measurement
- Describe basic measuring /Marking /cutting tools
- Describe clamping/holding methods
- Knowledge of wooden chisels
- Describe application of Dove tail joint
- Describe fits in joints

Tools and Equipment

SN	Tools
1	Work bench
2	Punching tools
3	Verier calliper
4	Scriber
5	Wood jackplane
6	Flat File
7	Tri-square

8	Wood Marking tools
9	Bench vice

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard**:** Make dovetail joint.

0713E&E38 Perform Oxy Acetylene Welding

Overview:

This competency standard covers the skills and knowledge required to make flame for gas welding Carburizing flame, Neutral Flame, oxidizing flame, Pool making, Bead Making, Edge Joint, Open square butt joint (M.S Flat 3mm OR 5mm Thickness), make 'V' Groove Butt joint (Flat Position), Corner joint, Open square brazing Butt joint (M.S Flat 5mm thick).

Competency Units	Performance Criteria
CU1. Make flame for gas welding Carburizing flame Neutral flame Oxidizing flame	P1. Open gas cylinder with the help of cylinder key P2. Adjust pressure of both gas cylinders with the help of regulator P3. Open acetylene gas knob of welding torch P4. Ignite acetylene gas with help of spark lighter P5. Open oxygen gas knob of welding torch P6. Make carburizing flame by increasing acetylene gas quantity P7. Make neutral flame by adjusting both gases at same quantity P8. Make oxidizing flame by increasing oxygen gas quantity P9. Close valves of welding torch P10. Close both gas cylinders' valves
CU2. Make Pool	P1. Open gas cylinder with the help of cylinder key P2. Adjust pressure of both gas cylinders with the help of regulator P3. Select the correct size of the nozzle P4. Set the both gas flame of welding torch as per standard P5. Make the pool as per standard Close welding torch valve P6. Close both gas cylinders' valves P7. Clean with wire brush
CU3. Make Bead	P1. Open gas cylinder with the help of cylinder key

	P2. Adjust pressure of both gas cylinders with the help of regulator P3. Select the correct size of the nozzle P4. Set the both gas flame of welding torch as per standard P5. Draw the straight line on the job P6. Keep appropriate distance between end of the inner core and job surface P7. Establish the weld pool P8. Add filler rod to the pool P9. Slowly withdraw the flame near the left hand edge of the shield P10. Finish the job with wire brush
CU4. Make Edge Joint	P1. Perform marking as per drawing P2. Cut the metal sheet according to drawing using shearing machine P3. Straighten the material with help of hammer P4. Perform filing of work piece if required P5. Open gas cylinder with the help of cylinder key P6. Adjust pressure of both gas cylinders with the help of regulator P7. Select the correct size of the nozzle P8. Adjust the both gas flame of welding torch as per standard P9. Arrange filler material as per requirement P10. Adjust both plates at edge joint position P11. Weld both plate using filler rod P12. Finish the job with wire brush
CU5. Make Open square butt joint (M.S Flat 3mm OR 5mm Thickness)	P1. Perform marking as per drawing P2. Cut the metal sheet according to drawing using shearing machine P3. Straighten the material with help of hammer P4. File work if required P5. Open gas cylinder with the help of cylinder key P6. Adjust pressure of both gas cylinders with the help of regulator P7. Select the correct size of the nozzle

	P8. Adjust both gas flame of welding torch as per standard P9. Arrange filler material as per requirement P10. Place gap in both plates according to joint P11. Weld both plate using filler rod P12. Finish the job with wire brush
CU6. Make 'V' Groove butt joint (Flat Position)	P1. Perform marking as per drawing P2. Cut the metal sheet according to drawing using shearing machine P3. Straighten the material with help of hammer P4. Open gas cylinder with the help of cylinder key P5. Adjust pressure of both gas cylinders with the help of regulator P6. Adjust the both gas flame of welding torch as per standard P7. Arrange filler material as per requirement P8. Prepare 45^0 angle on edge of metal plate according to drawing P9. Align edges of both plates according to drawing P10. Weld both plate using filler rod P11. Finish the job with wire brush
CU7. Make Corner joint	P1. Perform marking as per drawing P2. Cut the metal sheet according to drawing using shearing machine P3. Straighten the material with help of hammer P4. Perform filing of work piece if required P5. Open gas cylinder with the help of cylinder key P6. Adjust pressure of both gas cylinders with the help of regulator P7. Select the correct size of the nozzle P8. Adjust the both gas flame of welding torch as per standard P9. Arrange filler material as per requirement P10. Adjust both plates at corner joint position P11. Weld both plate using filler rod P12. Finish the job with wire brush
CU8. Make Open square brazing Butt	P1. Perform marking as per drawing P2. Cut the metal sheet according to drawing using shearing

joint(M.S Flat 5mm thick)	machine P3. Straighten the material with help of hammer P4. Perform filing of work piece if required P5. Open gas cylinder with the help of cylinder key P6. Adjust pressure of both gas cylinders with the help of regulator P7. Select the correct size of the nozzle P8. Adjust the both gas flame of welding torch as per standard P9. Arrange brazing rod and flux as per requirement P10. Adjust both plates at corner joint position P11. Weld both plate using filler rod P12. Finish the job with wire brush

Knowledge & Understanding

- Knowledge about back fire arrestor
- Knowledge about flash back arrestor
- Describe the pressure and its units
- Explain metal properties
- Explain temperature and its units
- Knowledge of basic drawing
- Explain marking tools
- Explain the of marking methods
- Describe the filler rod
- Knowledge of basic drawing
- Explain marking tools
- Explain the of marking methods
- Describe the filler rod
- Explain kinds of joints
- Describe joint symbols
- Knowledge about edge joint
- Knowledge of basic drawing
- Explain marking tools
- Explain the of marking methods
- Describe the filler rod

- Explain kinds of joints
- Describe joint symbols
- Knowledge about edge joint
- Knowledge of shearing machine
- Knowledge of square butt joint
- Explain the of marking methods
- Describe the filler rod
- Explain kinds of joints
- Describe joint symbols
- Knowledge about ‘V’ groove butt joint
- Knowledge of grinding machine
- Kinds of grinding machines
- Explain the of marking methods
- Describe the filler rod
- Explain kinds of joints
- Describe joint symbols
- Knowledge about corner joint
- Knowledge of grinding machine
- Kinds of grinding machines
- Explain the of marking methods
- Describe the brazing filler rod
- Explain kinds of joints
- Describe joint symbols
- Knowledge about soldering, brazing and its flux
- Knowledge of grinding machine
- Kinds of grinding machines

Tools and Equipment

SN	Tools
1	Oxygen cylinder
2	Acetylene gas cylinder
3	Pressure regulators
4	Cylinder key

5	Welding torch
6	Rubber house pipe
7	Back fire arrester
8	Flash back arrester
9	Spark lighter

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard**:** Make open square brazing butt joint.

0713E&E39 Perform Arc Welding

Overview:

This competency standard covers the skills and knowledge required tomake Arc, Bead Making, Open Square Butt Joint (MS Flat 5mm Thick), V Groove Butt Joint, Lap Joint, Corner Joint Flat Position, Corner Joint Vertical Position, Spot Welding Practice (0.5mm MS Sheet), Seam Welding Practice(0.5mm MS Sheet).

Competency Units	Performance Criteria
CU1. Make Arc	P1. Take M.S Flat as per drawing P2. Straiten it with the help of hammer and anvil P3. Place the work piece on welding table P4. Hold the electrode in electrode holder P5. Adjust the current on welding machine as per standard P6. Touch the electrode with base metal P7. Ensure that pre heating is accomplished by moving short arc rapidly back and forward P8. Remove the slag with chipping hammer P9. Clean with wire brush
CU2. Make Bead	P1. Take M.S Flat as per drawing P2. Straiten it with the help of hammer and anvil P3. Place the work piece on welding table P4. Hold the electrode in electrode holder P5. Set the current on welding machine as per standard P6. Position the electrode leaning about 20* from vertical in the direction of travel P7. Prepare the arc by touching the end of electrode with the base metal and withdrawing it to proper gap P8. Ensure the width and length of arc by watching the puddle P9. Remove the slag with chipping hammer P10. Clean with wire brush
CU3. Make Open Square	P1. Take M.S Flat as per drawing

Butt Joint (MS Flat 5mm Thick)	P2. Straiten it with the help of hammer and anvil P3. Place the work piece on welding table P4. Hold the electrode in electrode holder P5. Adjust the current on welding machine as per standard P6. Hold the electrode at right angle P7. Adjust the current at 120-125 ampere P8. Tack both pieces of M.S Flat P9. Prepare the arc by touching the end of electrode with the base metal and withdrawing it to proper gap P10. Lean the electrode at 70* to the base metal and complete the bead to form an open square butt joint P11. Remove the slag with chipping hammer clean with wire brush
CU4. Make V Groove Butt Joint	P1. Take M.S Flat as per drawing P2. Straiten it with the help of hammer and anvil P3. Place the work piece on welding table P4. Hold the electrode in electrode holder P5. Adjust the current on welding machine as per standard P6. Grind the work pieces on pedestal grinder as per drawing P7. Place both work pieces on welding table with equal distance and parallel to each other P8. Tack both work pieces of M.S Flat P9. Adjust the current to 200 amperes P10. Prepare an arc by touching the end of electrode with base metal P11. Complete the bead by back hand welding technique P12. Remove the slag with chipping hammer P13. Clean with wire brush
CU5. Make Lap Joint	P1. Take M.S Flat as per drawing P2. Straiten it with the help of hammer and anvil P3. Mark parallel line with the help of scriber for positioning of overlap the plate P4. Place the work piece on welding table P5. Place the Bottom piece on work table and place the Top

	plate along the marked line P6. Hold the electrode in electrode holder P7. Adjust the current on welding machine as per standard P8. Tack both work pieces of M.S Flat P9. Adjust the current to 200 amperes P10. Complete the bead by back hand welding technique P11. Remove the slag with chipping hammer P12. Clean with wire brush
CU5. Make Corner Joint Flat Position	P1. Take M.S Flat as per drawing P2. Straiten it with the help of hammer and anvil P3. Grind the work pieces on grinding machine to prepare the edges flat and parallel to each other P4. Place the Bottom piece on work table and place the Top plate at 90* to each other as per drawing P5. Hold the electrode in electrode holder P6. Adjust the current on welding machine as per standard P7. Tack both work pieces of M.S Flat P8. Lean the electrode and move along traverse direction P9. Remove the slag with chipping hammer P10. Clean with wire brush
CU6. Make Corner Joint Vertical Position	P1. Take M.S Flat as per drawing P2. Straiten it with the help of hammer and anvil P3. Grind the work pieces on grinding machine to prepare the edges flat and parallel to each other P4. Place the Bottom piece on work table and place the other piece vertically edge wise on it as per drawing P5. Hold the electrode in electrode holder P6. Adjust the current on welding machine as per standard P7. Check the squares of joint with try square. P8. Tack both work pieces of M.S Flat P9. Lean the electrode 20* downward and complete the joint by back hand technique P10. Remove the slag with chipping hammer P11. Clean with wire brush
	P1. Take M.S Sheet as per drawing

CU7. Make Spot Welding Practice(0.5mm MS Sheet)	P2. Straiten it with the help of rubber hammer and anvil P3. Mark parallel line with the help of scriber for positioning of overlap the plate P4. Grip the both part in Fixture P5. Switch on the spot welding machine and set the timer P6. Place the work piece on the lower electrode P7. Press down the pedal to make contact between the copper electrode to form spot weld for duration of 02 seconds P8. Perform this practice on the entire job as per drawing
CU8. Make Seam Welding Practice(0.5mm MS Sheet)	P1. Take M.S Sheet as per drawing P2. Straiten it with the help of rubber hammer and anvil P3. Check the squares of both work pieces P4. Mark parallel line with the help of scriber for positioning of overlap the plate P5. Grip the both part in Fixture P6. Switch on the seam welding machine and set the timer P7. Switch the motor to drive the electrode wheels P8. Place the work piece on the lower electrode P9. Press down the pedal to make contact between both electrode wheels P10. Perform this practice on the entire job as per drawing

Knowledge & Understanding

- Knowledge about electricity, current, ampere, voltage, wattage etc.
- Knowledge offsetting the current on welding machine
- Understand types of electrodes
- Understand motion of electrodes
- Define temperature of arc
- Explain types of temperature
- Explain positions of electrode according to work
- Knowledge of setting the current on welding machine
- Describe Bead in Arc welding
- Explain importance of gap between electrode and base metal
- Explain positions of electrode according to work

- Knowledge of setting the current on welding machine
- Describe Bead in Arc welding
- Explain importance of gap between electrode and base metal
- Define Butt Joint
- Define Lap Joint
- Explain positions of electrode according to work
- Knowledge of setting the current on welding machine
- Describe Bead in Arc welding
- Explain importance of gap between electrode and base metal
- Define Butt Joint
- Explain use on pedestal grinder
- Identify the factors on which the current setting base upon
- Explain positions of electrode according to work
- Knowledge of setting the current on welding machine
- Describe motion of electrode in ARC welding
- Explain importance of gap between electrode and base metal
- Describe use of tri square
- Explain positions of electrode according to work
- Knowledge of setting the current on welding machine
- Describe motion of electrode in ARC welding
- Explain importance of gap between electrode and base metal
- Describe use of tri square
- Describe importance of cleanliness of surface to be welded
- Explain positions of electrode according to work
- Knowledge of setting the current on welding machine
- Describe motion of electrode in ARC welding
- Explain importance of gap between electrode and base metal
- Describe use of tri square
- Describe back hand welding technique
- Explain properties of copper electrode
- Knowledge of setting the current on spot welding machine
- Knowledge of setting the timer on spot welding machine
- Explain importance of pressure and timing between electrode and base metal
- Define conductivity

- Explain Resistant welding
- Explain properties of copper electrode
- Knowledge of setting the current on
- seam welding machine
- Knowledge of setting the timer on seam welding machine
- Explain the purpose of seam welding
- Describe types of electrodes used in seam welding
- Explain Resistant welding
- Importance of cooling for seam welding

Tools and Equipment

SN	Tools
1	Welding transformer
2	Welding rectifier
3	Extension leads
4	Chipping Hammer
5	Wire brush
6	Face shield
7	Electrode holder
8	Generator

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard**:** Make Spot Welding on a working piece.

0713E&E40 Maintain Tools & Equipment for Three Phase Wiring

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.** Collect the required tools and equipment **P2.** Check insulation of **Tools and Equipment** **P3.** Perform insulation of the faulty tool/equipment
CU4. Calibrate measuring tools	**P1.** Check calibration status of the **P2.** measuring tools **P3.** Perform calibration of measuring **P4.** tools as per standards **P5.** Record calibration test results
CU5. Manage Inventory of tools and	**P1.** Check tools and equipment as **P2.** per record **P3.** Report for faulty tools and

equipment	**P4.** equipment to supervisor **P5.** Generate demand for deficit **P6.** tools and equipment **P7.** Maintain all records of tools and **P8.** 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

0713E&E41 Make Cable/Wire Joints (Heavy Cable Joints)

Overview:

This Competency Standard covers the skills and knowledge required to. Make Cross/Twist joint, Make Straight/Married joint, Make T- Joint, Make Rat tail joint and Make Britannia joint, 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.

Tools and Equipment

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

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

0713E&E42 Prepare and Install Distribution Board for Three 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**: :**

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

0713E&E43 Install Three Phase Electrical Wiring

Overview:

This Competency Standard covers the skills and knowledge required to Make and Install 3 phase motor connection ON/OFF by CAM Switch, Make and Install 3 phase motor connection reversing by CAM Switch, Make and Install 3 phase motor connection ON/OFF by Magnetic Contactor, Make and Install 3 phase motor connection ON/OFF by Magnetic Contactor.

Competency Units	Performance Criteria
CU1. Make and Install 3 phase motor connection ON/OFF by CAM Switch	**P1.** Draw power diagram of circuit. **P2.** Draw installation diagram of circuit. **P3.** Mark on exercise board according to installation/layout diagram. **P4.** Install accessories according to layout diagram. **P5.** Lay wires in duct/pipe according to layout diagram. **P6.** Make connections according to wiring diagram. **P7.** Check the circuit before connect the main supply. **P8.** Make connection with main supply. **P9.** Check the function of circuit after connect the main supply
CU2. Make and Install 3 phase motor connection reversing by CAM Switch	**P1.** Draw power diagram of circuit. **P2.** Draw installation diagram of circuit. **P3.** Mark on exercise board according to installation/layout diagram. **P4.** Install accessories according to layout diagram. **P5.** Lay wires in duct/pipe according to layout diagram. **P6.** Make connections according to wiring diagram. **P7.** Check the circuit before connect the main supply. **P8.** Make connection with main supply. Check the function of circuit after connect the main supply
CU3. Make and Install 3 phase motor	**P1.** Draw power diagram of circuit. **P2.** Draw control diagram of circuit. **P3.** Draw installation diagram of circuit.

connection ON/OFF by Magnetic Contactor	**P4.** Mark on exercise board according to installation/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 and Install 3 phase motor connection ON/OFF by Magnetic Contactor	**P1.** Draw power diagram of circuit. **P2.** Draw control diagram of circuit. **P3.** Draw installation diagram of circuit. **P4.** Mark on exercise board according to installation/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. Perform Electrical Work in Commercial Area.	**P1.** Install wire for grounding **P2.** Perform pre Installation module based Tests **P3.** Perform integrated tests. **P4.** Install conduits or Trunks in the building as per drawing **P5.** Install electrical wiring, as per drawing and standard. **P6.** Install centralize lighting, heating, cooling system and other appliances **P7.** Install main box and distribution box. **P8.** Install Electric Breakers in main box, as per load for safety measures **P9.** Install fire alarm and smoke detector system **P10.** Install the appliances used in electrical work as per drawing **P11.** Install emergency light system in main box, as per standard color scheme **P12.** Install Main Distribution Board. **P13.** Test and certify the Installed system.

Knowledge & Understanding

- Define three phase supply
- Describe three phase motor
- Describe types of three phase motor.
- Define power diagram.
- Define installation diagram.
- Describe CAM switch.
- Describe types of three phase motor connection.
- Explain On/Off Cam Switch circuit. And its
- Uses.
- Describe Star/ Delta connection.
- Define three phase supply.
- Describe three phase motor.
- Describe types of three phase motor.
- Define power diagram.
- Define installation diagram.
- Describe CAM switch.
- Describe types of three phase motor connection.
- Explain reversing Cam Switch circuit. And its uses.
- Describe Star/ Delta connection
- Define three phase supply.
- Describe three phase motor.
- Describe types of three phase motor.
- Define power diagram.
- Define control diagram
- Define installation diagram.
- Describe Magnetic contactor.
- Describe types of three phase motor connection.
- Explain On/Off Magnetic Contactor circuit. And its uses.
- Why we use magnetic contactor instead of CAM switch.
- Describe Star/ Delta connection
- Define three phase supply.
- Describe three phase motor.
- Describe types of three phase motor.

- Define power diagram.
- Define control diagram
- Define installation diagram.
- Describe Magnetic contactor.
- Describe types of three phase motor connection.
- Explain On/Off Magnetic Contactor circuit. And its uses.
- Why we use magnetic contactor instead of CAM switch.
- Describe the purpose of indicator in circuit.
- Describe Star/ Delta connection.
- .Describe the safety for installation
- Describe the Protective measures against too high voltage and electrical accidents.
- Explain Fundamentals of installation engineering
- Describe the Power overhead-line systems.
- Describe Low-voltage switchgear and distribution systems.
- Explain Mounting and connection of motor testing of installed plant.

Tools and Equipment

SN	Tools
1	Linesman pliers
2	Wire cutters
3	Tape
4	Hammer
5	Power saws
6	Drivers, Hammer/drills
7	Power drills and
8	Electrician Tool kit
9	Labeling machines
10	Measuring devices
11	Fishing tools
12	Wire strippers
13	Indicator
14	Overload relay
15	Push button
16	Screw

17	PVC Connector Bar
18	PVC Wire.
19	PVC Pipe/Duct
20	On/Off CAM switch.
21	Three phase induction motor
22	Fuse.
23	PVC Board.

Critical Evidence(s) Required

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

To Make and Install 3 phase motor connection reversing by CAM Switch

0713E&E44 Install Three Phase Complex Electrical Wiring

Overview:

This Competency Standard covers the skills and knowledge required to Make and Install 3 phase motor connection Reverse/ forward by Magnetic contactor, Make and Install 3 phase motor connection Reverse/ forward by Magnetic contactor with indicator, Make and Install 3 phase motor connection Star/Delta (Manual) by Magnetic contactor, Make and Install 3 phase motor connection Star/Delta (Manual) by Magnetic contactor with indicator, Make and Install 3 phase motor connection Star/Delta (Auto) by Magnetic contactor, Make and Install 3 phase motor connection Star/Delta (Auto) by Magnetic contactor with indicator, Make and Install 3 phase motor connection 2 speed by Magnetic contactor, Make and Install 3 phase motor connection 2 speed by Magnetic contactor with indicator.

Competency Units	Performance Criteria	
CU1. Make and Install 3 phase motor connection Reverse/ forward by Magnetic contactor.	**P1.**	Draw power diagram of circuit.
	P2.	Draw control diagram of circuit.
	P3.	Draw installation diagram of circuit.
	P4.	Mark on exercise board according to installation/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 and Install 3 phase motor connection Reverse/ forward by	**P1.**	Draw power diagram of circuit.
	P2.	Draw control diagram of circuit.
	P3.	Draw installation diagram of circuit.
	P4.	Mark on exercise board according to installation/layout diagram.
	P5.	Install accessories according to layout diagram.

Magnetic contactor with indicator.	**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 and Install 3 phase motor connection Star/Delta (Manual) by Magnetic contactor.	**P1.** Draw power diagram of circuit. **P2.** Draw control diagram of circuit. **P3.** Draw installation diagram of circuit. **P4.** Mark on exercise board according to installation/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 and Install 3 phase motor connection Star/Delta (Manual) by Magnetic contactor with indicator.	**P1.** Draw power diagram of circuit. **P2.** Draw control diagram of circuit. **P3.** Draw installation diagram of circuit. **P4.** Mark on exercise board according to installation/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 and Install 3 phase motor connection Star/Delta (Auto) by Magnetic contactor.	**P1.** Draw power diagram of circuit. **P2.** Draw control diagram of circuit. **P3.** Draw installation diagram of circuit. **P4.** Mark on exercise board according to installation/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 and Install 3 phase motor connection Star/Delta (Auto) by Magnetic contactor with indicator	**P1.** Draw power diagram of circuit. **P2.** Draw control diagram of circuit. **P3.** Draw installation diagram of circuit. **P4.** Mark on exercise board according to installation/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 and Install 3 phase motor connection 2 speed by Magnetic contactor.	**P1.** Draw power diagram of circuit. **P2.** Draw control diagram of circuit. **P3.** Draw installation diagram of circuit. **P4.** Mark on exercise board according to installation/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
CU8. Make and Install 3 phase motor connection 2 speed by Magnetic contactor with indicator	**P1.** Draw power diagram of circuit. **P2.** Draw control diagram of circuit. **P3.** Draw installation diagram of circuit. **P4.** Mark on exercise board according to installation/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.
CU9. Perform Electrical Work in Industrial Area.	**P1.**	Install wire for grounding
	P2.	Perform pre Installation module based Tests
	P3.	Perform integrated tests.
	P4.	Install conduits or Trunks in the building as per drawing
	P5.	Install electrical wiring, as per drawing and standard.
	P6.	Install centralize lighting, heating, cooling system and other appliances
	P7.	Install main box and distribution box.
	P8.	Install Electric Breakers and switch gears in main box, as per load for safety measures
	P9.	Install fire alarm and smoke detector system
	P10.	Install the appliances used in electric work as per drawing
	P11.	Install emergency light system in main box, as per standard color scheme
	P12.	Install Main Distribution Board.
	P13.	Test and certify the Installed system.

Knowledge & Understanding

- Define three phase supply.
- Describe three phase motor.
- Describe types of three phase motor.
- Define power diagram.
- Define installation diagram.
- Describe Control Diagram.
- Describe types of three phase motor connection
- Describe Star/Delta connection.
- Explain reverse/forward circuit and its uses.
- Define three phase supply.
- Describe three phase motor.
- Describe types of three phase motor.
- Define power diagram.
- Define installation diagram.
- Describe Control Diagram.
- Describe types of three phase motor connection.
- Describe Star/Delta connection.
- Describe the purpose of indicator.
- Explain reverse/forward circuit and its uses

- Define three phase supply.
- Describe three phase motor.
- Describe types of three phase motor.
- Define power diagram.
- Define installation diagram.
- Describe Control Diagram.
- Describe types of three phase motor connection.
- Describe Star/Delta connection.
- Describe the purpose of indicator.
- Explain reverse/forward circuit and its uses.
- Define star/delta circuit.
- Compare star/delta circuit.
- Describe purpose and uses of star/delta circuit.
- Define three phase supply.
- Describe three phase
- Motor.
- Describe types of three phase motor.
- Define power diagram.
- Define installation diagram.
- Describe Control Diagram.
- Describe types of three phase motor connection.
- Describe Star/Delta connection.
- Describe the purpose of indicator.
- Explain reverse/forward circuit and its uses.
- Define star/delta circuit.
- Compare star/delta circuit.
- Describe purpose and uses of star/delta circuit.
- Describe purpose of indicator.
- Define three phase supply.
- Describe three phase motor
- Describe types of three phase motor.
- Define power diagram.
- Define installation diagram.
- Describe Control Diagram.

- Describe types of three phase motor connection.
- Describe Star/Delta connection.
- Describe the purpose of indicator.
- Explain reverse/forward circuit and its uses.
- Define star/delta circuit.
- Compare star/delta circuit.
- Describe purpose and uses of star/delta circuit.
- Describe the function of timer.
- Define timer.
- Define three phase supply.
- Describe three phase
- Motor.
- Describe types of three phase motor.
- Define power diagram.
- Define installation diagram.
- Describe Control Diagram.
- Describe types of three phase motor connection.
- Describe Star/Delta connection.
- Describe the purpose of indicator.
- Explain reverse/forward circuit and its uses.
- Define star/delta circuit.
- Compare star/delta circuit.
- Describe purpose and uses of star/delta circuit.
- Describe the function of timer.
- Define timer.
- Define three phase supply.
- Describe three phase motor.
- Describe types of three phase motor.
- Define power diagram.
- Define installation diagram.
- Describe Control Diagram.
- Describe types of three phase motor connection.
- Describe 2 speed motor connection and its uses.
- Describe the purpose of 2 speed motor circuit.

- Define three phase supply.
- Describe three phase motor.
- Describe types of three phase motor.
- Define power diagram.
- Define installation diagram
- Describe Control Diagram.
- Describe types of three phase motor connection.
- Describe 2 speed motor connection and its uses.
- Describe the purpose of 2 speed motor circuit.
- Describe purpose of indicator.
- Describe the safety of installation
- Explain the Protective measures against too high voltage and electrical accidents.
- Explain Fundamentals of installation engineering
- Describe the Power overhead-line systems.
- Explain Low-voltage switchgear and distribution systems.
- Explain Mounting and connection of motor testing of installed plant.

Tools and Equipment

SN	Tools
1	hammer
2	wire cutters
3	linesman pliers
4	Tape
5	Power saws
6	Power drills and drivers, hammer/drills
7	Labeling machines
8	Fishing tools
9	Wire strippers
10	Measuring devices
11	Electrician Tool kit
12	Push button
13	Screw
14	PVC Connector Bar

15	PVC Wire.
16	PVC Pipe/Duct.
17	PVC Board.
18	Three phase induction motor
19	Magnetic Contactor
20	Electrician Tool kit
21	Three phase induction motor.
22	Fuse.
23	Over load relay
24	Three phase induction motor
25	Magnetic Contactor.
26	Fuse.
27	PVC Board.
28	PVC Wire.
29	PVC Connector Bar
30	Screw.
31	Push button.
32	PVC Pipe/Duct.
33	Fuse.
34	PVC Board.
35	PVC Wire
36	PVC Wire
37	PVC Connector Bar
38	PVC Connector Bar
39	Indicator
40	Phase induction motor.
41	Timer with base.
42	Three
43	Over load relay.
44	PVC Pipe/Duct.
45	Screw.

Critical Evidence(s) Required

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

To Make and Install 3 phase motor connection 2 speed by Magnetic contactor with indicator

0713E&E45 Perform Testing of 3 Phase Electrical Wiring

Overview:

This competency standard covers the skills and knowledge required to perform earth leakage test, perform open circuit test, perform short circuit test, perform continuity/loop test, perform visual test, perform insulation test, perform polarity test, perform earth resistance test, perform Murray loop test, and perform Blavier & earth loop test

Competency Units	Performance Criteria
CU1. Perform Earth leakage Test.	**P1.** Ensure the socket must be at least 13A for RCD plug in. **P2.** Adjust the sensitivity of RCD. **P3.** Ensure tripping time must not exceed than 200msec. **P4.** Plug the RCD in socket and switch on socket outlet. **P5.** Ensure P-N and P-E light up. **P6.** Press the test button. **P7.** Ensure that RCD will trip and reading must be shown less than 200msec. **P8.** Move the selection switch to 180^{o}. **P9.** Press the test button. **P10.** Ensure that RCD will trip and reading must be shown less than 200msec. **P11.** Move selection switch to 0^{0}. **P12.** Press the test button. **P13.** Ensure that RCD will trip and reading must be shown less than 200msec.
CU2. Perform Open Circuit Test	**P1.** Disconnect the supply source, neutral conductor and earth conductor from distribution fuse box. **P2.** Connect ohmmeter between starting and ending terminals of live conductor. **P3.** Ensure the reading must be near to 0 ohm. **P4.** Repeat P2 to P3 for neutral and earth conductor.

CU3. Perform Short Circuit Test	**P1.** Disconnect the supply source, neutral conductor and earth conductor from distribution fuse box. **P2.** Connect one terminal of ohmmeter with live conductor. **P3.** Connect the other terminals of ohmmeter with neutral conductor. **P4.** Ensure the reading must be infinity (No reading). **P5.** Connect ohmmeter between live conductor and earth conductor. **P6.** Ensure the reading must be infinity (No reading)
CU4. Perform Continuity/Loop Test	**P1.** Connect all metal clad switches, metal parts, conduits with earth. **P2.** Open the main switch. **P3.** Turn on all the switches. **P4.** Connect earth continuity tester with conduit and independent earth. **P5.** Measure the resistance value with tester which must not be more than 1 ohm.
CU5. Perform Visual Test	**P1.** Check the wires joints. **P2.** Check if there is any spark. **P3.** Check over heating of wires. **P4.** Check all the appliances are On or fluctuating. **P5.** Check all indications of meters. **P6.** Check Voltages on all phases. **P7.** Check the DB and Breakers. **P8.** Check the main supply is coming properly.
CU6. Perform Insulation Test	**P1.** Switch off the main breaker. **P2.** Short circuit all lighting connections. **P3.** Connect merger between line and earth. **P4.** Rotate the merger to generate the voltage. **P5.** Read the merger dial and ensure that the insulation resistance should not be less than 50M ohm of any single circuit.
CU7. Perform Polarity Test	**P1.** Switch off the main switch. **P2.** Disconnect all loads. **P3.** Switch on all circuit control switches. **P4.** Connect ohm meter between main line and all the terminal of sockets and load points one by one. **P5.** Ensure meter reading value must be less than 1 ohm.

CU8. Perform Earth Resistance Test	**P1.** Place 3 electrodes in earth at distance of 10m apart between every electrode. **P2.** Connect terminal E of earth resistance tester to first electrode. **P3.** Connect terminal P of earth resistance tester to the second electrode. **P4.** Connect terminal C of the earth resistance tester with third electrode. **P5.** Measure the resistances after applying specific voltage. **P6.** Repeat P1 to P5 by interacting earthling regions. **P7.** Ensure 3 readings must be equal.
CU9. Perform Murray Loop Test	**P1.** Connect galvanometer with Wheatstone bridge. **P2.** Connect positive terminal of DC source with Wheatstone bridge. **P3.** Connect negative terminal of DC source with ground. **P4.** Connect remaining two terminal of Wheatstone bridge with two cores of the cable. **P5.** Short the other end of these two cores of cable. **P6.** Note the reading of galvanometer. **P7.** Calculate Rx. **P8.** Repeat the P1 to P7 for other cores of the cable.
CU10. Perform BLAVIER & Earth Loop Test	**P1.** Connect galvanometer with Wheatstone bridge. **P2.** Connect positive terminal of DC source with Wheatstone bridge. **P3.** Connect negative terminal of DC source with ground. **P4.** Connect remaining two terminal of Wheatstone bridge with two cores of the cable. **P5.** Short the other end of these two cores of cable. **P6.** Note the reading of galvanometer. **P7.** Calculate Rx. **P8.** Repeat the P1 to P7 for other cores of the cable.

Knowledge & Understanding

- Define RCD
- Define sensitivity

- Explain P-E and P-N
- Explain the function of RCD.
- Explain the function of distribution box.
- Explain the function of fuse.
- Explain which meters are used for open circuit and short circuits test.
- What does it mean by 0 ohm reading in open circuit test?
- What does it mean by no
- Reading in short circuit test?
- Explain the purpose of continuity test.
- Explain the purpose of polarity test.
- Explain the purpose of insulation resistance test.
- Explain the purpose of Murray loop test.
- Explain the purpose of BLAVIER's loop test.
- Describe why Wheatstone bridge is attached in Murray loop test.
- What is the purpose of DC supply in Murray loop test?
- Explain the purpose of Galvanometer.

Tools and Equipment

SN	Tools
1	Sockets
2	Magger
3	Breakers
4	Earth resistance tester
5	RCD
6	Continuity tester
7	Ohmmeter
8	Supply source
9	Distribution Box
10	Loads

Critical Evidence(s) Required

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

Perform BLAVIER & Earth Loop Test

0713E&E46 Diagnose Electrical Fault in Generator

Overview:

This Competency Standard covers the skills and knowledge required to inspect and service ignition system, inspect and service alternator, inspect and service display panel, inspect and service governor /Actuator System, inspect and service charging system, inspect and service warning system, to diagnose electric fault (s) in generator.

Competency Units	Performance Criteria
CU1: Inspect and service Ignition system	P1. Identify the tools and equipment P2. Check DC power supply of ignition coil and distributor P3. Check HT leads P4. Check spark plug
CU2: Inspect and service alternator	P1. Identify the tools and equipment P2. Check DC output voltage P3. Check belt P4. connections of alternator
CU3:Inspect and service display panel	P1. Identify tools and equipment P2. Check gauges, circuit breakers, relays and wiring as per standard parameters
CU4: Inspect and service governor /Actuator System	P1. Identify the tools and equipment P2. Check actuator card supply P3. Check magnetic pick up P4. Check power supply on actuator/governor
CU5: Inspect and service charging system	P1. Identify the tools and equipment P2. Check battery power leads P3. Check charging circuit of alternator
CU6: Inspect and service warning	P1. Identify tools and equipment P2. Check oil sensor P3. Check temperature sensor

system	P4. Check fuel sensor P5. Check over/under load module
CU7: Inspect and repair wiring	**P1.** Identify the tools and equipment for checking of supply. **P2.** Check the main supply. **P3.** Check the breakers. **P4.** Ensure the supply off. **P5.** Perform open circuit and short Circuit test with meter. **P6.** Identify the faults. **P7.** Remove the fault.

Knowledge & Understanding

- Define Ignition coil and Distributor
- Define High Tension (HT) Leads
- Functions of Spark Plug.
- Describe DC alternator
- Knowledge about voltage of Alternator
- Knowledge about Display Panel
- Data Screen
- Types of circuit breakers / Relays
- Describe Governor / Actuator
- Describe charging system
- Describe Warning system
- Describe open circuit test
- Describe short circuit test.

- Define fuse, miniature circuit breaker.
- Distinguish between fuse and miniature circuit breaker.
- List the parts of fuse & M.C.B.
- Compare the advantages & disadvantages of fuse & M.C.B.

- Classify cables with respect to insulation, core, voltage grade
- & current carrying capacity.
- Explain different systems for
- Calculation of cable size.

- Find size of cable for respective load.
- Name components of earthling system.
- Define earth electrode, earth continuity conductor &earthling lead.
- Explain the earth fault current.
- Find size of earth continuity conductor, earthling lead & earth electrodes.

Tools and Equipment

SN	Tools
1	DC power supply.
2	Spark plugs.
3	Alternator

Critical Evidence(s) Required

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

-
- Ignition coil and Distributor
- High Tension (HT) Leads
- Functions of Spark Plug
- Display Panel / Data Screen
- Governor / Actuator
- Remove the fault in wiring.

0713E&E47 Repair/ Maintenance of 3 Phase Electrical Installations.

Overview:

This Competency Standard identifies the competencies required to. Analyze Fault in Electrical Installations, troubleshooting of electrical equipment's and Carry out Preventive Maintenance. Carry out repair and maintenance of electrical installations at workplace in accordance with the manufacturer's instructions and organizational requirements.

Competency Units	Performance Criteria
CU1. Analyze Fault in Electrical Installations Troubleshooting of electrical equipment's	**P1.** Inspect visually the electrical wiring, fixtures, equipment, soldering, connection, appliances and machinery for discovering the faults and defects **P2.** Check the installation for consistency with the electrical drawing **P3.** Draw the layout of equipment's before disassembling of electrical components **P4.** Check the faulty components with scope or meter **P5.** Re assembled the components as per drawing and the installation **P1.** Check the fault indication at relay for HT installation **P2.** Test electrical equipment as specified in the manufacturer's manual and record the results **P3.** Prepare a list of items/material(s) required for repair /replacement as per specifications **P4.** Draw circuit diagram of electrical equipment's be disassembling **P5.** Make necessary adjustments in the control and protective switchgear **P6.** Replace defective control & protective switch gear, cables and accessories with standard items **P7.** Replace defective earth electrode & faulty/damaged earthling conductors **P8.** Test installed electrical equipment for safe and optimum

	performance according to standards & regulations **P9.** Record the results of the test performed on a standard format

Knowledge & Understanding

- The candidate must be able to demonstrate underpinning Knowledge and Understanding: required to carry out the tasks covered in this competency standard.
- Interpretation of layout diagrams, technical sketches, graphic symbols and wiring diagrams, and manufacturer's specifications etc.
- Types of electrical tools used for troubleshooting and preventive maintenance purposes
- Types of electrical measuring instruments used in testing electrical installations
- Types of electrical wiring systems for domestic& industrial purposes
- Methods of tracing the fault
- Types of electrical control and protective switchgear and accessories used in electrical circuits
- Types and principles of operation of circuit breakers used in electrical installations and their applications
- Types of electrical wires and cables and their ratings
- Types of electrical accessories and their applicant
- electrical installations
- Types of earthling systems used in domestic& industrial

Electrical installations

- Importance of testing electrical installations Importance of corrective & preventive maintenance

Tools and Equipment

SN	Tools
1	Ammeter
2	Cable Cutter
3	Clamp Meter
4	Circuit Boards
5	Cells tester
6	Chisel

7	Cable Knife
8	Battery Cleaning Kit
9	Bearing Puller
10	Bench Vice
11	Cable / Wire Gauge
12	Battery Charger
13	Hammer
14	Hacksaw
15	Gloves
16	Grinder
17	Combination Plier Set
18	Disk Grinder
19	Duct Rod
20	Files (set
21	Earth Tester
22	Filler gauge
23	Flux
24	Generator
25	Handsaw
26	Hole saw
27	Hydrometer
28	IR Temperature Gun
29	L Scale
30	Lugs Punching Machine (Hydraulic and Manual)
31	Lux Meter
32	Magnetic Conductor
33	Megara (Insulation Tester)
34	Micron Meter
35	Mini Hydraulic Press Machine
36	Multimeter
37	OTDR Meter
38	Overall Combination
39	Phase Sequence Meter
0	Ring Spanner Set

41	Philips Screw drivers Set
42	RPM Meter
43	Safety Belt
44	Safety Goggles
45	Safety Helmet

Critical Evidence(s) Required

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

- Trace out the fault and take corrective action
- Carry out the preventive maintenance
- Update the service/repair record

0713E&E48 Carry Out Manual Electrical Planning and Estimation for 3 Phase

Overview:

This Competency Standard identifies the competencies required to analyse customer requirement and specification, Plan and estimate domestic electric work, Plan and estimate commercial electric work and Plan and estimate industrial electric work This competency standard covers the skills and knowledge in the estimation, planning and installation of an electrical work, keeping in view the necessary rules and regulations.

Competency Units	Performance Criteria
CU1. Analyze customer requirement and specification	**P1.** Draw the general value chain of the end user. **P2.** Highlight the various stages and set of activities in the value chain drawing **P3.** Enlist the electrical appliances/materials required in electrical development process **P4.** Identify critical stages in the development **P5.** Identify the safety aspect required in the critical stages of the development **P6.** Enlist the possible energy efficient appliance/devices and global trends in electrical works **P7.** Analyse the client requirement at broad level. **P8.** Generate a report of various stages of electrical works. **P9.** Proposed appliance/materials as per global trends and clarify the technical specification.
CU2. Plan and estimate domestic electric work	**P1.** Plan the client requirement at broad level from the proposal. **P2.** Plan the electrical appliances/materials / used in different stages of the electrical development process **P3.** Plan and estimate electrical wiring **P4.** Estimate Installation and Material Cost **P5.** Estimate Power consumption for lighting and appliances **P6.** Plan a main and sub distribution board. **P7.** Ensure safety system.
CU3. Plan and	**P1.** Analyze the client requirement at broad level from the proposal.

	estimate commercial electric work.	**P2.** Plan the electrical equipment /appliances/materials / used in different stages of the commercial electrical work **P3.** Plan and estimate electrical wiring **P4.** Estimate Installation and Material Cost **P5.** Estimate Power consumption for centralize lighting, heating, cooling system and other appliances. **P6.** Plan a main and sub distribution board. **P7.** Ensure safety measures in development process. **P8.** Enlist the material required.
CU4.	Plan and estimate industrial electric work.	**P1.** Analyze the client requirement at broad level from the proposal. **P2.** Plan the electrical equipment /appliances/materials / used in different stages of the commercial electrical work **P3.** Plan and estimate electrical wiring **P4.** Estimate Installation and Material Cost **P5.** Estimate Power consumption for centralize lighting, heating, cooling system and other appliances. **P6.** Plan 3-phase line for heavy loads **P7.** Plan a separate control panel box for heavy machinery. **P8.** **P9.** Plan a main and sub distribution board. **P10.** Design a safety system for protection of machinery and labor. **P11.** Assign color scheme for safety measures

Knowledge & Understanding

- Define the term ‘value chain’ of industry.
- Define human machine interface (HMI)
- Define the Standard operating procedure (SOP) of the organization for control panel development process.
- How to prepare a General arrangement drawing?
- Define IEC standards
- Describes the standard of electrical components.
- Understanding and knowledge of equipment properties.
- Understanding and knowledge of input and output of tool of electronic.
- Describe the rules and regulation of work.
- Understanding and knowledge of Electrical Specifications component used.

- Describes the standard of electrical components.
- Understanding and knowledge of equipment properties.
- Understanding and knowledge of input and output of tool of electronic.
- Describe the rules and regulation of work
- Describes the standard of electrical components.
- Understanding and knowledge of equipment properties.
- Understanding and knowledge of input and output of tool of electronic
- Describe the rules and regulation of work

Tools and Equipment

SN	Tools
1	Site Visit
2	Reference Material
3	Clipboard
4	Calculation Sheet
5	Calculator
6	Psychometric Charts and Tables
7	Protective gear such as helmets, goggles, gloves, rubber shoes, etc.

Critical Evidence(s) Required

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

- Installation techniques

0713E&E49 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

Tools 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**:**

Make multiplier for Galvanometer range extension.

0713E&E50 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-type TC.
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

Tools 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**:**

Measure the light intensity with lux meter

0713E&E51 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.

Tools 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**:**

Measure high DC current by using shunt

0713E&E52 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.

Tools 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**:**

Measure inductance using CRO

0713E&E53 Measure Capacitance and Inductance by RCL Meter, Dismantle and Assemble the Instruments.

Overview:

This competency standard covers the skills and knowledge required to.Measure Capacitance by RCL Meter, Measure Inductance by RCL Meter and Dismantle and assemble the moving iron and permanent magnet type instrumentmeasure capacitance & inductance, dismantle and assemble the instruments.

Competency Units	Performance Criteria
CU1. Measure Capacitance by RCL Meter	P1. Select Capacitance function on RCL Meter. P2. Short the test probes and zero the RCL meter P3. Connect probes across unknown capacitance P4. Read the value on display and record it.
CU2. Measure Inductance by RCL Meter	P1. Select Inductance function on RCL Meter. P2. Short the test probes and zero the RCL meter P3. Connect probes across unknown inductance P4. Read the value on display and record it.
CU3. Dismantle and assemble the moving iron and permanent magnet type instrument	**P1.** Determine the instrument type (attraction/ repulsion/permanent magnet type) **P2.** Perform isolation of Instruments (if applicable) **P3.** Establish a method for disassembling activity as per SOP. **P4.** Use standard tools described in user manual **P5.** Apply disassembling techniques **P6.** Organize the tag-identification of the parts/components/wires of instruments. **P7.** Draw sketches of removable parts (coil, needle, scale, moving iron, balance and control weight, scale, air damping chamber, permanent magnet etc.) **P8.** Determine the quality of service required for performing the task. **P9.** Check for the proper operation/ functionality **P10.** Apply assembling techniques.

Knowledge & Understanding

- Describe the operational procedure of RCL Meter.
- Differentiate between resistance, capacitance, inductance and impedance.
- Explain Electrical symbols.
- Explain law of electro magnetism.
- Describe the instrument's functional parameter.
- Explain the various parts and components of the instrument.
- Explain Tagging techniques of connections
- Describe assembling & disassembling technique

Tools and Equipment

SN	Tools
1	Power supply
2	RCL Meter
3	Capacitor
4	Inductor Electrical test bench
5	Power source (AC/DC)
6	Multimeter
7	Test probes
8	Magnetic/ compass
9	Tweeze
	Static hand gloves
	Screw drivers
	Wire Cutter

Critical Evidence(s) Required

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

Dismantle and assemble the moving iron and permanent magnet type instrument.

0713E&E54 Identify the Parts and Connection of Energy Meter (Single/3-Phase), Factor (PF) Meter, MDI Meter, Magger.

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	**P1.** Isolate the unit under test **P2.** Connect the Magger with cable of unknown insulation resistance as per standard

Magger	**P3.** Hand crank the Magger 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 Magger
- Explain the working principle of Magger
- Describe the standard insulation resistances for different systems

Tools 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**:**

Measure insulation resistance by Magger

0713E&E55 Calibrate Electrical Equipment

Overview: This competency standard covers the skills and knowledge required to calibrate ammeter, voltmeter, ohmmeter, multi-meter, capacitor, inductor and 2-wire/4-wire resistor by direct comparison method.

Competency Units	Performance Criteria
CU1 Perform Pre-Calibration activity	**P1.** Perform functional and physical check of under test equipment/UUT (Unit Under Test) **P2.** Prepare equipment receipt with specifications and allot unique code. **P3.** Keep the equipment in controlled environment for thermal stabilization as per its manual. **P4.** Turn ON the equipment for warm-up as per equipment manual **P5.** Record the under test equipment specifications, environmental condition of laboratory.
CU2 Calibrate Ammeter	**P1.** Select the Reference/Standard Current Source and connecting cable on the basis of under test ammeter range. **P2.** Connect the under test ammeter with Reference/Standard Current Source at current terminals. **P3.** Select calibration points on under test ammeter such that it may cover the whole range. **P4.** Perform zeroing on under test (if zero function available) otherwise record zero error. **P5.** Verify the connections are as per connection diagram in the equipment manual before applying current **P6.** Apply the Reference current and record the value displayed on the under test ammeter and Reference. **P7.** Change the reference value and observe it on under test equipment. **P8.** Take at least three set of measurement on each calibration point. **P9.** Take values in ascending (zero to maximum) order then descending (max to zero) order and again ascending order.

	P10. Stop the current source and remove the connecting cables.
CU3 Calibrate Voltmeter	**P1.** Select the Reference/Standard Voltage Source. **P2.** Connect the under test voltmeter with Reference/Standard Voltage Source at voltage terminals. **P3.** Select calibration points on under test voltmeter such that it may cover the whole range. **P4.** Perform zeroing on under test (if zero function available) otherwise record zero error. **P5.** Verify the connections are as per connection diagram in the equipment manual before applying voltage **P6.** Apply the Reference voltage and record the value displayed on the under test voltmeter and Reference. **P7.** Change the reference value and observe it on under test equipment. **P8.** Take at least three set of measurement on each calibration point. **P9.** Take values in ascending (zero to maximum) order then descending (max to zero) order and again ascending order. **P10.** Stop the voltage source and remove the connecting cables.
CU4 Calibrate Ohmmeter	**P1.** Select the Reference/Standard Resistance Source (Fixed/Discrete). **P2.** Connect the under test ohmmeter with Reference/Standard Resistance Source at resistance terminals. **P3.** Select calibration points on under test ohmmeter such that it may cover the whole range. **P4.** Check zero error by shortening the probes and perform zeroing on under test (if zero function/adjustment available) otherwise record zero error. **P5.** Verify the connections are as per connection diagram in the equipment manual before applying resistance **P6.** Apply the Reference resistance and record the value displayed on the under test ohmmeter and Reference. **P7.** Change the reference value and observe it on under test equipment.

	P8. Take at least three set of measurement on each calibration point. **P9.** Take values in ascending (zero to maximum) order then descending (max to zero) order and again ascending order. **P10.** Stop the resistance source and remove the connecting cables.
CU5 Calibrate multi-meter	**P1.** Select the Reference/Standard according to the multi-meter specifications. **P2.** Connect the under test multi-meter with Reference/Standard as per selected parameter. **P3.** Select parameter (Voltage AC/DC, Current AC/DC, Resistance, Capacitance) on both Reference and under test equipment one by one. **P4.** Check zero error for each parameter and nullify (if zero function/adjustment available) otherwise record zero error. **P5.** Verify the connections are as per connection diagram in the equipment manual before applying Reference value for each parameter **P6.** Apply the Reference value of each parameter and record the value displayed on the under test Multimeter and Reference. **P7.** Take at least three set of measurement on each calibration point. **P8.** Take values in ascending (zero to maximum) order then descending (max to zero) order and again ascending order. **P9.** Stop the Standard Reference and remove the connecting cables.
CU6 Calibrate 2-terminal/4-terminal Resistor (Direct method)	**P1.** Select the Resistance function on Reference/Standard RCL Meter **P2.** Short the connecting probes of RCL meter and zero the meter. **P3.** Connect the probes of RCL meter with the 2-terminal resistor/Current terminals(C1,C2) of 4-terminal resistor **P4.** Verify the connections are as per connection diagram. **P5.** Note the value marked on resistor and record the value displayed on the Reference RCL meter. **P6.** Take at least three set of measurement. **P7.** Remove the connecting probes of RCL meter

CU7 Calibrate 2-terminal/4-terminal Resistor (Indirect method)	**P1.** Connect the probes of Current Source with the 2-terminal resistor/Current terminals(C1,C2) of 4-terminal resistor **P2.** Select rated current to be applied to UUT and measure the corresponding value of voltage drop at the voltage terminals. **P3.** 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. **P4.** Take at least three set of measurement. **P5.** Remove the connecting probes of Current Source
CU8 Calibrate Standard Capacitor	**P1.** Select the Capacitance function on Reference/Standard RCL Meter **P2.** Short the connecting probes of RCL meter and zero the meter. **P3.** Connect the probes of RCL meter with Capacitor terminals **P4.** Verify the connections are as per connection diagram. **P5.** Note the value marked on Capacitor and record the value displayed on the Reference RCL meter. **P6.** Take at least three set of measurement. **P7.** Remove the connecting probes of RCL meter
CU9 Calibrate Standard Inductor	**P1.** Select the Inductance function on Reference/Standard RCL Meter **P2.** Short the connecting probes of RCL meter and zero the meter. **P3.** Connect the probes of RCL meter with Inductor terminals **P4.** Verify the connections are as per connection diagram. **P5.** Note the value marked on Inductor and record the value displayed on the Reference RCL meter. **P6.** Take at least three set of measurement. **P7.** Remove the connecting probes of RCL meter
CU10 Prepare calibration report	**P1.** Prepare data sheet by filling in the details of equipment under test and reference equipment to be used. **P2.** Identify and mention the procedure details and traceability statement. **P3.** Calculate the average, error, standard deviation and type-A uncertainty from the measured values. **P4.** Identify and add B-type uncertainties from the factors affecting measurement **P5.** Calculate the Combined and expanded uncertainty from type A and B uncertainties

	P6. Report the final result which includes nominal value, measured value and expanded uncertainty.

Knowledge & Understanding

- Explain Calibration and technical procedure for the calibration of ammeter, voltmeter, ohmmeter, multi-meter, inductor, capacitor and resistor.
- Differentiate between Reference Standard and (Unit under Test) UUT.
- Explain resolution, standard deviation, and uncertainty.
- Explain difference between precision and accuracy
- Differentiate between fixed and discrete resistor
- Explain calculation method of error off error and uncertainty budget
- What is the coverage factor

Tools and Equipment

SN	Tools
1.	Ammeter
2.	Voltmeter
3.	Ohmmeter
4.	Multimeter
5.	Capacitor
6.	Inductor
7.	2-wire Resistor
8.	4-wire Resistor
9.	Connecting Cables and Connectors
10.	Reference Standard Current Source
11.	Reference Standard Voltage Source
12.	RCL Meter

Critical Evidence(s) Required

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

Calibrate Standard Inductor.

0713E&E56 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

Tools 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

0713E&E57 Process Data (Files, Documents & Presentations) with MS Office

Overview:

These Competency standard deals with the skills and knowledge required to Use MS Office (MS-Word), Use MS Office (MS-Excel), and use MS-Office (MS-Power Point).

Competency Units	Performance Criteria
CU1. Use MS OFFICE (MS-WORD)	**P1.** Open the MS Word Screen and its menu. **P2.** Create a new document, save it and re-open it from the location and apply spell check & grammar. **P3.** Perform Page Formatting (Borders, Character Spacing, Paragraph, Bullets & Numberings and Fonts). **P4.** Apply different tool bars like standard, format& drawing tool bars. **P5.** Insert pictures, clipart, and shapes. **P6.** Use header and footer. **P7.** Insert table and also format of table. **P8.** Set the page margins, and printing documents. **P9.** Implement a lab report in MS word and insert table for measurement
CU2. Use MS OFFICE (MS-EXCEL)	**P1.** Open the MS EXCEL Screen and its menu. **P2.** Create a new excel sheet, save and re-open it from the location and spell check. **P3.** Insert and delete row and columns (format of cell). **P4.** Apply Merge cell and wrap text command. **P5.** Change text size and formats **P6.** Check print previews and page setup **P7.** Set the page margins, and printing documents. **P8.** Make a lab report in MS word **P9.** Enter data and Apply formulas in worksheet(Add, Subtract, Multiplying, and Divide

	& Average)
CU3. Use MS-OFFICE (MS-POWER POINT)	**P1.** Open PPT **P2.** Select page theme and style **P3.** Make a presentation on Mechanical technology. **P4.** Select Edit & format a text box **P5.** Insert pictures & colors to a slide **P6.** Make slide show **P7.** Apply Hide and unhide a slide **P8.** Insert and delete new slide **P9.** Insert table and video in slide. **P10.** Use different style of Writing.

Knowledge & Understanding

- Define basic input.
- Explain of basic issues/problems related to rectification of computer operations.
- Explain basic hardware configuration required for software.
- Describe detail knowledge of MS Office functions.
- Explain basic input and out devices and their use.
- Explain knowledge of basic issues/problems related to rectification of computer
- Operations.
- Explain basic hardware configuration required for software.
- Explain detail knowledge of MS Excel functions.
- Explain about the usage of Ready-made templates.
- Describe advance features

Tools and Equipment

SN	Tools
1	MS Office
2	PC

Critical Evidence(s) Required

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

- Create a report using word

0713E&E58 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++

Tools 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

0713E&E59 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

Tools 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.

0713E&E60 Construct 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 of circles (Inside &Outside)When the centre of the given circle is known and when the circle of centre is not known.	**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 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

Tools 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

0713E&E61 Perform Multi-View Drawings

Overview:

This competency standard covers the skills and knowledge required to Sketch Orthographic projection 1st angle, Sketch Orthographic projection 3rd angle, Sketch Oblique Drawing, Construct multi view drawing of Simple Bearing, Construct multi view drawing of Open Bearing, Sketch prism, Sketch cone and Draw pyramid.

Competency Units	Performance Criteria
CU1 Sketch Orthographic projection 1st angle.	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in equal parts. **P6.** Draw plan view **P7.** Draw front view **P8.** Draw side view
CU2 .Sketch Orthographic projection 3rd angle.	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in equal parts. **P6.** Draw plan view **P7.** Draw front view **P8.** Draw side view
CU3 Sketch Oblique Drawing	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in equal parts **P6.** Draw the front or side view of the object.
CU4 .Construct multi view	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards.

drawing of Simple Bearing.	**P4.** Make title bar **P5.** Divide the sheets in equal parts. **P6.** Draw plan view of simple bearing **P7.** Draw front view of simple bearing **P8.** Draw side view of simple bearing
CU5 .Construct multi view drawing of Open Bearing.	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in equal parts. **P6.** Draw plan view of open bearing **P7.** Draw front view of open bearing **P8.** Draw side view of open bearing
CU6 .Sketch prism	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in equal parts. **P6.** Sketch prism
CU7 .Sketch cone	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in equal parts. **P6.** Draw horizontal oval **P7.** Draw the two sides of a triangle which meets at a common point
CU8 .Draw pyramid	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in equal parts. **P6.** Sketch pyramid

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Knowledge & Understanding

- Define Orthographic projection 1st angle.
- Define Orthographic projection 3rd angle.
- Define Oblique Drawing.
- Describe Multi view drawing of Simple Bearing.
- Define Prism, Cone and pyramid.

Tools and Equipment

SN	Tools
1	Graph and drawing sheet.
2	Drawing Board/Table.
3	Tea-Square
4	Set Square.
5	Temples.
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**:**

- Draw Boundaries lines as per standards

0713E&E62 Draw Production Drawing

Overview:

This competency standard covers the skills and knowledge required to draw the assembly drawing of Boiler Stop Valve, draw the views of Connecting Rod in detail and assembly drawing, draw the assembly drawing of Screw Jack and draw the assembly of Tail Stock in full section showing its parts.

Competency Units	Performance Criteria
CU1 Draw the assembly drawing of Boiler Stop Valve	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Sketch the 1st angle orthographic projection views **P6.** Sketch the 3rd angle orthographic projection views **P7.** Sketch Assembly of boiler stop valve
CU2.Draw the views of Connecting Rod in detail and assembly drawing	**P8.** Prepare Drawing sheet. **P9.** Select the tools. **P10.** Draw Boundaries lines as per standards. **P11.** Make title bar **P12.** Sketch the 1st angle orthographic projection views **P13.** Sketch the 3rd angle orthographic projection views **P14.** Sketch Assembly of connecting rod
CU3. Draw the assembly drawing of Screw Jack	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Sketch the 1st angle orthographic projection views **P6.** Sketch the 3rd angle orthographic projection views **P7.** Sketch Assembly of screw jack
CU4. Draw the assembly of Tail Stock in full section showing its parts	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar

	P5. Sketch the 1st angle orthographic projection views **P6.** Sketch the 3rd angle orthographic projection views **P7.** Sketch Assembly of tail stock

Knowledge & Understanding

- Identify the parts and material of Boiler Stop Valve
- Explain the parts detail of Screw Jack
- Identify parts of Tail Stock
- Describe the parts of connecting rod
- Describe the parts of boiler stop valve
- Describe the parts of screw jack
- Describe the parts of Tail Stock

Tools and Equipment

SN	Tools
1	Plotter
2	Multimedia Projector
3	Computer
4	Scanner
5	Printer
6	Computer
7	Drafting Table
8	Board
9	Portable Drawing
10	Clutch Pencil
11	Templates
12	French Curves
13	Lead Pencil
14	Set Square
15	Tee Square
16	Instruments Box
17	Erasing Machine (Manual)

Critical Evidence(s) Required

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

- Sketch the 3rd angle orthographic projection views

0713E&E63 Design and Simulate the Electronic Circuit by Using Computer Aided Design (CAD) Software

Overview:

This competency standard covers the skills and knowledge required to. Analyse customer requirement and specification. Plan and estimate domestic electric work. Plan and estimate commercial electric work and Plan and estimate industrial electric work.

Competency Units	Performance Criteria
CU1.Analyze customer requirement and specification	**P1.** Draw the general value chain of the end user. **P2.** Highlight the various stages and set of activities in the value chain drawing **P3.** Enlist the electrical appliances/materials required in electrical development process **P4.** Identify critical stages in the development **P5.** Identify the safety aspect required in the critical stages of the development **P6.** Enlist the possible energy efficient appliance/devices and global trends in electrical works **P7.** Analyse the client requirement at broad level. **P8.** Generate a report of various stages of electrical works. **P9.** Proposed appliance/materials as per global trends and clarify the technical specification.
CU2. Plan and estimate domestic electric work	**P1.** Plan the client requirement at broad level from the proposal. **P2.** Plan the electrical appliances/materials / used in different stages of the electrical development process **P3.** Plan and estimate electrical wiring **P4.** Estimate Installation and Material Cost **P5.** Estimate Power consumption for lighting and appliances **P6.** Plan a main and sub distribution board. **P7.** Ensure safety system.
CU2. Plan and estimate	**P8.** Analyze the client requirement at broad level from the proposal. **P9.** Plan the electrical equipment /appliances/materials / used in

commercial electric work.	different stages of the commercial electrical work **P10.** Plan and estimate electrical wiring **P11.** Estimate Installation and Material Cost **P12.** Estimate Power consumption for centralize lighting, heating, cooling system and other appliances. **P13.** Plan a main and sub distribution board. **P14.** Ensure safety measures in development process. **P15.** Enlist the material required
CU3. Plan and estimate industrial electric work.	**P1.** Analyze the client requirement at broad level from the proposal. **P2.** Plan the electrical equipment /appliances/materials / used in different stages of the commercial electrical work **P3.** Plan and estimate electrical wiring **P4.** Estimate Installation and Material Cost **P5.** Estimate Power consumption for centralize lighting, heating, cooling system and other appliances. **P6.** Plan 3-phase line for heavy loads **P7.** Plan a separate control panel box for heavy machinery. **P8.** **P9.** Plan a main and sub distribution board. **P10.** Design a safety system for protection of machinery and labor. **P11.** Assign color scheme for safety measures

Knowledge & Understanding

- Define the term ‘value chain’ of industry.
- Define human machine interface (HMI)
- Define the Standard operating procedure (SOP) of the organization for control panel development process.
- How to prepare a General arrangement drawing?
- Define IEC standards
- Describes the standard of electrical components.
- Understanding and knowledge of equipment properties.
- Understanding and knowledge of input and output of tool of electronic.
- Describe the rules and regulation of work.
- Understanding and knowledge of Electrical Specifications component used.
- Describes the standard of electrical components.

- Understanding and knowledge of equipment properties.
- Understanding and knowledge of input and output of tool of electronic.
- Describe the rules and regulation of work
- Describes the standard of electrical components.
- Understanding and knowledge of equipment properties.
- Understanding and knowledge of input and output of tool of electronic.
- Describe the rules and regulation of work

Tools and Equipment

SN	Tools
1	Site Visit
2	Protective gear such as helmets, goggles, gloves, rubber shoes, etc.
3	Reference Material
4	Clipboard
5	Calculation Sheet
6	Calculator
7	Psychometric Charts and Tables

Critical Evidence(s) Required

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

Installation techniques

0713E&E64 Verify Basic Laws of Electrical Machines

Overview:

This competency standard covers the skills and knowledge required to verify Faraday's law by moving permanent magnet inside the coil, verify Faraday's law by moving coil near the magnet field, verify Faraday's law using relative motion of coil and magnet, verify Faraday's Law using simple loop generator, verify EMF through induction, verify Torque induce in a current carrying loop and verify Mutual induction.

Competency Units	Performance Criteria
CU1. Verify Faraday's law by moving permanent magnet inside the coil.	**P1.** Construct a coil. **P2.** Connect Galvanometer with coil. **P3.** Move permanent magnet inside the coil fast and slow. **P4.** Record the effect of movement of magnet on reading of Galvanometer. **P5.** Hold the magnet inside the coil and do not move. **P6.** Record the effect on reading of Galvanometer again.
CU2. Verify Faraday's law by moving coil near the magnet field.	**P1.** Construct a coil. **P2.** Connect Galvanometer with coil. **P3.** Fix permanent magnet and move the coil fast and slow on it. **P4.** Record the effect of movement of coil on reading of Galvanometer. **P5.** Hold the coil near the magnetic field and do not move. **P6.** Record the effect on reading of Galvanometer.
CU3. Verify Faraday's law using relative motion of coil and magnet.	**P1.** Construct a coil. **P2.** Connect Galvanometer with coil. **P3.** Make relative motion of coil and magnet. **P4.** Record the effect of movement on reading of Galvanometer.
CU4. Verify Faraday's Law using simple loop generator.	**P1.** Identify single loop generator and its parts. **P2.** Select field winding. **P3.** Connect Galvanometer with single loop coil. **P4.** Rotate the single loop coil of generator in the field

	P5. Measure the voltage induced in loop generator. **P6.** Record the effect of movement on reading of Galvanometer.
CU5. Verify Torque induce in a current carrying loop	**P1.** Construct a coil. **P2.** Apply DC voltage to this coil. **P3.** Place a current carrying loop in this coil. **P4.** Check the direction of force to verify the torque produce.
CU6. Verify Mutual induction	**P1.** Construct 2 coils on two different legs of single core. **P2.** Apply AC voltage to the any one coil. **P3.** Check the volts induce in other coil by voltmeter.

Knowledge & Understanding

- What is first law of 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 torque?
- Why force produce on current carrying conductor.
- What is core?
- 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?
- Which machine work on the principle of mutual induction

Tools and Equipment

SN	Tools
1	Coil
2	Galvanometer.
3	Magnet
4	Connecting leads

5	Transformer
6	Rheostat
7	Loop
8	Voltmeter
9	DC source
10	Coil
11	Connecting leads
12	Rheostat

Critical Evidence(s) Required

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

Verify Mutual induction

0713E&E65 Analyze DC Generators

Overview:

This competency standard identifies the competencies required to measure the stator winding resistance with DC test, perform no load test, perform short circuit test, measure the efficiency of an alternator, measure the effect of field current on terminal voltage, measure the effect of speed changes on alternator frequency and active power and perform parallel operation of Alternators.

Competency Units	Performance Criteria
CU1. Measure the stator winding resistance with DC test.	**P1.** Connect DC Ampere meter in series with armature. **P2.** Apply DC voltage to any one of the other two phases. **P3.** Measure current and voltage. **P4.** Measure the resistance per phase by ohm's law.
CU2. Perform no load test.	**P1.** Make connection according to diagram. **P2.** Run the alternator with prime mover to its rated speed. **P3.** Supply the field current to make the terminal voltage to its rated value. **P4.** Measure Iron losses from watt meter.
CU3. Perform short circuit test.	**P1.** Make connection according to diagram. **P2.** Run the alternator with prime mover to its rated speed. **P3.** Supply the field current to make the terminal voltage 10 to 15% to its rated value. **P4.** Measure the copper loss from the watt meter.
CU4. Measure the efficiency of an alternator.	**P1.** Perform no load test to measure Iron losses. **P2.** Perform short circuit test to measure copper losses. **P3.** Apply formula to find efficiency.
CU5. Measure the effect of field current on terminal voltage.	P1. Run the alternator with prime mover to its rated speed. P2. Regulate the field current from zero to high value to make the terminal voltage to its rated value P3. Note values of field current and respective terminal voltage P4. Draw no load curve between field current and terminal

	voltage.
CU6. C.	**P1.** Run the alternator with prime mover to its rated speed. **P2.** Supply the field current to make the terminal voltage to its rated value. **P3.** Apply electrical load on alternator. **P4.** Measure the effects of load on alternator speed and frequency. **P5.** Regulate the prime mover speed from lower to its rated value. **P6.** Measure the effect of this change on alternator speed and frequency.
CU7. Perform parallel operation of Alternators.	**P1.** Run the incoming alternator to its rated speed. **P2.** Supply the field current to make the terminal voltage to its rated value. **P3.** Use synchronous scope to synchronize alternator's frequency and phase angle. **P4.** Check the phase sequence with dark lamp method. **P5.** Check the voltage of bus bar and incoming machine with volt meter. **P6.** Switch on the breaker after completing parallel operation.

Knowledge and Understanding:

- How to connect DC source with three phase stator?
- How to calculate the resistance of winding by using meter reading.
- Which type of losses is found with no load test?
- What is iron loss?
- What is copper loss?
- Which types of losses are found with short circuit test?
- Which types of losses are found with no load test?
- Explain the effect of field current on terminal voltage.
- Explain the effect of rheostat resistance on terminal voltage.
- What is core saturation?
- Why the graph between field current and armature voltage is not a straight line

- How to change the RPM of the generator?
- Explain the conditions of paralleling of alternators.
- Why we connect alternators in parallel.
- Explain the working of synchronous scope.
- What is phase sequence?
- What is phase angle?

Tools and Equipment

SN	Tools
1	Alternator
2	Ampere meter
3	Voltmeter
4	Wattmeter
5	Frequency meter
6	DC source
7	Resistive load
8	Connecting wires

Critical Evidence(s) Required

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

Perform parallel operation of Alternators.

0713E&E66 Analyze Single Phase Motors.

Overview:

This competency standard identifies the competencies required to operate split phase single phase AC motor, operate capacitor start and Capacitor run single phase AC motor and operate shaded pole single phase motor.

Competency Units	Performance Criteria
CU1. Operate split phase single phase AC motor.	**P1.** Make connections according to circuit diagram. **P2.** Apply rated voltage to the stator. **P3.** Measure RPM and direction of rotation. **P4.** Disconnect the auxiliary winding from centrifugal switch. **P5.** Check the effect of this change.
CU2. Operate capacitor start and Capacitor run single phase AC motor.	**P1.** Make connections according to circuit diagram. **P2.** Apply rated voltage to the stator. **P3.** Measure the RPM. **P4.** Remove the starting capacitor with centrifugal switch. **P5.** Measure the RPM again. **P6.** Check the effect of starting capacitor on motor torque.
CU3. Operate shaded pole single phase motor.	**P1.** Make connections according to circuit diagram. **P2.** Apply rated voltage to the stator. **P3.** Change the applied voltage to measure the effect on motor speed.

Knowledge and Understanding:

- What is starting winding?
- What is running winding?
- How to rotate magnetic field in single phase motor.
- Why we connect capacitor with starting winding.
- Explain the effect of capacitor on starting torque.
- How to rotate magnetic field
  In single phase motor

- Explain the working of shaded pole motor.

Tools and Equipment

SN	Tools
1	Single phase induction motor
2	Tachometer
3	Centrifugal switch
4	Connecting wires

Critical Evidence(s) Required

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

Operate capacitor start and Capacitor run single phase AC motor.

0713E&E67. Analyze Special Purpose Motors.

Overview:

This competency standard identifies the competencies required to operate and speed control of AC series motor, operate miniature (reluctance and hysteresis) single phase AC motors, construct and operate stepper motor and construct and operate and develop control circuit with the help of servo motor.

Competency Units		Performance Criteria	
CU1.	Operate and speed control of AC series motor.	**P1.** **P2.** **P3.**	Connect the armature and field winding in series. Apply rated voltage to the motor. Measure the effect on motor speed by change in applied voltage.
CU2.	Operate miniature (reluctance and hysteresis) single phase AC motors.	**P1.** **P2.** **P3.** **P4.**	Connect the stator of motor with single phase supply. Apply mechanical load by hand Measure the effect of load change on motor speed. Draw torque speed curves.
CU3.	Construct and operate stepper motor.	**P1.** **P2.** **P3.** **P4.** **P5.** **P6.**	Connect the stator of the motor with control circuit. Adjust the control voltage of control unit. Measure the RPM. Readjust the control voltage of control unit. Measure the RPM again. Make comparison between Control voltage and RPM.
CU4.	Construct, Operate and develop	**P1.** **P2.**	Pair the servo motor with some encoder to provide position and speed feedback. Compare the measured position to external input to the controller.

control circuit of servo motor.	**P3.** Check the effect of feedback on motor position.

Knowledge and Understanding:

- Explain the working of AC series motor.
- Explain the effect of applied voltage on speed of the motor.
- Explain the working of reluctance motor.
- Explain the working of hysteresis motor.
- Explain the working of stepper motor.
- Explain the working of control unit for stepper motor.
- Explain the working of servo motor.

Tools and Equipment

SN	Tools
1	AC series motor
2	Tachometer
3	Connecting wires
4	Reluctance motor
5	Hysteresis motor
6	Tachometer
7	Connecting wires
8	Stepper motor
9	Control unit
10	Tachometer
11	Connecting wires
12	Servo motor
13	Control circuit

Critical Evidence(s) Required

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

Construct, Operate and develop control circuit of servo motor

0713E&E68 Analyze Three Phase Motors.

Overview:

This competency standard identifies the competencies required to identify and operate 3 phase Squirrel cage motor, verify rotating magnetic field , measure the starting and running current of three phase induction motor, draw torque slip curve of three phase induction motor, determine the slip of 3 phase induction motor by stroboscope, start 3 phase Induction motor with direct on line, start 3 phase Induction motor with Auto transformer starter, start 3 phase Induction motor with Star Delta starter, make connection to reverse the direction of induction motor, determine the efficiency of three phase induction motor, control the speed of three phase induction motor by changing primary voltage, control the speed of three phase induction motor by rotor resistance control method, operate two motors in cascade, start the synchronous motor using external prime mover and identify the effect of field current on three phase synchronous motor.

Competency Units	Performance Criteria
CU1. Identify and operate 3 phase Squirrel cage motor.	**P1.** Identify and select 3 phase squirrel cage motor. **P2.** Make connection as per diagram. **P3.** Connect the supply and interpret the result.
CU2. Verify rotating magnetic field	**P1.** Connect the three terminals of stator winding with each other and with ground. **P2.** Apply three phase supply to the other terminals. **P3.** Place a compass between the stator and note the direction of rotating magnetic field. **P4.** Change the two phases with each other. **P5.** Note the direction of rotating magnetic field.
CU3. Measure the starting and running current of three phase induction motor.	**P1.** Connect the stator winding in star. **P2.** Connect an ammeter in series with stator. **P3.** Note the ammeter reading at instant of just starting. **P4.** Note the reading of ammeter at running condition.

CU4.	Draw torque slip curve of three phase induction motor	**P1.** Connect three phase induction motor with electro dynamo meter with Belt. **P2.** Start the motor and run at rated speed **P3.** Measure the RPM. **P4.** Change the torque with electro dynamo meter and note the speed **P5.** Calculate slip with given values of speed. **P6.** Draw graph between slip and torque.
CU5.	Determine the slip of 3 phase induction motor by stroboscope	**P1.** Connect the stator of three phase induction motor in star **P2.** Apply single phase AC supply to the stroboscope. **P3.** Mark dot on motor shaft with marker. **P4.** Apply three phase supply to the motor **P5.** Note the RPM of the motor with the help of stroboscope. **P6.** Calculate slip.
CU6.	Start 3 phase Induction motor with direct on line.	**P1.** Draw line diagram of direct-on 3-phase motor Starter. **P2.** Identify and select 3 phase Induction motor. **P3.** Make Connection of motor with DOL as per diagram. **P4.** Switch on the 3 phase breaker and interpret the result.
CU7.	Start 3 phase Induction motor with Auto transformer starter.	**P1.** Connect power circuit with the help of diagram. **P2.** Connect control circuit with the help of diagram. **P3.** Apply rated voltage to the motor. **P4.** Gradually reduce the taping of auto transformer with the help of control circuit.
CU8.	Start 3 phase Induction motor with Star Delta starter.	P1**:** Draw line diagram of a starter-delta starter. P2**:** Identify and select 3 phase Induction motor. P3**:** Make Connection of motor with star delta starter as per diagram. P4**:** Switch On the 3 phase breaker and interpret the result.
CU9.	Make connection to reverse the direction of	P1**:** Draw line diagram to reverse the direction of induction motor P2**:** Identify and select 3 phase Induction motor. P3**:** Make Connection of motor through 3 pole 2 way switch

	induction motor.	as per diagram. P4**:** Move the handle of 3Pole 2 Way switch from off position to position 1. P5**:** Move the handle of 3 Pole 2 Way switch from Position 1 to off position and wait for stopping of motor P6**:** Move the handle of 3Pole 2 way switch from off position to position 2 and interpret the result.
CU10.	Determine the efficiency of three phase induction motor	**P1.** Connect wattmeter, ammeter with the stator of three phase induction motor. **P2.** Run the motor at rated speed. **P3.** Measure the reading of wattmeter and voltmeter. **P4.** Stop the motor **P5.** Couple three phase induction motor and electro dynamo meter with belt. **P6.** Run the motor. **P7.** Supply single phase supply to the dynamo meter. **P8.** Adjust the supply of electro dynamo meter so that the maximum current passes through the motor. **P9.** Read the meters reading. **P10.** Calculate the efficiency of the motor by using these reading.
CU11.	Control the speed of three phase induction motor by changing primary voltage	**P1.** Connect the stator of the motor in star connection. **P2.** Insert rheostat in series with stator of the motor. **P3.** Set the rheostat resistance to its max value. **P4.** Run the motor **P5.** Change rheostat resistance and note the effect of speed changes.
CU12.	Control the speed of three phase induction motor by rotor resistance control method	**P1.** Select wound rotor induction motor. **P2.** Connect the stator of motor in star connection. **P3.** Connect a star connected starter with motor rotor. **P4.** Set rotor resistance to its max value. **P5.** Run the motor. **P6.** Change the rotor resistance and note the effect of speed change.

CU13. Operate two motors in cascade	**P1.** Select two wound rotor induction motor. **P2.** Couple shaft of the both motors. **P3.** Connect the stator of motor 2 with the rotor of motor 1. **P4.** Connect the motor 2 rotor in star connection. **P5.** Apply three phase voltage to the stator of motor 1. **P6.** Control the speed of both motors by changing the rotor resistance of motor 2.
CU14. Start the synchronous motor using external prime mover.	**P1.** Couple the shaft of the synchronous motor with external prime mover (DC Shunt motor) **P2.** Connect the stator winding of synchronous motor in star connection. **P3.** Apply rated voltage to the stator. **P4.** Run the prime mover, which results in locking of rotor with stator magnetic field
CU15. Identify the effect of field current on three phase synchronous motor.	**P1.** Apply rated voltage to stator. **P2.** Excite the field winding. **P3.** Change the field winding voltage and measure the effect on Armature current. **P4.** Draw the V curve between Armature Current and Field current.

Knowledge and Understanding:

- How many types of three phase induction motor with respect to the rotor?
- Explain the term rotating magnetic field
- How to change the direction of rotation of motor.
- Why we initially start the motor in star connection.
- Why motor take large current at the time of starting.
- What is back EMF?
- How to change the mechanical load on motor?
- How to measure the speed of DC motor?
- What is motor slip?
- Explain the effect of torque on motor slip.
- Explain the working of stroboscope.

- How to calculate the slip from motor speed.
- What in magnetic contactor.
- What is relay?
- Explain the working of DOL
- What is auto transformer?
- How to change the taping of auto transformer?
- Why we never start motor without load.
- Which type of connection is use at the starting of motor?
- Which type of connection is use at the running of motor?
- What is different between control circuit and power circuit
- What in magnetic contactor.
- How to reverse the direction of motor.
- Explain the connection of wattmeter.
- Explain the working of electro dynamo meter.
- What is iron loss?
- What is copper loss?
- Why we find copper loss at full load.
- Which loss having maximum value and why
- How many techniques are used to control the speed of three phase induction motor?
- What is rheostat?
- Explain the effect of voltage changes on speed of motor.
- Why we connect the stator of motor in star.
- How to insert the resistance in rotor circuit at the time of starting

- What is mean by cascade?
- Why we insert maximum resistance in rotor circuit at the time of starting.

- Write the name of starting method of synchronous motor.
- Why synchronous motor is not self-starting.
- Which type of supply voltage is applied to the synchronous motor rotor?
- How to change the field excitation of synchronous motor?
- Explain over and under excitation.
- Explain V curve of synchronous motor.

Tools and Equipment

SN	Tools
1	Three phase squirrel cage induction motor
2	Connecting wires
3	Wires
4	Meter
5	Belt
6	Tachometer
7	Ammeter
8	Connecting
9	wires
10	Tachometer
11	DOL starter
12	Auto transformer
13	Ammeter
	Electro dynamo meter
	Rotor start
	DC shunt motor

Critical Evidence(s) Required

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

Identify the effect of field current on three phase synchronous motor.

0713E&E69 Repairs/Maintenance and Service of Electric Motors and Generators

Overview:

This Competency Standard identifies the competencies required to Diagnose Fault in Electric Motor, carry out Service/Repair in Electric Motor, carry out Preventive Service/ Maintenance of Generators and Diagnose and Repair Electric Generator carry out repair and maintenance of AC motors and generators in accordance with the manufacturer's instructions. The underpinning knowledge regarding repair and maintenance of electrical motor & generators will be sufficient to provide the basis for your work.

Competency Units	Performance Criteria
CU1. Diagnose Fault in Electric Motor	**P1.** Identify the type of electric motor from data / name plate or manual and motor ratting. **P2.** Check the tripping of protective device using specified test instruments, while the motor is running with power supply connected with suitable control and protective device, the difficulty in starting/low RPM/ unusual noises/ excessive heat/ grounded winding etc. **P3.** Perform dismantling of three-phase motor **P4.** Inspect visual mechanical defect such as, loose or tight bearings, bent shaft, noisy running. **P5.** Check the motor by using specified test instruments to detect electrical defects such as loose/or burnt electrical connections, burnt windings, low insulation resistance. **P6.** Perform test to locate short circuit, circuit break, earth fault, wiring fault, bearing fault.
CU2. Carry out Service/Repair in Electric Motor	**P1.** Clean the parts of the motor with specified cleaning agents/tools & material **P2.** Repair the motor as per diagnosed mechanical faults **P3.** Check the windings insulation resistance with insulation tester **P4.** Rewind the motor as per requirement **P5.** Check the insulation resistance of repaired motor as per standard

	P6. Assemble the electric motor after performing internal tests/servicing/repairs according to manufacturer's instructions **P7.** Carry out the No load and load tests as per standard practices
CU3. Carry out Preventive Service/ Maintenance of Generators	**P1.** Carry out routine maintenance of the generator as specified in the manufacturer's manual **P2.** Check out the switch, timer, relay, protective device and wire connection **P3.** Update the maintenance/service records
CU4. Diagnose and Repair Electric Generator	**P1.** Check Load regulator of the generator and its control circuit. **P2.** Check control circuit of the auxiliary generator. **P3.** Check control circuit of the battery unit **P4.** Check circuit breaker and relay. **P5.** Dismantle the electric Generator for internal tests/servicing/repairs according to manufacturer's instructions **P6.** Clean the parts of the generator with specified cleaning agents/tools & material **P7.** Find out the root cause of fault according to the signs of fault by applying the working principles of control equipment of generators**:** Speed controller, Magnetic field control circuit and equipment of the generator. **P8.** Repair the fault after finding out the faulty equipment or component **P9.** Check the windings insulation resistance with insulation tester as per standard **P10.** Repair / rewind the generator winding as per diagnosed fault. **P11.** Assemble the generator after performing internal tests/servicing/repairs according to manufacturer's instructions **P12.** Carry out the No load and load tests as per standard practices

Knowledge & Understanding

- Understand Type and Construction and working principal of Motors (Induction, Servo, Synchronous, DC motor DC Series Motor, DC shunt Motor, D.C. compound motor, Squirrel Cage Induction motor, Wound Rotor Induction motor, Synchronous

motor, split phase motors (capacitor start and capacitor run motors), Universal motors, Synchronous motors.

- Understand working principal of
- electrical Generator, D.C. series generator, D.C. shunt generator, D.C. compound generator, 3 phase salient pole type 3 phase non salient pole type (Smooth Cylindrical type)
- Servicing of motors and standby generators
- Types of electrical measuring instruments used in testing electric motors & generators
- Fundamentals of electrical rotating machines
- Auto Transfer switch (ATS)/Auto Main Failure (AMF) module
- Maintenance procedures on standby generators
- Working principles of electric
- motors &generators
- Types of electrical control and protective devices
- Dis-assembling & re-assembling
- of electric motors
- Common faults found in electric motors/generators and troubleshooting methods
- Electrical legislation and regulations related to electric motors and allied motor control switchgear
- Preventive maintenance work on motors and stand by generators
- Record keeping and reporting

Tools and Equipment

SN	Tools
1	AC Motors
2	Ammeter
3	Battery Cleaning
4	Battery Charger
5	Kit
6	Bearing Puller
7	Bench Vice
8	Cable / Wire Gauge

9	Cable Cutter
10	Cable Knife
11	Cells tester
12	Chisel
13	Circuit Boards
14	clamp Meter
15	Earth Tester
16	Hammer
17	Safety Belt
18	RPM Meter
19	Philips Screw Drivers Set
20	Ring Spanner Set
21	Multi-meter
22	Lux Meter
23	Megger (Insulation Tester)
24	Micron Meter
25	OTDR Meter
26	Phase Sequence
27	Meter
28	Magnetic
29	Hacksaw
30	Safety Goggles
31	Safety Helmet
32	Safety Shoes
33	Set of Screw Drivers
34	Set of Nose Pliers
35	Thermometer
36	Splicing Machine
37	Test lamp
38	Soldering Lead
39	Soldering Iron
40	Gloves
41	Grinder
42	Generator

43	Filler gauge
44	Files (set)
45	Duct Rod
46	Disk Grinder
47	Combination Plier Set
48	Thimble Press Plier

Critical Evidence(s) Required

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

- Perform insulation, frequency, no-load, load testing etc.
- Troubleshooting of starting system of AC motor & generator
- Replacement of capacitor and bearings of motor

0713E&E70 Verify Basic Laws of Electrical Machines

Overview:

This competency standard covers the skills and knowledge required to verify Faraday's law by moving permanent magnet inside the coil, verify Faraday's law by moving coil near the magnet field, verify Faraday's law using relative motion of coil and magnet, verify Faraday's Law using simple loop generator, verify EMF through induction, verify Torque induce in a current carrying loop and verify Mutual induction.

Competency Units	Performance Criteria
CU1. Verify Faraday's law by moving permanent magnet inside the coil.	**P1.** Construct a coil. **P2.** Connect Galvanometer with coil. **P3.** Move permanent magnet inside the coil fast and slow. **P4.** Record the effect of movement of magnet on reading of Galvanometer. **P5.** Hold the magnet inside the coil and do not move. **P6.** Record the effect on reading of Galvanometer again.
CU2. Verify Faraday's law by moving coil near the magnet field.	**P1.** Construct a coil. **P2.** Connect Galvanometer with coil. **P3.** Fix permanent magnet and move the coil fast and slow on it. **P4.** Record the effect of movement of coil on reading of Galvanometer. **P5.** Hold the coil near the magnetic field and do not move. **P6.** Record the effect on reading of Galvanometer.
CU3. Verify Faraday's law using relative motion of coil and magnet.	**P1.** Construct a coil. **P2.** Connect Galvanometer with coil. **P3.** Make relative motion of coil and magnet. **P4.** Record the effect of movement on reading of Galvanometer.
CU4. Verify Faraday's Law using simple loop generator.	**P1.** Identify single loop generator and its parts. **P2.** Select field winding. **P3.** Connect Galvanometer with single loop coil. **P4.** Rotate the single loop coil of generator in the field

	P5. Measure the voltage induce in loop generator. **P6.** Record the effect of movement on reading of Galvanometer.
CU5. Verify Torque induce in a current carrying loop	**P1.** Construct a coil. **P2.** Apply DC voltage to this coil. **P3.** Place a current carrying loop in this coil. **P4.** Check the direction of force to verify the torque produce.
CU6. Verify Mutual induction	**P1.** Construct 2 coils on two different legs of single core. **P2.** Apply AC voltage to the any one coil. **P3.** Check the volts induce in other coil by voltmeter.

Knowledge & Understanding

- What is Faraday's first law of Electro-Magnetic Induction?
- 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 torque?
- Why force produce on current carrying conductor?
- What is core?
- What is induction?
- What is meaning of coupled coils?
- Why EMF induced in 2nd coil, when voltage is applied to 1st coil?
- What is mutual induction?
- Which machine work on the principle of mutual induction?

Tools and Equipment

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SN	Tools
1	Coil
2	Galvanometer.
3	Voltmeter
4	Transformer
5	Connecting leads.
6	Magnet.
9	DC source

10	Rheostat
12	Loop

Critical Evidence(s) Required

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

Verify Faraday's Law using simple loop generator.

0713E&E71 Operate Single Phase Transformer

Overview:

This competency standard identifies the competencies required to identify types of transformer, Measure transformer ratio of single phase transformer, make transformer winding, determine voltage regulation of single phase transformer with different load and perform parallel operation of single phase transformer.

Competency Units		Performance Criteria	
CU1.	Identify types of transformer.	**P1.**	Identify no of windings on primary and secondary side of transformer.
		P2.	Identify the types of transformer cores.
		P3.	Identify connection of the windings.
		P4.	Separate single phase, three phase and auto transformer.
CU2.	Measure transformation ratio of single phase transformer.	**P1.**	Connect volt meters on both side of the transformer.
		P2.	Apply rated voltage to the primary.
		P3.	Note the volt meter reading.
		P4.	Calculate transformation ratio using ratio formula.
		P5.	Repeat P1 to P4 for different secondary tapping.
CU3.	Make transformer winding	**P1.**	Design the core of transformer according to the transformer rating.
		P2.	Select the wire for primary and secondary winding.
		P3.	Perform winding according to require turns with the help of winding machine.
		P4.	Cover the winding with insulating paper.
		P5.	Adjust the core pieces into the winding.
		P6.	Remove the insulation of enameled wire.
		P7.	Cover the ends of wire with sleeve.
		P8.	Perform continuity test with ohm meter.
CU4.	Determine voltage regulation of single phase transformer with different	**P1.**	Connect watt meter, ampere meter, and volt meter to the primary side of transformer.
		P2.	Connect the voltmeter to secondary side of transformer.
		P3.	Connect resistive load to secondary side.
		P4.	Apply rated voltage to primary side of transformer.
		P5.	Calculate voltage drop and voltage regulations (%) from

	load.	meter readings. **P6.** Repeat from P1 to P5 for inductive load. **P7.** Repeat from P1 to P5 for capacitive load.
CU5.	Perform parallel operation of single phase transformer.	**P1.** Identify two transformer having same rated voltage, frequency and transformation ratio. **P2.** Mark the terminals with the help of polarity test. **P3.** Connect secondary sides of both transformers in parallel. **P4.** Connect secondary sides of both transformers with load bus bar having ampere meters between them. **P5.** Connect the primary side of both transformers in parallel. **P6.** Connect primary side of transformer with generation bus bar. **P7.** Adjust the ammeter readings to zero by adding inductor and resistor in series with secondary side of the transformer.

Knowledge and Understanding:

- Define primary and secondary windings of transformer.
- Explain the types of transformer cores.
- Explain connection of the windings.
- Differentiate single phase, three phase, and auto and instrument transformer.
- How to connect volt meters on both side of the transformer.
- How to apply voltage to the primary?
- Explain transformer ratio.
- How to select the wire for primary and secondary winding?
- Explain winding procedure.
- Explain winding insulation with insulating paper.
- How to adjust the core pieces into the winding?
- How to remove the insulation of enameled wire?
- What is sleeve?

- Explain continuity test with ohm meter.
- Explain voltage regulation of the transformer.
- Explain the word voltage drop
- What is transformation ratio?
- Explain polarity test of transformer.
- Describe the conditions for paralleling of the transformer.
- What is indicator?

Tools and Equipment

SN	Tools
1	Winding wire
2	Winding machine
3	Ohmmeter
4	Sleeve
5	Hammer
6	Insulating pap
7	Single phase transformer
8	Voltmeters
9	Connecting wires
12	Core

Critical Evidence(s) Required

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

Perform parallel operation of single phase transformer.

0713E&E72 Perform Tests on Single Phase Transformer

Overview:

This competency standard identifies the competencies required to perform polarity test of single phase transformer, Perform Open circuit test of transformer, Perform Short Circuit Test of Transformer, calculate efficiency of transformer by direct method and calculate efficiency of transformer by Back to Back test.

Competency Units		Performance Criteria
CU1.	Perform polarity test of single phase transformer.	**P1.** Connect the circuit according to the diagram. **P2.** Note the reading of both volt meter. **P3.** Identify additive and subtractive polarity. **P4.** Mark the terminal according to the additive and subtractive polarity.
CU2.	Perform Open circuit test of transformer.	**P1.** Connect watt meter, ampere meter, and volt meter to the lower voltage side of transformer. **P2.** Open the high voltage side of transformer. **P3.** Apply rated voltage to lower voltage side of transformer. **P4.** Read the instrument/meters reading. **P5.** Calculate iron losses and excitation branch component (Ro, Xo).
CU3.	Perform Short circuit Test of Transformer.	**P1.** Connect watt meter, ampere meter, and volt meter to the higher voltage side of transformer. **P2.** Connect lower voltage side terminal with each other (Short Circuit) **P3.** Apply 10 % to 15 % of rated voltage to higher voltage side of transformer. **P4.** Read the instrument/meters readings. **P5.** Calculate copper losses and winding component (Ro1, Xo1)
CU4.	Calculate efficiency of transformer by direct method.	**P1.** Perform open circuit test. **P2.** Perform short circuit test. **P3.** Calculate iron losses and copper losses from above tests. **P4.** Calculate input power and output power. **P5.** Calculate efficiency from calculated powers.

CU5.	Calculate efficiency of transformer by Back to Back test.	**P1.** Identify two transformer of same rating. **P2.** Connect both transformer in parallel. **P3.** Connect another variable voltage transformer to secondary side of parallel transformers. **P4.** Connect a switch, watt meter and ammeter between variable voltage transformer and parallel transformer. **P5.** Connect voltmeter and watt meter to primary side of transformer parallel transformer. **P6.** Apply rated voltage to the primary side of the parallel transformers. **P7.** Open the switch. **P8.** Calculate iron losses. **P9.** Close the switch **P10.** Adjust the voltage of variable voltage transformer until the full load current passes from secondary side of parallel transformers. **P11.** Calculate copper losses. **P12.** Calculate efficiency from above calculated losses.

Knowledge and Understanding:

- Differentiate between additive and subtractive polarity.
- How to use watt meter?
- What is iron loss?
- How many components of excitation branch?
- Why we connect watt meter, ampere meter and volt meter to the higher voltage side of transformer in short circuit test.
- Why we short Circuit the low voltage side of the transformer in short circuit test.
- Explain the reason to apply 10 % to 15 % of rated voltage to higher voltage side of transformer.
- What is copper loss?
- How many components of transformer winding?
- Why we perform open circuit test in transformer?
- Why we perform short circuit test in transformer.

- What is iron loss?

Tools and Equipment

SN	Tools
1	Voltmeters
2	Wattmeter
3	Ohmmeters
4	connecting wires
5	Ammeters
7	Single phase transformer

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard**:** Calculate efficiency of transformer by Back to Back test.

0713E&E73 Operate Auto Transformer

Overview:

This competency standard identifies the competencies required to identify the connection of auto transformer, Calculate Voltage ratio of Auto Transformer and calculate Current ratio of Auto Transformer.

Competency Units	Performance Criteria
CU1. Identify the connection of auto transformer	**P1.** Connect voltmeters to the both side of the transformer. **P2.** Apply rated voltage to the primary side. **P3.** Identify the lower voltage and higher voltage side with the help of volt meter reading. **P4.** Identify step up and step down transformer.
CU2. Calculate Voltage ratio of Auto Transformer	**P1.** Connect voltmeters to the both side of the transformer. **P2.** Apply rated voltage to the primary side. **P3.** Read the voltmeters reading. **P4.** Calculate voltage ratio with the help of voltmeters reading.
CU3. Calculate Current ratio of Auto Transformer	**P1.** Connect ammeters to the both side of the transformer. **P2.** Connect a resistive load to secondary side of the transformer. **P3.** Apply rated voltage to the primary side. **P4.** Read the ammeters reading. **P5.** Calculate current ratio with the help of ammeters reading.

Knowledge and Understanding:

- What is the different between auto transformer and ordinary transformer?
- How to identify step up and step down transformer.
- Explain voltage ratio of auto transformer.
- Explain the connection of ammeter and volt meter

Tools and Equipment

SN	Tools
1	Voltmeter
2	Auto transformer
3	Ohmmeter

4	connecting wires
5	Ammeter

Critical Evidence(s) Required

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

Calculate Voltage ratio of Auto Transformer

0713E&E74 Perform Tests on Auto Transformer.

Overview:

This competency standard identifies the competencies required to Perform open circuit Test of auto transformer, perform short circuit test of auto transformer and calculate efficiency of auto transformer.

Competency Units	Performance Criteria
CU1. Perform open circuit Test of auto transformer.	**P1.** Connect watt meter, ampere meter, and volt meter to the lower voltage side of transformer. **P2.** Open the high voltage side of transformer. **P3.** Apply rated voltage to lower voltage side of transformer. **P4.** Read the instrument/meters reading. **P5.** Calculate iron losses and excitation branch component (Ro, Xo).
CU2. Perform short circuit test of auto transformer	**P1.** Connect watt meter, ampere meter, and volt meter to the higher voltage side of transformer. **P2.** Connect lower voltage side terminal with each other (Short Circuit) **P3.** Apply 10 % to 15 % of rated voltage to higher voltage side of transformer. **P4.** Read the instrument/meters readings. **P5.** Calculate copper losses and winding component (Ro1, Xo1)
CU3. Calculate efficiency of auto transformer.	**P1.** Perform open circuit test. **P2.** Perform short circuit test. **P3.** Calculate iron losses and copper losses from above tests. **P4.** Calculate input power and output power. **P5.** Calculate efficiency from calculated powers.

Knowledge and Understanding:

- How to use watt meter?
- Why we connect wattmeter, ampere meter and volt meter to the lower voltage side of transformer.
- Why we open high voltage side of transformer instead of low voltage side.

- How many components of excitation branch
- Why we connect watt meter, ampere meter, and volt meter to the higher voltage side of transformer in short circuit test.
- Why we short Circuit the low voltage side of the transformer in short circuit test.
- Explain the reason to apply 10 % to 15 % of rated voltage to higher voltage side of transformer.
- What is copper loss?
- How many components of transformer winding.
- Why we perform open circuit test in transformer.
- Why we perform short circuit test in transformer.
- What is iron loss?

Tools and Equipment

SN	Tools
1	Voltmeters
2	Wattmeter
	Ammeters
3	Ohmmeters
4	connecting wires
5	Auto transformer

Critical Evidence(s) Required

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

Calculate efficiency of auto transformer

0713E&E75 Operate Three Phase Transformer

Overview:

This competency standard identifies the competencies required to Make Three Phase Transformer Winding, Perform Star to Star Connection of Three Phase Transformer, Perform Star to Delta Connection of Three Phase Transformer, Perform Delta to Delta Connection of Three Phase Transformer, Perform Delta to Star Connection of Three Phase Transformer, Connect Two Single Phase Transformers in Open Delta and perform Parallel operation of 3 phase transformers.

Competency Units		Performance Criteria
CU1.	Make Three Phase Transformer Winding.	**P1.** Design the core of transformer according to the transformer rating. **P2.** Select the connection of primary and secondary. **P3.** Select the wire for primary and secondary winding. **P4.** Perform winding according to require turns with the help of winding machine. **P5.** Cover the winding with insulating paper. **P6.** Adjust the core pieces into the winding. **P7.** Remove the insulation of enameled wire. **P8.** Cover the ends of wire with sleeve. **P9.** Connect the winding terminals in star or delta. **P10.** Perform continuity test with ohm meter.
CU2.	Perform Star To Star Connection Of Three Phase Transformer.	**P1.** Select three same rated single phase transformers. **P2.** Mark the polarity of the winding terminals. **P3.** Connect primary terminals and secondary terminals in star. **P4.** Connect voltmeters with primary and secondary. **P5.** Apply rated voltage to the primary. **P6.** Calculate and Verify line voltage and phase voltage
CU3.	Perform Star To Delta Connection Of Three Phase	**P1.** Select three same rated single phase transformers. **P2.** Mark the polarity of the winding terminals. **P3.** Connect primary terminals in star and secondary terminals in delta. **P4.** Connect voltmeters with primary and secondary.

	Transformer.	**P5.**	Apply rated voltage to the primary.
		P6.	Calculate and Verify line voltage and phase voltage
CU4.	Perform Delta To Delta Connection Of Three Phase Transformer	**P1.**	Select three same rated single phase transformers.
		P2.	Mark the polarity of the winding terminals.
		P3.	Connect primary terminals and secondary terminals in delta.
		P4.	Connect voltmeters with primary and secondary.
		P5.	Apply rated voltage to the primary.
		P6.	Calculate and Verify line voltage and phase voltage
CU5.	Perform Delta To Star Connection Of Three Phase Transformer	**P1.**	Select three same rated single phase transformers.
		P2.	Mark the polarity of the winding terminals.
		P3.	Connect primary terminals in Delta and secondary terminals in Star.
		P4.	Connect voltmeters with primary and secondary.
		P5.	Apply rated voltage to the primary.
		P6.	Calculate and Verify line voltage and phase voltage.
CU6.	Connect Two Single Phase Transformers In Open Delta.	**P1.**	Select two same rated single phase transformers.
		P2.	Mark the polarity of the winding terminals.
		P3.	Connect opposite terminals of primary winding of both transformers
		P4.	Take out connected terminals and other two terminals.
		P5.	Repeat P2 to P4 of CU6 for secondary side of transformer.
		P6.	Connect voltmeters with primary and secondary sides of transformers.
		P7.	Apply rated voltage to the primary.
		P8.	Calculate and Verify line voltage and phase voltage.
CU7.	Perform Parallel operation of 3 phase transformers.	**P1.**	Identify two three phase transformer having same rated voltage, frequency and transformation ratio.
		P2.	Connect the primary of each transformer in star connection.
		P3.	Connect the secondary of each transformer in Delta connection.
		P4.	Connect secondary sides of both transformers in parallel.
		P5.	Connect secondary sides of both transformers with load bus bar having indicator between them.
		P6.	Connect the primary side of both transformers in parallel.
		P7.	Connect primary side of transformer with generation bus bar.

	P8. Adjust the series resistance and series inductance to off the indicator.

Knowledge and Understanding:

- How to select the wire for primary and secondary winding?
- Explain winding procedure.
- Explain winding insulation with insulating paper.
- How to adjust the core pieces into the winding?
- How to remove the insulation of enameled wire?
- What is sleeve?
- What is star connection?
- What is delta connection?
- Explain continuity test with ohm meter.
- What is star to star connection?
- How to mark the polarity of the winding terminals?
- Explain the relation between line voltage and phase voltage in star connection.
- Explain the relation between line current and phase current in star connection
- What is star to Delta connection?
- Explain the relation between line current and phase current in delta connection
- What is delta to delta connection?
- What is delta to star connection?
- Explain open delta connection.
- Explain the relation between line voltage and phase voltage in open delta connection.
- Explain polarity test of transformer.
- Describe the conditions for paralleling of the transformer.
- What is indicator?
- What is transformation ratio?

Tools and Equipment

SN	Tools
1	Voltmeter
2	Wattmeter
3	Ohmmeter

4	connecting wires
5	Ammeter
10	Three phase transformer

Critical Evidence(s) Required

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

Perform Parallel operation of 3 phase transformers.

0713E&E76 Identify Vector Group of Three Phase Transformer

Overview:

This competency standard identifies the competencies required to Connect 3-phase transformers as per given vector group Yyo and Yy6, connect 3-phase transformers as per given vector group Ddo and Dd6 and connect 3-phase transformers as per given vector group Yd11 and Yd1

Competency Units	Performance Criteria
CU1. Connect 3-phase transformers as per given vector group Yyo and Yy6	**P1.** Connect three identical single phase transformer in star to star connection. **P2.** Connect phase angle meter between primary and secondary. **P3.** Apply rated voltage to the primary side of transformer. **P4.** Measure the phase angle between primary and secondary with the help of phase angle meter (0^0 and 180^0).
CU2. Connect 3-phase transformers as per given vector group Ddo and Dd6	**P1.** Connect three identical single phase transformer in delta to delta connection. **P2.** Connect phase angle meter between primary and secondary. **P3.** Apply rated voltage to the primary side of transformer. **P4.** Measure the phase angle between primary and secondary with the help of phase angle meter (0^0 and 180^0).
CU3. Connect 3-phase transformers as per given vector group Yd11 and Yd1	**P1.** Connect three identical single phase transformer in star to delta connection. **P2.** Connect phase angle meter between primary and secondary. **P3.** Apply rated voltage to the primary side of transformer. **P4.** Measure the phase angle between primary and secondary with the help of phase angle meter (30^0 lag or 30^0 lead).

Knowledge and Understanding:

- Explain star to star connection.
- Explain the term phase angle.
- How to connect phase angle meter between primary and secondary of the transformer.
- What is the phase angle of vector group Yy_0.
- How to connect phase angle meter between primary and secondary of the transformer.
- What is the phase angle of vector group Yy6.
-
- What is the phase angle of vector group Dd_0.
- What is the phase angle of vector group Dd_6.
- Explain star to delta connection.
- What is the phase angle of vector group Yd_{11}?

Tools and Equipment

SN	Tools
1	Single phase transformers
2	Phase angle meter
3	Connecting wires

Critical Evidence(s) Required

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

Connect 3-phase transformers as per given vector group Yd11 and Yd1

0713E&E77 Repair/ Maintenance and Service of Transformer

Overview

This Competency Standard identifies the competencies required to Diagnose Fault in transformer, carry out Service/Repair of Transformer and Carry out Preventive Service/ Maintenance of transformer. Carry out repair and maintenance of transformer in accordance with the manufacturer's instructions. The underpinning knowledge regarding repair and maintenance of transformer will be sufficient to provide the basis for your work.

Competency Units	Performance Criteria
CU1. Diagnose Fault in transformer	**P1.** Identify the type of transformer from data / name plate or manual and transformer rating. **P2.** Check the tripping/continuity of protective device using specified test **P3.** Dismantle the transformer, inspect visual mechanical defect such as, leakage of tank, noisy running, short circuit, LT, HT, coil, insulation and temperatures. **P4.** Before dissembling the transformer from assembly take snapshot ore draw layout diagram. **P5.** Check the transformer by using specified test instruments to detect electrical defects such as loose/or burnt electrical connections, burnt coil. Transformer oil, low insulation resistance etc. **P6.** Test Coil by humming method ore any standard method. **P7.** Check core lamination **P8.** Check continuity of Buchholz relay. **P9.** Check Short circuit faults such as inter turn faults, incipient winding faults, and core faults may occur due to the impulse breakdown of the insulating transformer oil. **P10.** Diagnose the faulty area
CU2. Carry out Service/Repair of Transformer	**P1.** Clean the parts of the transformer with specified cleaning agents/tools & material. **P2.** Repair the transformer as per diagnosed fault

	P3. Rewind and assembled the transformer as per requirement **P4.** Check the insulation resistance of repaired transformer as per standard **P5.** Carry out the No load and load tests as per standard practices **P6.** Carry out de-hydration of oil **P7.** Carry out de-hydration of silica gel **P8.** Check and repair leakage in transformer tank
CU3. Carry out Preventive Service/ Maintenance of transformer	**P1.** Carry out routine maintenance of the transformer as specified in the manufacturer's manual **P2.** Check out the, protective relay and other allied device and wire connection **P3.** Update the maintenance/service records

Knowledge & Understanding

- Explain the types of electrical measuring instruments used in testing
- Discuss the transformer faults.
- Explain preventive maintenance work on transformer.

Tools and Equipment

SN	Tools
1	Various type of transformers
2	Ammeters
3	Cable Knife
4	Combination Plier Set
5	Magger

Critical Evidence(s) Required

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

- Perform insulation, frequency, no-load, load testing etc.
- Troubleshooting of transformer fault

0713E&E78 Develop Workplace Policy and Procedures for Sustainability

Overview:

This unit describes the skills and knowledge required to develop and implement a workplace sustainability policy and to modify the policy to suit changed circumstances. It applies to individuals with managerial responsibilities who undertake work developing approaches to create, monitor and improve strategies and policies within workplaces and engage with a range of relevant stakeholders and specialists.

Unit of Competency	Performance Criteria
CU1 Develop workplace sustainability policy	**P1** Define scope of sustainability policy **P2** Gather information from a range of sources to plan and develop policy **P3** Identify and consult stakeholders as a key component of the policy development process **P4** include appropriate strategies in policy at all stages of work for minimizing resource use, reducing toxic material and hazardous chemical use and employing life cycle management approaches **P5** Make recommendations for policy options based on likely effectiveness, timeframes and cost **P6** Develop policy that reflects the organization s commitment to sustainability as an integral part of business planning and as a business opportunity **P7** Agree to appropriate methods of implementation, outcomes and performance indicators
CU2 Communicate workplace sustainability policy	**P1** Promote workplace sustainability policy, including its expected outcome, to key stakeholders **P2** Inform those involved in implementing the policy about expected outcomes, activities to be undertaken and assigned responsibilities
CU3 Implement	**P1** Develop and communicate procedures to help

	workplace sustainability policy	implement workplace sustainability policy **P2** Implement strategies for continuous improvement in resource efficiency **P3** Establish and assign responsibility for recording systems to track continuous improvements in sustainability approaches
CU4	4. Review workplace sustainability policy implementation	**P1** Review workplace sustainability policy implementation Investigate successes or otherwise of policy **P2** Monitor records to identify trends that may require remedial action and use to promote continuous improvement of performance **P3** Modify policy and or procedures as required to ensure improvements are made

Knowledge and Understanding:

- Outline the environmental or sustainability legislation, regulations and codes of practice applicable to the organization identify internal and external sources of information and explain how they can be used to plan and develop the organization s sustainability policy
- Explain policy development processes and practices
- Outline organizational systems and procedures that relate to sustainability
- Outline typical barriers to implementing policies and procedures in an organization and possible strategies to address them.

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to develop workplace policy and procedures for sustainability. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to**:**

- scope and develop organizational policies and procedures that comply with legislative requirements and support the organization s sustainability goals covering at a minimum**:**
  - minimizing resource use
  - resource efficiency
  - reducing toxic material and hazardous chemical use
  - employing life cycle management approaches
  - continuous improvement
- plan and implement sustainability policy and procedures including**:**
  - agreed outcomes
  - performance indicators
  - activities to be undertaken
  - assigned responsibilities
  - record keeping, review and improvement processes
- consult and communicate with relevant stakeholders to generate engagement with sustainability policy development, implementation and continuous improvement
- Review and improve sustainability policies.

0713E&E79 Maintain Professionalism in the Workplace

Overview:

This Unit of Competency describes the outcomes required maintain a professional image in the workplace, including behaving ethically, demonstrating motivation, respecting timeframes and maintaining personal appearance.

Unit of Competency		Performance Criteria	
CU1	Respect work timeframes	**P1**	Demonstrate punctuality in meeting, set working hours and times.
		P2	Utilize working hours only for working and follow company regulations.
		P3	Complete work tasks within deadlines according to order of priority
		P4	Supervisors are informed of any potential delays in work times or projects.
CU2	Maintain personal appearance and hygiene	**P1**	Clean hair, body and nails regularly.
		P2	Wear suitable cloths for the workplace, and respect local and cultural contexts
		P3	Meet specific company dress code requirements
CU3	Maintain adequate distance with colleagues and clients	**P1**	Respect personal space of colleagues and clients with reference to local customs and cultural contexts.
		P2	Keep sufficient distance from others
		P3	Avoid cross transmission of infections (especially through respiration).
CU4	Work in an ethical manner	**P1**	Follow company values/ethics codes of ethics and/or conduct, policies and guidelines.
		P2	Use company resources in accordance with company ethical standards.
		P3	Conduct personal behavior and relationships in accord with ethical standards and company policies.
		P4	Undertake work practices in compliance with company

	ethical standards, organizational policy and guidelines. **P5** Instruct co-workers on ethical, lawful and reasonable directives. **P6** Share Company values/practices with co-workers using appropriate behavior and language. **P7** Report work incidents/situations and/or resolved in accordance with company protocol/guidelines.

Knowledge and Understanding:

- Explain application of good manners and right conduct
- Explain basic practices for oral and personal hygiene
- Describe common products used for oral and personal hygiene
- Outline the company code of conduct/values
- Outline the Company regulations, performance and ethical standards
- Explain work responsibilities/job functions
- Describe communication skills
- State workplace hygiene standards

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to maintain professionalism in the workplace The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Evidence of the following is essential**:**

- clarify and affirm work values/ethics/concepts consistently in the workplace;
- comply with required working times;
- conduct work practices satisfactorily and consistently, in compliance with work ethical standards, organizational policy and guidelines;
- Develop suitable hygiene

Keep adequate distance while interacting with colleagues and clients.

0713E&E80 Manage Personal Work Priorities and Professional Development

Overview:

This unit describes the skills and knowledge required to create systems and process to organize information and prioritize tasks. It applies to individuals working in managerial positions who have excellent organizational skills. The work ethic of individuals in this role has a significant impact on the work culture and patterns of behavior of others as managers at this level are role models in their work environment.

Unit of Competency		Performance Criteria
CU1	Establish personal work goals	**P1** Serve as a positive role model in the workplace through personal work planning **P2** Ensure personal work goals, plans and activities reflect the organization s plans, and own responsibilities and accountabilities **P3** Measure and maintain personal performance in varying work conditions, work contexts and when contingencies occur
CU2	Set and meet own work priorities	**P1** Take initiative to prioritize and facilitate competing demands to achieve personal, team and organizational goals and objectives **P2** Use technology efficiently and effectively to manage work priorities and commitments **P3** Maintain appropriate work-life balance, and ensure stress is effectively managed and health is attended to
CU2	3. Develop and maintain professional competence	**P1** Assess personal knowledge and skills against competency standards to determine development needs, priorities and plans **P2** Seek feedback from employees, clients and colleagues and use this feedback to identify and develop ways to improve competence **P3** P3 Identify, evaluate, select and use development opportunities suitable to personal learning style/s to develop competence **P4** Participate in networks to enhance personal knowledge,

	skills and work relationships **P5** Identify and develop new skills to achieve and maintain a competitive edge

Knowledge and Understanding:

- Explain principles and techniques involved in the management and organization of**:**
- Performance measurement
- Personal behavior, self-awareness and personality traits identification
- Personal development plan
- Personal goal setting
- Time
- Discuss management development opportunities and options for self
- Describe methods for achieving a healthy work-life balance
- Outline organization s policies, plans and procedures
- Explain types of learning style/s and how they relate to the individual
- Describe types of work methods and practices that can improve personal performance.

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to manage personal work priorities and professional development. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to**:**

- use business technology to create and use systems and processes to organize and priorities tasks and commitments
- measure and maintain personal work performance including assessing competency against competency standards and seeking feedback
- maintain an appropriate work-life balance to manage personal health and stress
- participate in networks

- develop a personal development plan which includes career objectives and an action plan
- Develop new skills.

0713E&E81 Manage Workforce Planning

Overview:

This unit describes the skills and knowledge required to manage planning in relation to an organization's workforce including researching requirements, developing objectives and strategies, implementing initiatives and monitoring and evaluating trends. It applies to individuals who are human resource managers or staff members with a role in a policy or planning unit that focuses on workforce planning.

Unit of Competency		Performance Criteria	
CU1	Research workforce requirements	**P1**	Review current data on staff turnover and demographics
		P2	Assess factors that may affect workforce supply
		P3	Establish the organization's requirements for a skilled and diverse workforce
CU2	Develop workforce objectives and strategies	**P1**	Review organizational strategy and establish aligned objectives for modification or retention of the workforce
		P2	Consider strategies to address unacceptable staff turnover, if required
		P3	Define objectives to retain required skilled labor
		P4	Define objectives for workforce diversity and cross-cultural management
		P5	Define strategies to source skilled labor
		P6	Communicate objectives and rationale to relevant stakeholders
		P7	Obtain agreement and endorsement for objectives and establish targets
		P8	Develop contingency plans to cope with extreme situations
CU3	Implement initiatives to support	**P1**	Implement action to support agreed objectives for recruitment, training, redeployment and redundancy

	workforce planning objectives	**P2**	Develop and implement strategies to assist workforce to deal with organizational change
		P3	Develop and implement strategies to assist in meeting the organization's workforce diversity goals
		P4	Implement succession planning system to ensure desirable workers are developed and retained
		P5	Implement programs to ensure workplace is an employer of choice
CU4	Monitor and evaluate workforce trends	**P1**	Review workforce plan against patterns in exiting employee and workforce changes
		P2	Monitor labor supply trends for areas of over- or under-supply in the external environment
		P3	Monitor effects of labor trends on demand for labor
		P4	Survey organizational climate to gauge worker satisfaction
		P5	Refine objectives and strategies in response to internal and external changes and make recommendations in response to global trends and incidents
		P6	Regularly review government policy on labor demand and supply
		P7	Evaluate effectiveness of change processes against agreed objectives

Knowledge and Understanding:

- Explain current information about external labor supply relevant to the specific industry or skill requirements of the organization
- Outline industrial relations relevant to the specific industry

- Describe labor force analysis and forecasting techniques

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to manage workforce planning. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to**:**

- review and interpret information from a range of internal and external sources to identify**:**
  - current staff turnover and demographics
  - labor supply trends factors that may affect workforce supply
  - organization's workforce requirements objectives and strategies
- manage workforce planning including developing, implementing, monitoring and reviewing strategies to meet workforce needs
- review relevant trends and supply and demand factors that will impact on an organization's workforce
- Develop a workforce plan that includes relevant research and specific strategies to ensure access to a skilled and diverse workforce.

0713E&E82 Undertake Project Work

Overview:

This unit describes the skills and knowledge required to undertake a straightforward project or a section of a larger project. It covers developing a project plan, administering and monitoring the project, finalizing the project and reviewing the project to identify lessons learned for application to future projects. This unit applies to individuals who play a significant role in ensuring a project meets timelines, quality standards, budgetary limits and other requirements set for the project.

Unit of Competency	Performance Criteria
CU1. Define project	**P1** Access project scope and other relevant documentation **P2** Define project stakeholders **P3** Seek clarification from delegating authority of issues related to project and project parameters **P4** Identify limits of own responsibility and reporting requirements **P5** Clarify relationship of project to other projects and to the organization's objectives **P6** Determine and access available resources to undertake project
CU2. Develop project plan	**P1** Develop project plan in line with the project parameters **P2** Identify and access appropriate project management tools **P3** Formulate risk management plan for project, including Work Health and Safety (WHS) **P4** Develop and approve project budget **P5** Consult team members and take their views into account in planning the project **P6** Finalize project plan and gain necessary approvals to commence project according to documented plan
CU3. Administer and monitor project	**P1** Take action to ensure project team members are clear about their responsibilities and the project requirements **P2** Provide support for project team members, especially with

	regard to specific needs, to ensure that the quality of the expected outcomes of the project and documented time lines are met **P3** Establish and maintain required recordkeeping systems throughout the project **P4** Implement and monitor plans for managing project finances, resources and quality **P5** Complete and forward project reports as required to stakeholders **P6** Undertake risk management as required to ensure project outcomes are met **P7** Achieve project deliverables
CU4. Finalize project	**P1** Complete financial recordkeeping associated with project and check for accuracy **P2** P2 Ensure transition of staff involved in project to new roles or reassignment to previous roles **P3** P3 Complete project documentation and obtain necessary sign-offs for concluding project

Knowledge and Understanding:

- Give examples of project management tools and how they contribute to a project
- Outline types of documents and other sources of information commonly used in defining the parameters of a project
- Explain processes for identifying and managing risk in a project
- Outline the organization's mission, goals, objectives and operations and how the project relates to them

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to undertake project work. The evidence should integrate employability skills

with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to**:**

- define the parameters of the project including**:**
  - project scope
  - project stakeholders, including own responsibilities
  - relationship of project to organizational objectives and other projects
  - reporting requirements
  - resource requirements
- use project management tools to develop and implement a project plan including**:**
  - deliverables
  - work breakdown
  - budget and allocation of resources
  - timelines
  - risk management
  - recordkeeping and reporting
- consult and communicate with relevant stakeholders to generate input and engagement in planning, implementing and reviewing the project
- provide support to team members to enable them to achieve deliverables and to transition them as appropriate at completion of the project
- finalize the project including documentation, sign-offs and reporting

Review and document the project outcomes.

0713E&E83 Prepare and Implement Negotiation

Overview:

This unit covers the skills, knowledge and attitudes required to prepare for and participate in a process of negotiation.

Unit of Competency	Performance Criteria
CU1 Prepare for the negotiation	**P1** Identify objectives and preferred outcome of the negotiation and determine minimum acceptable outcome **P2** Understand in relation to what can be offered and what is needed from the other party **P3** Gather information regarding the other party – objectives, **P4** needs, preferences, resources, what they want to achieve - in **P5** order to determine best negotiating points **P6** List and rank the issues to consider concessions that may be made. **P7** Find examples and refine negotiation argument. **P8** Check information to ensure it is correct and up-to-date. **P9** Develop a negotiation plan that includes information about the other party and its interests and a set of responses and strategies to the anticipated tactics. **P10** Prepare an agenda in advance, which includes discussion topics, participants, location and schedule
CU2 Participate in negotiations	**P1** Analyze all aspects of the incident for degree of hazard, priorities, optional outcomes and appropriate strategies **P2** Analyze and determine strategies and priorities on the incident sought from a range of sources **P3** Assess long term objectives against resources and priorities **P4** Apply a range of communication techniques to make and maintain contact with the key people **P5** Provide clear and factual information to enable an honest and realistic assessment of the interests of the key people and their positions

	P6	Resolve the conflict and express their likely consequences clearly and do an analysis of the benefits
	P7	Reassess points of disagreements for common positive
	P8	positions
CU3 Coordinate support Services	**P1**	Assess the need for support services in terms of the determined strategies and priorities
	P2	Negotiate the resources of support services according to established procedures and availability
	P3	Provide information on strategies to support services and maintain the communication
	P4	Delegate roles and responsibilities according to expertise and resources
CU4 Restore order	**P1**	Assess the incidents for degree of risk and take appropriate action to reduce and remove the impact of the incident and restore order
	P2	Take action designed to minimize risk and the preserve the safety and security of all involved
	P3	Take action to prevent the escalation of the incident appropriate to the circumstances and agreed procedures.
	P4	Carry out the use of force for the restoration of control and the maintenance of security in the least restrictive manner.
	P5	Complete reports accurately and clearly provided to the appropriate authority promptly
	P6	Review, evaluate and analyze the incident and the organizational response to it and report it promptly and accurately.
CU5 Provide leadership. direction and guidance to the work group	**P1**	Link between the function of the group and the
	P2	goals of the organization
	P3	Participate in decision making routinely to develop, implement and review work of the group and to allocate responsibilities where appropriate
	P4	Give opportunities and encouragement to others to develop new and innovative work practices and strategies
	P5	Identify conflict and resolve with minimum disruption to work group function

	P6 Provide staff with the support and supervision necessary to perform work safely and without risk to health **P7** Allocate tasks within the competence of staff and support with appropriate authority, autonomy and training **P8** Supervise appropriately the changing priorities and situations and takes into account the different needs of individuals and the requirements of the task

Knowledge and 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**:**

- Explain organization's policies, guidelines and procedures related to control and surveillance, safety and preventing and responding to incidents and breaches of orders covered in the range of variables.
- Explain organization's management and accountability systems
- Describe teamwork principles and strategies
- Outline the principles of effective communication
- Outline the guidelines for use of equipment and technology
- Explain code of conduct

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to solve problems which jeopardize safety and security. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Evidence of the following is essential**:**

- evidence of effective communication strategies including negotiation, counseling, mediation, advocacy demonstrated under pressure working effectively in a team environment
- evidence of knowledge and application of organizations policies, procedures and
- guidelines for critical incidents
- evidence of accurate and safe use of all emergency equipment
- evidence of managing effective outcomes using strategic planning, team

Leadership and situational analysis

0713E&E84 Manage Meetings.

Overview:

This unit describes the skills and knowledge required to manage a range of meetings including overseeing the meeting preparation processes, chairing meetings, organizing the minutes and reporting meeting outcomes. It applies to individuals employed in a range of work environments who are required to organize and manage meetings within their workplace, including conducting or managing administrative tasks in providing agendas and meeting material. They may work as senior administrative staff or may be individuals with responsibility for conducting and chairing meetings in the workplace.

Unit of Competency	Performance Criteria
CU1 Prepare for meetings	**P1** Develop agenda in line with stated meeting purpose **P2** Ensure style and structure of meeting are appropriate to its purpose **P3** Identify meeting participants and notify them in accordance with organizational procedures **P4** Confirm meeting arrangements in accordance with requirements of meeting **P5** Dispatch meeting papers to participants within designated timelines
CU2 Conduct meetings	**P1** Chair meetings in accordance with organizational requirements, agreed conventions for type of meeting and legal and ethical requirements **P2** Conduct meetings to ensure they are focused, time efficient and achieve the required outcomes **P3** Ensure meeting facilitation enables participation, discussion, problem-solving and resolution of issues **P4** Brief minute-taker on method for recording meeting notes in accordance with organizational requirements and conventions for type of meeting
CU3 Follow up meetings	**P1** Check transcribed meeting notes to ensure they reflect a true and accurate record of the meeting and are formatted in

	accordance with organizational procedures and meeting conventions **P2** Distribute and store minutes and other follow-up documentation within designated timelines, and according to organizational requirements **P3** Report outcomes of meetings as required, within designated timelines

Knowledge and 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**:**

- outline meeting terminology, structures, arrangements
- outline responsibilities of the chairperson and explain group dynamics in relation to managing meetings
- describe options for meetings including face-to-face, teleconferencing, web-conferencing and using webcams
- Identify the relevant organizational procedures and policies regarding meetings, chairing and minutes including identifying organizational formats for minutes and agendas.

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to manage meetings. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to**:**

- apply conventions and procedures for formal and informal meetings including**:**
    - developing and distributing agendas and papers
    - identifying and inviting meeting participants
    - organizing and confirming meeting arrangements
    - running the meeting and following up
- organize, take part in and chair a meeting
- record and store meeting documentation
- Follow organizational policies and procedures.

0713E&E85 Organize Schedules

Overview:

This unit describes the skills and knowledge required to manage appointments and diaries for personnel within an organization, using manual and electronic diaries, schedules and other appointment systems. It applies to individuals employed in a range of work environments who provide administrative support to teams and individuals.

Unit of Competency	Performance Criteria
CU1 Establish schedule requirements	**P1** Identify organizational requirements and protocols for diaries and staff planning tools **P2** identify organizational procedures for different types of appointments **P3** Determine personal requirements for diary and schedule items for individual personnel **P4** Establish appointment priorities and clarify in discussion with individual personnel
CU2 Manage schedules	**P1** Identify recurring appointments and deadlines, and schedule these in accordance with individual and organizational requirements **P2** Establish availability of attendees, and schedule new appointments in accordance with required timelines and diary commitments **P3** Negotiate alternative arrangements and confirm when established appointments are changed **P4** Record appointments and manage schedules in accordance with organizational policy and procedures

Knowledge and 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**:**

- identify the key provisions of relevant legislation, standards and codes that affect aspects of business operations or the achievement of team goals
- describe organizational requirements for managing appointments for personnel within the organization
- summarize the range of appointment systems that could be used
- Outline important considerations when managing the schedules of others.

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to organize schedules. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to**:**

- Appropriately manage the schedules of various individuals through a process of careful planning and negotiation.

0713E&E86 Identify and Communicate Trends in Career Development

Overview:

His unit describes the skills and knowledge required to research and confirm career trends, Assess and confirm ongoing career development needs of target group and Maintain quality of career development services and professional practice conduct research to identify and communicate career trends. It establishes the need to interact professionally with others in assessing career needs, to effectively assist clients identify competencies they require for a career and employability in a given context. It also examines how to maintain quality of career development services and professional practice. It applies to individuals seeking to identify and communicate trends in career development.

Unit of Competency	Performance Criteria
CU1. Research and confirm career trends	P1 Apply knowledge of changing organizational structures, lifespan of careers and methods of conducting work search, recruitment and selection processes P2 Analyze changing worker and employer issues, rights and responsibilities in context of changing work practices P3 Examine importance of quality careers development services P4 Maintain all research, documentation, sources and references (electronic or physical) to a high degree of currency and relevance P5 Analyze implications of relevant policy, legislation, professional codes of practice and national standards relating to worker and employer issues P6 Research changes and trends in theory of career development counseling and practice P7 Confirm clusters, levels and combinations of transferable employability skills and preferences that may open employment options spanning more than one

	occupation or career pathway
CU2. Assess and confirm ongoing career development needs of target group	P1 Analyze history and records in assessing needs of target group P2 Assess success of previous career development services and techniques used for individual or target group P3 Deploy other means to investigate appropriate care and counseling approaches as required P4 Maintain privacy and security of all data, research and personal records according to relevant policy, legislation, professional codes of practice and national standards P5 Establish existing work-life balance requirements, issues and needs
CU3. Maintain quality of career development services and professional practice	P1 Analyze and review relevance of career theories, models, frameworks and research for target group P2 Incorporate into career development services and professional practice, major changes and trends influencing workplace and career-related options and choices P3 Comply with all relevant policy, legislation, professional codes of practice and national standards that influence delivery of career development services

Knowledge and 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**:**

- explain client care and counseling techniques and processes in the context of career development services
- describe diversity and its potential effects on career choices
- outline human psychological development and needs in relation to careers development

- outline relevant policy, legislation, codes of practice and standards relevant to career development
- explain recruitment and selection processes in the context of career development services
- describe a range of data gathering and research techniques
- Explain techniques used to analyze trends.

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to identify and communicate trends in career development. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance Requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints.
Demonstrated evidence is required of the ability to**:**

- research and analyze current economic, labor market, employment, career and vocational, educational and training trends
- identify choices and career development needs for individuals and target groups within a given context
- report and document management of research and career development materials
- Comply with all relevant local, state/territory and national legislation, policies and practices.

0713E&E87 Apply Specialist Interpersonal and Counselling Interview Skills

Overview:

This unit describes the skills and knowledge required to communicate effectively, Use specialized counseling interviewing skills and use advanced and specialized communication skills in the client-counselor relationship. This unit applies to individuals whose job role involves working with clients on personal and psychological issues within established policies, procedures and guidelines.

Unit of Competency	Performance Criteria
CU1. Communicate effectively	P1 Identify communication barriers and use strategies to overcome these barriers in the client-counselor relationship P2 Facilitate the client-counselor relationship through selection and use of micro skills P3 Integrate the principles of effective communication into work practices P4 Observe and respond to non-verbal communication cues P5 Consider and respond to the impacts of different communication techniques on the client-counselor relationship in the context of individual clients P6 Integrate case note taking with minimum distraction
CU2. Use specialized counseling interviewing skills	P1 Select and use communication skills according to the sequence of a counseling interview P2 Identify points at which specialized counseling interviewing skills are appropriate for inclusion P3 Use specialized counseling communication techniques based on their impacts and potential to enhance client development and growth P4 Identify and respond appropriately to strong client emotional reactions

CU3. Evaluate own communication	P1 Reflect on and evaluate own communication with clients P2 Recognize the effect of own values and beliefs on communication with clients P3 Identify and respond to the need for development of own skills and knowledge

Knowledge and 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**:**

- Legal and ethical considerations for communication in counseling practice, and how these are applied in individual practice**:**
- codes of conduct/practice
- discrimination
- duty of care
- human rights
- practitioner/client boundaries
- privacy, confidentiality and disclosure
- rights and responsibilities of workers, employers and clients
- work role boundaries responsibilities and limitations of the counselor role
- work health and safety
- principles of person-centered practice
- key objectives of counseling interviewing
- stages of a counseling interview
- potential impacts of using different communication skills and techniques in counseling contexts
- communication techniques and micro-skills including**:**
- attending behaviors active listening, reflection of content feeling, summarizing
- questioning skills open, closed, simple and compound questions
- client observation skills
- noting and reflecting skills
- providing client feedback
- specialized counseling communication techniques, and how they are used, including**:**
- challenging

- reframing
- focusing
- components of the communication process including:
- encoder
- decoder
- primary factors that impact on the communication process including:
- context
- participants
- rules
- messages
- channels
- noise
- feedback
- communication barriers and resolution strategies, including:
- environmental
- physical
- individual perceptions
- cultural issues
- language
- age issues
- disability
- observational techniques including:
- facial expressions
- non-verbal behavior
- posture
- silence
- ways in which different people absorb information, including:
- visual
- auditory
- kinesthetic
- obstacles to the counseling process
- impacts of trauma and stress on the communication process, including on:
- concentration and attention
- memory

- use of verbal and written language
- use of body language
- challenging within the counseling session
- self-evaluation practices, including:
- how to recognize own biases
- Impact of own values on the counseling relationship

Critical Evidence(s) Required

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

:

A person who demonstrates competency in this unit must be able to provide evidence of the ability to apply specialist interpersonal and counseling interview skills. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance Requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- interviewed at least 3 different clients using specialized interpersonal communication and counseling interviewing skills, including:
- micro-skills and communication techniques, including:
  - attending behaviors active listening,
  - reflection of content, summarizing
  - questioning skills open, closed, simple and compound questions
  - client observation skills
  - noting and reflecting skills
  - providing client feedback
- specialized counseling interviewing skills, including:
  - challenging
  - reframing
  - focusing

- integrated clear case note taking into the interview process
- Completed a structured process of self-reflection and evaluation of own communication used during the 3 interviews.

0713E&E88 Perform Pre-Electroplating Activities

Overview:

After this competency, the trainee will be able to perform disassembly and stripping, perform mechanical cleaning and perform chemical cleaning. Carry out pre electroplating activities which includes disassembly and stripping; chemical and mechanical cleaning.

Competency Units	Performance Criteria
CU1. Perform Disassembly and Stripping	**P1.** Select the metal object (to be electroplated) **P2.** Disassemble all the connected parts **P3.** Perform Stripping in order to remove particles which can blister or flake a plate-layer
CU2. Perform Mechanical Cleaning	**P1.** Perform Sand or Ball blasting cleaning. **P2.** Choose appropriate size of grinding wheel. **P3.** Select the speed of grinding wheel. **P4.** Carry out Grinding cleaning. **P5.** Select the optimum speed for Polishing **P6.** Carry out Polishing. **P7.** Select optimum speed for cotton wheels. **P8.** Perform Buffing.
CU3. Perform Chemical Cleaning	**P1.** Select the appropriate solvent from White Spirit, Naphtha, Tri-Chloric-Ethylene **P2.** Remove the grease by using solvent above **P3.** Prepare the solvent for chemical cleaning **P4.** Connect the steel tank(anode) with the battery **P5.** Perform Chemical Cleaning. **P6.** Prepare a mild acid solvent **P7.** Perform Acid Dip/Bath Cleaning **P8.** Use steel tank as anode and cleaning metal as cathode **P9.** Perform Electrochemical Cleaning

Knowledge and Understanding:

- Describe the process of disassembly
- Describe the process of stripping
- Describe the equipment required in various cleaning process
- How to select rating and size of the equipment
- Describe the different processes of chemical cleaning
- Describe the equipment required in various cleaning process
- What are the different solvents required in chemical cleaning?
- How to select rating and size of the equipment

Tools and Equipment

SN	Tools
1	Pre Electroplating Tools
2	Toolbox
3	Safety equipment
4	Machine
5	Cleaning Solvents
6	Re-Electroplating Tools
7	Buffing

Critical Evidence(s) Required

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

0713E&E89 Perform Electroplating

Overview:

After this competency, the trainee will be able to ensure safety at workshop, select appropriate chemical solution, Prepare and Perform plating of Zinc, Cadmium, Tin, Silver, Gold and Brass chemical solutions carry out electroplating of various metals.

Competency Units	Performance Criteria
CU1. Ensure safety at workshop	**P1.** Identify safety symbols and Hazards. **P2.** Take preventive measures for electrical accidents and practice steps to be taken in such accidents. **P3.** Practice safe methods of fire fighting in case of electrical fire. **P4.** Ensure proper dressing and hand gloves in shop **P5.** Ensure insulation of tools and equipment.
CU2. Select appropriate chemical solution	**P1.** Take basic safety precautions to be taken while handling different types of electroplating solutions **P2.** Adopt safety precautions to be taken while handling cyanide base electroplating salts. **P3.** Determine ECE (Electrochemical Equivalent) values of different solutions. **P4.** Identify acids and alkalis using litmus paper and other methods. **P5.** Identify soft water & de-mineralized water **P6.** Measure the specific gravity of liquid sample and check the temperature.
CU3. Prepare chemical solutions	**P1.** Perform effluent treatment of hazardous chemicals plating shop. **P2.** Practice first aid and antidotes for cyanide poisonings **P3.** Perform setting up of plating tanks and connections. **P4.** Mix the chemicals and prepare solution of Zinc, Cadmium, Tin, Gold, and Gold. **P5.** Identify acids and alkalis using Red/ Blue litmus paper **P6.** Measure the specific gravity of liquid sample

CU4.Perform plating of Zinc, Cadmium, Tin, Silver, Gold and Brass	**P1.** Plan work in compliance with occupational safety and health. **P2.** Test the acidity and density of the solution. **P3.** Perform zinc plating on different ferrous metals in acid bath and passivity with different colors. **P4.** Perform cadmium plating on different ferrous metals and passivity with different colors. **P5.** Perform Tin plating on different ferrous metals. **P6.** Perform Silver plating on different ferrous metals **P7.** Perform Gold plating on different ferrous metals. **P8.** Perform Brass plating on different ferrous metals. **P9.** Perform masking and cleaning for different plating.

Knowledge and Understanding:

- Define the First aid safety practice.
- How to identify hazards and take preventive measures?
- What are different safety rules and safety signs
- Describe the whole process and advantages of electroplating.
- Describe the types of corrosions and importance of protective treatments
- Define the Principles and applications of Electroplating.
- Basic knowledge of General terms and definition used in electroplating.
- Understands and applies Safety precautions in Electro plating shop.
- Define First aid and antidotes for chemical poisoning
- Describe Exothermic and endothermic reactions.
- Describe chemical formulas of different acids, alkalis & cyanides.
- Properties and Values of ECE for different metals
- Basic knowledge of Precautions to be observed.
- Define method of mixing of electrolyte use of hydrometer & thermometer.
- Knowledge of various types of Zinc, Cadmium, Tin, Silver, Gold, and plating.
- Knowledge of Equipment for
- zinc, cadmium, tin, silver, Gold and their properties
- Describe the Applications and uses of zinc, Cadmium, Tin, Silver, Gold, and Brass plating.

Tools and Equipment

SN	Tools
1	Safety signs
2	First Aid box
3	Fire extinguisher
4	Hand gloves
5	Alkalis
6	Antidotes
7	Acids
8	Electroplate solution.
9	Laboratory dress
10	Cyanides
11	Hand gloves
12	Brass solution for cyanide bath
13	different colors for plating
14	First Aid box

Critical Evidence(s) Required

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

Perform plating of Zinc, Cadmium, Tin, Silver, Gold and Brass

0713E&E90 Perform Post-Electroplating Activities and Tests

Overview:

After this competency, the trainee will be able to carry out quenching/cooling of the metal, carry out visual inspection and physical examination of the electroplated part, perform adhesion tests by various methods and perform thickness and corrosion resistance test carry out pre electroplating activities which includes quenching and cooling; physical inspection; adhesion tests; corrosion and resistance tests.

Competency Units	Performance Criteria
CU1. Carry Out Quenching/Cooling Of The Metal.	**P1.** Select the suitable temperature for heating **P2.** Heat the metal up to the suitable temperature **P3.** Quench the metal in water or oil to harden to full hardness **P4.** Ensure that quenched parts must be aged, tempered or stress relieved to achieve the proper toughness, final hardness and dimensional stability
CU2. Carry Out Visual Inspection And Physical Examination Of The Electroplated Part.	**P1.** Inspect the Electroplated part carefully **P2.** Carry out physical examination **P3.** Look for poor adhesion **P4.** Check for uneven layers of coating **P5.** Check the thickness of coating **P6.** Check the impurities in coating (If any)
CU3. Perform adhesion tests by various methods	**P1.** Perform the Knife test **P2.** Perform the tape test **P3.** Perform the pull off test **P4.** Perform the scrap test
CU4.Perform thickness and corrosion resistance test	**P1.** Select the gauge amongst ultrasonic thickness gauge and micrometer as per requirement **P2.** Check the thickness at different points on a surface **P3.** Carryout Salt spray test in order to check corrosion resistance of materials and surface coating

	P4. Ensure that the coating is even across the material

Knowledge and Understanding:

- Define quality control methods of electroplating
- Describe the process of quenching and cooling
- Describe the advantage of above process
- What factors should be kept in mind while carrying out physical examination
- How to identify uneven layers of coating?
- How to identify impurities of coating?
- Describe the process of Knife test
- Describe the process of tape test
- Describe the process of pull off test
- Describe the process of scrap test
- Describe various thickness test
- Describe the gauges used for checking the thickness
- Describe the process of salt spray test

Tools and Equipment

SN	Tools
1	Post Electroplating Tools
2	Thermometer
3	Solvents
4	Post Electroplating Tools
5	Cleaning Solvents
6	Buffing machine
7	Solvents
8	Cleaning Solvents
9	Ultrasonic thickness taste

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard**:** Perform thickness and corrosion resistance test.

0713E&E91 Plan an Electroplating Shop

Overview:

After this competency, the trainee will be able to prepare a layout for the workshop, Setup pre-Electroplating workstation, Setup Electroplating workshop and Setup post-Electroplating workstation and Prepare an Estimate for Finance and Budgeting gain knowledge and competence required to plan an electroplating workshop.

Competency Units	Performance Criteria
CU1.Prepare a layout for the electroplating workshop	**P1.** Choose the place of the workshop wisely (having access to basic needs and market) **P2.** Prepare a comprehensive layout plan for various processes involved in electroplating. **P3.** Prepare a list of tools and equipment required in a workshop **P4.** Prepare a raking design for the workshop **P5.** Prepare an electric wiring circuit for the workshop.
CU2. Setup pre-Electroplating workstation	**P1.** Select the tools and equipment required for pre-treatment operations **P2.** Select the solvents required for cleansing. **P3.** Select the ball blasting machine as per requirement. **P4.** Select the Grinding (abrasive cutting) machine as per requirement. **P5.** Select the Buffing machine as per requirement.
CU3. Setup Electroplating workshop	**P1.** Setup the suitable power supply circuit. **P2.** Select the appropriate size of bath tub. **P3.** Choose the temperature sensors **P4.** Select the magnetic stirrer as per requirement **P5.** Select the Electroplating apparatus as per requirement **P6.** Choose electroplating rectifier as per requirement standards. **P7.** Choose electroplating solutions as per requirement

CU4. Setup post-Electroplating workstation	**P1.** Select the tools and equipment required for post-treatment operations **P2.** Select the solvents required for cleansing **P3.** Make a choice of the ball blasting machine as per requirement **P4.** Select the Grinding (abrasive cutting) machine as per requirement **P5.** Select the Buffing machine as per requirement. **P6.** Choose the Coating thickness gauge as per standards
CU5. Prepare an Estimate for Finance and Budgeting	**P1.** Estimate Rental/Acquisition cost of the workshop. **P2.** Calculate the Equipment cost **P3.** Calculate the Installation cost **P4.** Calculate the operating cost **P5.** Generate a Finance Report for the workshop.

Knowledge and Understanding:

- What factors should be kept in mind while choosing the location of workshop
- Describe the processes involved in an electroplating process
- Define the tools and equipment required in a workshop
- How to create a design for raking?
- How to design an electric circuit
- Define the tools and equipment required in a pre-treatment operation
- Describe the various steps used in mechanical and chemical cleaning
- Define the criteria for selection of various machines
- Describe Electroplating
- Define the processes involved in electroplating
- Describe the equipment required in this process
- What is the purpose of electroplating rectifier
- Define the tools and equipment required in a post-treatment operation
- Describe the various steps used in cleaning
- Define the criteria for selection of various machines
- Describe the types of thickness tests
- Describe the process involved in calculation the financial plan
- How to prepare a financial report and make its analysis

Tools and Equipment

SN	Tools
1	Drawing page
2	Drawing software
3	List of material
4	Pen
5	Notepad
6	Buffing machine
7	Ball blasting machine
8	Electroplating tools
9	Grinding machine
10	Post Electroplating Tools
11	Cleaning Solvents
12	Buffing machine
13	Thickness gauge
14	Financial Report
15	Calculation sheet
16	Calculator

Critical Evidence(s) Required

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

Setup post-Electroplating workstation.

0713E&E92 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	**P1.** Open turbo C++ software **P2.** Create new file

Function Program	**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 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
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	P1. Open turbo C++ software P2. Create new file P3. Write a program for conversion of rectangular to polar

program	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
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- Describe operational procedure of C++.
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- 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
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- 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

Tools 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

0713E&E93 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
CU1. 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
CU2. 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++.

Tools 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 & programming techniques

0713E&E94 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

Tools 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**:**

Write Program for Improvement of Power Factor

0713E&E95 Develop and Analyze Electrical Circuit with MULTISM

Overview:

This competency standard covers the skills and knowledge required to identify computer software components Install and operate MULTISM. Idenitify toolbox and libraries. Develop RC circuit and Develop RLC circuit identify computer requirements and assemble procedures and Use of computer software MULTISM for developing/analyzing electrical networks.

Competency Units	Performance Criteria
CU1. Identify computer software components	**P1.** Classify the software components of Computer. **P2.** Install the necessary plug-ins **P3.** Install computer software's as for requirement.
CU2.Install and operate MULTISM	**P1.** Open the MULTISM Screen and its menu. **P2.** Select component of circuit diagrams. **P3.** Insert electric component. **P4.** Wiring schematic. **P5.** Simulating circuit. **P6.** Transfer to PCB layout. **P7.** Routing the board. **P8.** Analyze result by changing components.
CU3. Idenitify toolbox and libraries	**P1.** Open the MULTISM Screen and its menu. **P2.** Select component of circuit diagrams. **P3.** Study electric component simples. **P4.** Study wiring **P5.** Study tool box **P6.** Study PCB layout. **P7.** Study routing the board.
CU4.Develop RC circuit	P1. Open the MULTISM screen and its menu. P2. Select component of circuit diagrams. P3. Insert electric component. P4.Wiring schematic. P5. Transfer to PCB layout.

	P6.Analyze results for AC and DC.
CU5.Develop RLC circuit	P1. Open the MULTISM screen and its menu. P2. Select component of circuit diagrams. P3. Insert electric component. P4. Wiring schematic. P5. Transfer to PCB layout Analyze results for AC and DC.
CU6. Construct active filter	P1. Open the MULTISM screen and its menu. P2. Select component of circuit diagrams. P3. Insert electric component. P4.Wiring schematic. P5. Transfer to PCB layout. P6.Analyze results follow pass and band pass filter.
CU7.Construct passive filter	P1. Open the Multiscreen and its menu. P2. Select component of circuit diagrams. P3. Insert electric component. P4.Wiring schematic. P5.tranfer to PCB layout .analyze results for low, high, band and all pass.
CU8.Construct Amplifier frequency response	P1. Open the MULTISM and its menu. P2. Select component of circuit diagrams. P3. Insert electric component. P4.Wiring schematic. P5.Transfer to PCB layout Analyze frequency response.
CU9. Construct half wave rectifier	P1. Open the MULTISM screen and its menu. P2. Select component of circuit diagrams. P3. Insert electric component. P4.Wiring schematic. P5. Transfer to PCB layout analyze results
CU10.Construct full wave rectifier	P1. Open the MULTISM screen and its menu. P2. Select component of circuit diagrams. P3. Insert electric component. P4.Wiring schematic.

	P5. Transfer to PCB layout. Analyze results.

Knowledge & Understanding

- Define Basic purpose of computer
- Describe basic software components of computer.
- Describe Input and Output devices.
- Describe basic input and output devices and their function.
- Describe basic issues/problems related to electric circuit.
- Describe basic hardware configuration required for software.
- Detail knowledge of circuit
- Diagram functions.
- Detail knowledge of electrical components.
- Describe basic input and output screen of software.
- Describe basic issues/problems related to software.
- Describe basic symbol for components.
- Understand basic input and output devices and their function.
- Understand basic issues/problems related to RC circuit.
- Understand basic hardware configuration required for software.
- Understand knowledge of circuit diagram functions.
- Understand and knowledge of basic input and output devices
- And their function.
- Understand and knowledge of basic issues/problems related to RLC circuit.
- Understand and knowledge of basic hardware configuration required for software.
- Understand and knowledge of circuit diagram functions
- Describe basic input and output devices and their function.
- Describe basic issues/problems related to active filter circuit.
- Describe basic hardware configuration required for software.
- describe knowledge of circuit diagram functions
- Describe basic input and output devices and their function.
- describe basic issues/problems
- Related to electric circuit.
- Describe basic hardware configuration required or software.
- Detail knowledge of circuit diagram functions.

- Describe basic input and output devices and their function.
- Describe basic issues/problems related to electric circuit.
- Describe basic hardware configuration required for software.
- Detail knowledge of circuit diagram functions
- Describe basic input and output devices and their function.
- Describe basic issues/problems related to rectifier circuit.
- Describe basic hardware configuration required for software.
- Describe knowledge of circuit
- Diagram functions
- Describe basic input and output devices and their function.
- Describe basic issues/problems related to electric circuit.
- Describe basic hardware configuration required for software.
- Detail knowledge of circuit diagram functions.

Tools 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
15	Tool kits and Windows 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**:**

- Installation & Programming techniques

0713E&E96 Develop and Analyze Electrical Circuit with PSPICES Software.

Overview:

This competency standard covers the skills and knowledge required to Install and operate PSPICE Develop filters and Develop Rectifier Identify computer requirements and assemble procedures and Use of computer software PSPICE for developing/analysing electrical networks.

Competency Units	Performance Criteria
CU1.Install and operate PSPICE	P1. Install the PSPICE from setup P2. Open the PSPICE Screen and its menu. P3. Select component of circuit diagrams. P4. Insert electric component. P5. Wiring schematic Save file and Analysis setup. P6.AC sweep to change frequency. P7.Analyze result by changing components.
CU2.Develop filters	**P1.** Open the PSPICE Screen and its menu. **P2.** Select component of circuit diagrams. **P3.** Insert electric component. **P4.** Wiring schematic. **P5.** Save file and Analysis setup. **P6.** AC sweep to change frequency. **P7.** Analyze result for low pass filter and high pass filter.
CU3.Develop rectifier	**P1.** Open the PSPICE Screen and its menu. **P2.** Select component of circuit diagrams. **P3.** Insert electric component. **P4.** Wiring schematic. **P5.** Save file and Analysis setup. **P6.** AC sweep to change frequency. **P7.** Analyze result for half and full rectifier.
CU4. Construct CE Amplifier	**P1.** Open the PSPICE Screen and its menu.

	P2. Select component of circuit diagrams. **P3.** Insert electric component. **P4.** Wiring schematic. **P5.** Save file and Analysis setup. **P6.** AC sweep to change frequency. **P7.** Analyze frequency response for CE Amplifier
CU5. Cconstruct CS amplifier	**P1.** Open the PSPICE Screen and its menu. **P2.** Select component of circuit diagrams. **P3.** Insert electric component. **P4.** Wiring schematic. **P5.** Save file and Analysis setup. **P6.** AC sweep to change frequency. **P7.** Analyze frequency response for CS amplifier.
CU6.Construct CC Amplifier	**P1.** Open the PSPICE Screen and its menu. **P2.** Select component of circuit diagrams. **P3.** Insert electric component. **P4.** Wiring schematic. **P5.** Save file and Analysis setup. **P6.** AC sweep to change frequency. **P7.** Analyze frequency response for CC amplifier.
CU7. Design WEIN Bridge Oscillator	P1. Open the PSPICE Screen and its menu. **P1.** Select component of circuit diagrams. **P2.** Insert electric component. **P3.** Wiring schematic. **P4.** Save file and Analysis setup. **P5.** AC sweep to change frequency. **P6.** Analyze the result at oscillator

Knowledge & Understanding

- Describe basic input and output devices and their function.
- Describe basic issues/problems related to electric circuit.

- Describe basic hardware configuration required for software.
- Detail knowledge of circuit diagram functions.
- Detail knowledge of electrical components.
- Describe basic input and output devices and their function.
- Describe basic issues/problems related to filters circuit.
- Describe basic hardware configuration required for software.
- Detail knowledge of circuit diagram functions.
- Describe basic input and output devices and their function.
- Describe basic issues/problems related to rectifier's circuit.
- Describe basic hardware configuration required for software.
- Describe knowledge of circuit diagram functions.
- Describe basic input and output devices and their function.
- Describe basic issues/problems related to amplifiers circuit.
- Describe basic hardware configuration required for software.
- describe knowledge of circuit diagram functions
- Describe basic input and output devices and their function.
- Describe basic issues/problems related to amplifiers circuit.
- Describe basic hardware configuration required for software.
- Describe knowledge of circuit diagram functions
- Describe basic input and output devices and their function.
- Describe basic issues/problems related to amplifiers circuit.
- Describe basic hardware configuration required for software.
- Describe knowledge of circuit diagram functions
- Describe basic input and output devices and their function.
- Describe basic issues/problems related to Oscillator.
- Describe basic hardware configuration required for
- Software.
- Describe knowledge of WEIN bridge oscillator diagram

Tools 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
15	Tool kits and Windows 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**:**

Develop the given circuit on PSPICE

0713E&E97 Carry Out Electrical Planning and Estimation

Overview:

This Competency Standard identifies the competencies required to. Analyse customer requirement and specification, Plan and estimate domestic electric work, Plan and estimate commercial electric work and Plan and estimate industrial electric work.

Competency Units	Performance Criteria
CU1. .Analyze customer requirement and specification	**P1.** Draw the general value chain of the end user. **P2.** Highlight the various stages and set of activities in the value chain drawing **P3.** Enlist the electrical appliances/materials required in electrical development process **P4.** Identify critical stages in the development **P5.** Identify the safety aspect required in the critical stages of the development **P6.** Enlist the possible energy efficient appliance/devices and global trends in electrical works **P7.** Analyse the client requirement at broad level. **P8.** Generate a report of various stages of electrical works. **P9.** Proposed appliance/materials as per global trends and clarify the technical specification.
CU2. Plan and estimate domestic electric work	**P1.** Plan the client requirement at broad level from the proposal. **P2.** Plan the electrical appliances/materials / used in different stages of the electrical development process **P3.** Plan and estimate electrical wiring **P4.** Estimate Installation and Material Cost **P5.** Estimate Power consumption for lighting and appliances **P6.** Plan a main and sub distribution board. **P7.** Ensure safety system.
CU3. Plan and estimate	**P1.** Analyze the client requirement at broad level from the proposal. **P2.** Plan the electrical equipment /appliances/materials / used in

commercial electric work.	different stages of the commercial electrical work **P3.** Plan and estimate electrical wiring **P4.** Estimate Installation and Material Cost **P5.** Estimate Power consumption for centralize lighting, heating, cooling system and other appliances. **P6.** Plan a main and sub distribution board. **P7.** Ensure safety measures in development process. **P8.** Enlist the material required.
CU4. Plan and estimate industrial electric work.	**P1.** Analyze the client requirement at broad level from the proposal. **P2.** Plan the electrical equipment /appliances/materials / used in different stages of the commercial electrical work **P3.** Plan and estimate electrical wiring **P4.** Estimate Installation and Material Cost **P5.** Estimate Power consumption for centralize lighting, heating, cooling system and other appliances. **P6.** Plan 3-phase line for heavy loads **P7.** Plan a separate control panel box for heavy machinery. **P8.** Plan a main and sub distribution board. **P9.** Design a safety system for protection of machinery and labor. **P10.** Assign color scheme for safety measures

Knowledge & Understanding

- Define the term ‘value chain’ of industry.
- Define human machine interface (HMI)
- Define the Standard operating procedure (SOP) of the organization for control panel development process.
- How to prepare a General arrangement drawing?
- Define IEC standards
- Describes the standard of electrical components.
- Understanding and knowledge of equipment properties.
- Understanding and knowledge of input and output of tool of electronic.
- Describe the rules and regulation of work.
- Understanding and knowledge of Electrical Specifications component used.
- Describes the standard of electrical components.

- Understanding and knowledge of equipment properties.
- Understanding and knowledge of input and output of tool of electronic.
- Describe the rules and regulation of work
- Describes the standard of electrical components.
- Understanding and knowledge of equipment properties.
- Understanding
- And
- Knowledge of input and output of tool of electronic.
- Describe the rules and regulation of work.

Tools and Equipment

SN	Tools
1	Site Visit
2	Reference Material
3	Clipboard
4	Calculation Sheet
5	Calculator
6	Psychometric Charts and Tables
7	Protective gear such as helmets, goggles, gloves, rubber shoes, etc.

Critical Evidence(s) Required

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

Prepare an estimate for electrical wiring of a domestic living room.

0713E&E98 Carry Out Industrial Automation and PLC Installation

Overview:

After this competency standard, the trainee will be able to get basic knowledge and competence to install PLC software and Simulator, Program a PLC using simulator and analyse user requirements and specifications.

Competency Units	Performance Criteria
CU1. Install PLC software and Simulator	**P1.** Install the PLC Programming **P2.** Software as per PLC manufacturer such as rest Logic 5000 and rest links classic etc. **P3.** Select the best and most frequently used Simulator for programming **P4.** Select the module **P5.** Input the generic value as per universal settings (check from internet/helped) **P6.** Start The Simulator. **P7.** Open PLC programming software
CU2. Program a PLC using simulator	P1. Open the programming software as per PLC manufacturer P2. Ensure that the Simulator is connected and is in ON condition P3. Create a basic ladder logic program for ON/OFF of a bulb using Examine ON and Examine OFF switch P4. Create a basic ladder logic program for Simple Start/Stop Ladder Logic Relay P5. Create a basic ladder logic program for Single Push Button On/Off Ladder Logic P6. Create a basic ladder logic program for with On Delay Timer P7. Create a basic ladder logic program for with Off Delay Timer P8. Create a basic ladder logic program for Traffic signal

	lights P9.Create a basic ladder logic program for Elevator Control.
CU3. Analyse user requirements and specifications	**P1.** Draw the general value chain of the end user industry **P2.** Highlight the set of activities that a firm operating in a specific industry performs in the value chain drawing **P3.** Enlist the equipment/gauges/sensors/actuators/transducers used in different stages of the process **P4.** Identify critical stages in the process **P5.** Identify the safety aspect required in the critical stages of the process **P6.** Analyse the possible automation in the existing processes and global trends in automation **P7.** Analyse the client requirement at broad level from the proposal **P8.** Generate a report of various industrial processes involved in industry **P9.** Collect the required specification of the equipment (if already prepared by the user) and clarify the technical specification.

Knowledge & Understanding

- Describe the advantages of the PLC
- Describe the major components and
- Describe the applications of PLC.
- Describe the types of input and output signals.
- Define Piping and instrumentation diagram/drawing (P&ID)
- List down the PLC, DCS programming software
- List Down the SCADA, HMI development software
- Knowledge of Relevant documents and documentation procedures
- Define Ladder Logic

- Explain the Examine ON and Examine OFF switch
- How to use ladder logic to create basic programs?
- What is push button?
- Define the types of Timers.
- What is the working of traffic light?
- Describe the working of an elevator
- Define the term ‘value chain’ of industry.
- Define human machine interface (HMI)
- Define the Standard operating procedure (SOP) of the organization for control panel development process.
- How to prepare a General arrangement drawing?
- Define IEC standards

Tools and Equipment

SN	Tools
1	Site Visit
2	Reference Material
3	Clipboard
4	Calculation Sheet
5	Calculator
6	Psychometric Charts and Tables
7	Protective gear such as helmets, goggles, gloves, rubber shoes, etc.
8	PLC Software
9	Helping Manual
10	Simulator
11	User guide
12	Simulator
13	Page
14	Pen

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard**:** Simulate the given program

0713E&E99 Verify Basic Laws of Electrical Machines

Overview:

This competency standard covers the skills and knowledge required to verify Faraday's law by moving permanent magnet inside the coil, verify Faraday's law by moving coil near the magnet field, verify Faraday's law using relative motion of coil and magnet, verify Faraday's Law using simple loop generator, verify EMF through induction, verify Torque induce in a current carrying loop and verify Mutual induction.

Competency Units	Performance Criteria
CU1. Verify Faraday's law by moving permanent magnet inside the coil.	**P1.** Construct a coil. **P2.** Connect Galvanometer with coil. **P3.** Move permanent magnet inside the coil fast and slow. **P4.** Record the effect of movement of magnet on reading of Galvanometer. **P5.** Hold the magnet inside the coil and do not move. **P6.** Record the effect on reading of Galvanometer again.
CU2. Verify Faraday's law by moving coil near the magnet field.	**P1.** Construct a coil. **P2.** Connect Galvanometer with coil. **P3.** Fix permanent magnet and move the coil fast and slow on it. **P4.** Record the effect of movement of coil on reading of Galvanometer. **P5.** Hold the coil near the magnetic field and do not move. **P6.** Record the effect on reading of Galvanometer.
CU3. Verify Faraday's law using relative motion of coil and magnet.	**P1.** Construct a coil. **P2.** Connect Galvanometer with coil. **P3.** Make relative motion of coil and magnet. **P4.** Record the effect of movement on reading of Galvanometer.
CU4. Verify Faraday's Law using simple loop generator.	**P1.** Identify single loop generator and its parts. **P2.** Select field winding. **P3.** Connect Galvanometer with single loop coil. **P4.** Rotate the single loop coil of generator in the field

	P5. Measure the voltage induce in loop generator. **P6.** Record the effect of movement on reading of Galvanometer.
CU5. Verify Torque induce in a current carrying loop	**P1.** Construct a coil. **P2.** Apply DC voltage to this coil. **P3.** Place a current carrying loop in this coil. **P4.** Check the direction of force to verify the torque produce.
CU6. Verify Mutual induction	**P1.** Construct 2 coils on two different legs of single core. **P2.** Apply AC voltage to the any one coil. **P3.** Check the volts induce in other coil by voltmeter.

Knowledge & Understanding

- What is Faraday's first law of Electro-Magnetic Induction?
- 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 torque?
- Why force produce on current carrying conductor?
- What is core?
- What is induction?
- What is meaning of coupled coils?
- Why EMF induced in 2nd coil, when voltage is applied to 1st coil?
- What is mutual induction?
- Which machine work on the principle of mutual induction?

Tools and Equipment.

SN	Tools
1	Coil
2	Galvanometer.
3	Voltmeter
4	Transformer
5	Connecting leads.

6	Magnet.
9	DC source
10	Rheostat
12	Loop

Critical Evidence(s) Required

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

Verify Faraday's law by moving coil near the magnetic field

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0713E&E100 Analyze Dc Generators

Overview:

This competency standard identifies the competencies required to calculate different terms used in armature winding of DC machines, develop Single Layer Lap Winding, develop Double Layer Wave Winding, measure the resistance of field winding, armature winding and terminal polarity, identify DC shunt generator, identify DC series generator and identify DC compound generator.

Competency Units	Performance Criteria
CU1. Calculate different terms used in armature winding of DC machines	**P1.** Count the number of slots (S) of armature. **P2.** Calculate pole pitch (Y). **P3.** Calculate Coil span/pitch. **P4.** Calculate Back pitch (Y_b) **P5.** Calculate Front pitch (Y_f) **P6.** Calculate Resultant Pitch (Y_R) **P7.** Calculate commentator pitch (Y_c)
CU2. Develop Single Layer Lap Winding	**P1.** Count the number of slot in armature core and numbering on it. **P2.** Calculate total number of conductors (Z) **P3.** Calculate average pitch, back pitch and commentator pitch. **P4.** Start winding from slot no 1. **P5.** Add the value of back pitch in conductor. **P6.** Connect conductor 1 from back side to the added value. **P7.** Subtract the value of back pitch from the added value. **P8.** Connect added value from front side to subtracted value. **P9.** Continue this process till completion of all conductors. **P10.** Connect armature segment with armature conductor. **P11.** Insert brushes in proper position.
CU3. Develop Double Layer Wave Winding	**P1.** Count the number of slot in armature core and numbering on it. **P2.** Calculate total number of conductors (Z) **P3.** Calculate average pitch, back pitch and commentator pitch.

	P4. Start winding from slot no 1. **P5.** Add the value of back pitch in conductor. **P6.** Connect conductor 1 from back side to the added value. **P7.** Add the value of front pitch in previous added value. **P8.** Continue this process till completion of all conductors. **P9.** Connect armature segment with armature conductor. **P10.** Insert brushes in proper position.
CU4. Measure the resistance of field winding, armature winding and terminal polarity	**P1.** Open the terminal box. **P2.** Connect the ohm meter with the terminal of both winding. **P3.** Read down ohm meter reading. **P4.** Connect the probe of galvanometer with any terminal and touch other probe to other terminals one by one. **P5.** Rotate the generator slowly by hand. **P6.** Touch the probe of galvanometer with each winding. **P7.** Identify armature with the deflection of galvanometer pointer. **P8.** Mark the polarity of terminals with the deflection of galvanometer.
CU5. Identify DC shunt generator	**P1.** Measure the terminal resistance of generator with ohm meter. **P2.** Identify DC shunt generator from measured value of resistance. **P3.** Disconnect both windings. **P4.** Identify the shunt field winding of shunt generator. **P5.** Identify armature of shunt generator. **P6.** Measure the resistance of both winding separately. **P7.** Record the resistance of armature winding and field winding. **P8.** Compare the resistance of armature winding and field winding to identify the difference between them.
CU6. Identify DC series generator	**P1.** Measure the terminal resistance of generator with ohm meter. **P2.** Identify DC series generator from measured value of resistance.

	P3. Disconnect both windings. **P4.** Identify the series field winding of series generator. **P5.** Identify armature of series generator. **P6.** Measure the resistance of both winding separately. **P7.** Record the resistance of armature winding and field winding. **P8.** Compare the resistance of armature winding and field winding to identify the difference between them.
CU7. Identify DC compound generator	**P1.** Measure the terminal resistance of generator with ohm meter. **P2.** Identify DC Compound generator from measured value of resistance. **P3.** Disconnect both windings. **P4.** Identify the series field winding of generator. **P5.** Identify the shunt field winding of generator. **P6.** Identify armature of shunt generator. **P7.** Measure and record the resistance of both winding separately. **P8.** Measure and Record the resistance of armature winding. **P9.** Compare the resistance of armature winding, series field winding and shunt field winding to identify the difference between them.

Knowledge and Understanding:

- Explain the term armature slots.
- What is pole pitch (Y)?
- What is coil span/pitch?
- What is Back pitch (Yb)
- What is Front pitch (Yf)
- What is Resultant Pitch (YR)
- What is commutation pitch (Yc)
- What is lap winding?
- How many parallel paths in lap winding?

- What is mean by single layer winding?
- What is wave winding?
- How many parallel paths in wave winding.
- What is mean by double layer winding?
- How to read the scale of galvanometer?
- What is difference between field winding and armature winding?
- Which winding having low resistance and why?
- Explain the technique to identify the terminal polarity
- How many winding in shunt generator?
- How to disconnect both winding of shunt generator
- How many winding in series generator?
- How to disconnect both winding of series generator.
- Which conditions you follow at the time of reconnection of both winding.
- Explain faraday's law.
- Explain rules of generators.
- Define the Type of DC machines
- Explain the principle of simple loop generator.

Tools and Equipment

SN	Tools
1	Connecting wires
2	Galvanometer
3	Ohm meter
4	DC machines
18	Soldering wire
19	Soldering iron
20	Sleeve
22	Winding machine
23	Insolating paper
24	Carbon brushes

Critical Evidence(s) Required

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

Measure the resistance of field winding, armature winding and terminal polarity.

0713E&E101 Perform Tests on DC Generators

Overview

This competency standard identifies the competencies required to Plot the Open circuit characteristics of a Separately excited D.C generator, plot the Open circuit characteristics of a D.C shunt generator, plot the load characteristics of D.C shunt generator, plot the load characteristics of D.C series generator, plot the load characteristics of D.C compound generator for under, flat and over compounding, perform parallel operation of two DC shunt generators and determine copper, iron & friction losses of shunt generator by actual loading.

Competency Units	Performance Criteria
CU1. Plot the Open circuit characteristics of a Separately excited D.C generator	**P1.** Connect DC supply to field coil through rheostat and ampere meter. **P2.** Rotate armature at constant speed. **P3.** Connect voltmeter across armature terminal. **P4.** Decrease the resistance of rheostat in steps and measure and record the relevant output voltage of armature and field current. **P5.** Repeat the P2 to P4 till voltage of armature reach at its saturation point. **P6.** Plot the graph between field current and armature voltage from the recorded values.
CU2. Plot the Open circuit characteristics of a D.C shunt generator	**P1.** Connect DC supply to field coil through rheostat and ampere meter. **P2.** Rotate armature at constant speed. **P3.** Connect voltmeter across armature terminal. **P4.** Decrease the resistance of rheostat in steps and measure and record the relevant output voltage of armature and field current. **P5.** Repeat the P2 to P4 till voltage of armature reach at its saturation point. **P6.** Plot the graph between field current and armature voltage from the recorded values.

CU3. Plot the load characteristics of D.C shunt generator.	**P1.** Select DC shunt generator and connect variable load. **P2.** Connect ampere meter and voltmeter across the load. **P3.** Rotate armature at constant speed and note the readings of ampere meter and voltmeter. **P4.** Increase the load in steps till specific reduce in terminal voltage observed. **P5.** Plot the graph between load current and terminal voltage from the recorded values.
CU4. Plot the load characteristics of D.C series generator.	**P1.** Select DC series generator and connect variable load. **P2.** Connect ampere meter and voltmeter across the load. **P3.** Rotate armature at constant speed and note the readings of ampere meter and voltmeter. **P4.** Increase the load in steps till specific reduce in terminal voltage observed. **P5.** Plot the graph between load current and terminal voltage from the recorded values.
CU5. Plot the load characteristics of D.C compound generator for under, flat and over compounding	**P1.** Select DC compound generator and connect variable load. **P2.** Connect ampere meter and voltmeter across the load. **P3.** Rotate armature at constant speed and note the readings of ampere meter and voltmeter. **P4.** Adjust field diverter on zero ohm. **P5.** Increase the load in steps till specific reduce in terminal voltage observed. **P6.** Plot the graph between load current and terminal voltage from the recorded values. **P7.** Such off the load. **P8.** Adjust the field diverter at such position that the terminal voltages are equal to no load voltages. **P9.** Increase the load in steps till specific reduce in terminal voltage observed. **P10.** Plot the graph between load current and terminal voltage from the recorded values. **P11.** Such off the load. **P12.** Adjust the field diverter at such position that the

	terminal voltages are greater than no load voltages. **P13.** Increase the load in steps till specific reduce in terminal voltage observed. **P14.** Plot the graph between load current and terminal voltage from the recorded values.
CU6. Perform parallel operation of two DC shunt generators.	**P1.** Connect the circuit according to the circuit diagram. **P2.** Place all switches in off position. **P3.** Run generator 1 at rated speed. **P4.** Reduce field resistance of generator 1 **P5.** Connect generator with bus bar after attaining rated voltage. **P6.** Run generator 2 with prime mover. **P7.** Reduce the field resistance of generator 2 to attain its rated voltage. **P8.** Close the switches for parallel operation. **P9.** Calculate and record the reading of voltage and current on different loads.
CU7. Determine copper, iron & friction losses of shunt generator by actual loading.	**P1.** Connect ammeter in series with both winding. **P2.** Connect voltmeter in parallel with both winding. **P3.** Apply 10-20 DC volt. **P4.** Record the readings of voltmeter and ammeter. **P5.** Calculate R_a and R_{sh}. **P6.** Run the generator at rated speed with prime mover. **P7.** Turn on the load switch and record the meter reading. **P8.** Calculate input power and output power. **P9.** Calculate total losses (Copper loss, Friction loss, Iron loss)

Knowledge and Understanding:

- What is different between shunt and separately excited generator?
- What is rheostat?
- How to use rheostat with field winding?
- Explain the effect of rheostat resistance on terminal voltage.
- What is core saturation?
- Why the graph between field current and armature voltage is not a straight line?

- What is armature reaction?
- Explain the reason of voltage reduce due to increase in load.
- How to compensate armature reaction?
- How to connect field and armature winding?
- How to connect field and armature winding in compound generator?
- Explain under compounding.
- Explain flat compounding.
- Explain over compounding.
- Explain the conditions of paralleling of DC generators.
- How to connect field and armature winding in shunt generator?
- Why we connect DC generators in parallel.
- What is iron loss?
- What is copper loss?
- Why we find copper loss at full load.
- Which loss having maximum value and why?

Tools and Equipment

SN	Tools
1	DC generators
2	Ampere meters
3	Voltmeters
4	Connecting wires
5	Rheostat
6	Tachometer
7	DC source

Critical Evidence(s) Required

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

Determine copper, iron & friction losses of shunt generator by actual loading.

0713E&E102 Analyze Dc Motors.

Overview

This competency standard identifies the competencies required to identify DC shunt motor, identify DC series motor and identify DC compound motor.

Competency Units		Performance Criteria
CU1.	Identify DC shunt motor	**P1.** Measure the terminal resistance of motors with ohm meter. **P2.** Identify DC shunt motor from measured value of resistance. **P3.** Disconnect both windings. **P4.** Identify field winding of shunt motor. **P5.** Identify armature of shunt motor. **P6.** Measure the resistance of both winding separately. **P7.** Record the resistance of armature winding and field winding. **P8.** Compare the resistance of armature winding and field winding to identify the difference between them.
CU2.	Identify DC series motor	**P1.** Measure the terminal resistance of DC motors with ohm meter. **P2.** Identify DC series motor from measured value of resistance. **P3.** Disconnect both windings. **P4.** Identify the series field winding of series motor. **P5.** Identify armature of series motor. **P6.** Measure the resistance of both winding separately. **P7.** Record the resistance of armature winding and field winding. **P8.** Compare the resistance of armature winding and field winding to identify the difference between them.
CU3.	Identify DC compound motor	**P1.** Measure the terminal resistance of DC motor with ohm meter. **P2.** Identify DC Compound motor from measured value of resistance.

	P3. Disconnect both windings. **P4.** Identify the series field winding of motor. **P5.** Identify the shunt field winding of motor. **P6.** Identify armature of compound motor. **P7.** Measure and record the resistance of both winding separately. **P8.** Record the resistance of armature winding. **P9.** Compare the resistance of armature winding, series field winding and shunt field winding to identify the difference between them.

Knowledge and Understanding:

- How many winding in shunt motor?
- Explain the technique to identify the terminal polarity.
- How to disconnect both winding of shunt motor?
- How many winding in series motor?
- What is different between field winding and armature winding?
- Which winding having low resistance and why?
- How to disconnect both winding of series generator.
- Which condition you follow at the time of reconnection of both winding?
- Define the Type of DC machines

Tools and Equipment

SN	Tools
1	DC compound motor
2	Ohm meter
3	Connecting wires
6	DC series motor
7	DC shunt motor

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard**:** Identify DC compound motor.

0713E&E103 Perform Tests on DC Motors.

Overview

This competency standard identifies the competencies required to Plot the load characteristics of D.C shunt motor, plot the load characteristics of D.C series motor, plot the load characteristics of D.C compound motor, control the speed of DC series motor, control the speed of DC shunt motor, start DC shunt motor with 3 point starter, identify the effect of back EMF in DC motor, calculate BHP of motor by Brake test, calculate efficiency of the motor by Swinburne Test and perform Regenerative / Hopkinson/ Back to back Test.

Competency Units		Performance Criteria
CU1.	Plot the load characteristics of D.C shunt motor	**P1.** Couple electro dynamo meter to the DC motor with belt **P2.** Connect shunt motor according to the diagram. **P3.** Set the dynamo meter control knob in such position to produce a minimum starting load. **P4.** Turn on the power supply **P5.** Run the motor at rated RPM. **P6.** Apply a load to DC motor by varying the dynamo meter control knob. **P7.** Measure and calculate the current, speed and torque. **P8.** Plot the load characteristics on DC shunt motor..
CU2.	Plot the load characteristics of D.C series motor.	**P1.** Select DC series motor and achieve connection as per diagram. **P2.** Turn on DC power supply and increase the load to full value. **P3.** Record the value of speed and current on each load. **P4.** Draw the graph between load current and speed
CU3.	Plot the load characteristics of D.C compound motor	**P1.** Couple electro dynamo meter to the DC motor with belt **P2.** Connect compound motor according to the diagram. **P3.** Set the dynamo meter control knob in such position to produce a minimum starting load. **P4.** Turn on the power supply **P5.** Run the motor at rated RPM. **P6.** Apply a load to DC motor by varying the dynamo meter control knob.

		P7. Measure and calculate the current, speed and torque. **P8.** Plot the load characteristics on DC compound motor..
CU4.	Control the speed of DC series motor.	**P1.** Make the connection as per circuit diagram. **P2.** Insert external resistances in series to armature and field coil. **P3.** Switch on the supply and increase the voltage gradually to its rated voltage. **P4.** Record speed at different supply voltages. **P5.** Make graph between speed and applied voltage.
CU5.	Control the speed of DC shunt motor.	**P1.** Make the connection as per circuit diagram. **P2.** Switch on the supply and increase the voltage gradually to its rated voltage. **P3.** Record speed at different field current. **P4.** Make graph between speed and field current **P5.** Fixed the field current and very armature current **P6.** Record the speed at different armature current. **P7.** Make graph between speed and armature current
CU6.	Start DC shunt motor with 3 point starter.	**P1.** Make the connection as per circuit diagram. **P2.** Switch on the supply and move starter handle from off position to position 1. **P3.** Move the starter arm from position 1 to position 2 and continue this process till starter arm reach at its extreme position.
CU7.	Identify the effect of back EMF in DC motor.	**P1.** Select DC series motor and make connection as per diagram. **P2.** Turn on DC power supply and increase the load 0 to full value. **P3.** Record the value of speed and current on each load. **P4.** Calculate back EMF by using the recoded values and appropriate formula. **P5.** Make graph between speed and back EMF and interpret the result.
CU8.	Calculate Brake Horse	**P1.** Connect the spring balance with one end of the rope. **P2.** Connect other end of rope with weight (W1).

	Power (BHP) of motor by Brake test.	**P3.** Measure the radius of the pulley. **P4.** Hang the weight on the pulley of the motor and fix the spring balance end with earth. **P5.** Run the motor. **P6.** Measured the RPM of the motor. **P7.** Adjust the weight to pass full load current from motor. **P8.** Calculate spring balance weight and hanged weight (W1) **P9.** Calculate shaft torque. **P10.** Calculate BHP of motor by shaft torque.
CU9.	Calculate efficiency of the motor by Swinburne Test	**P1.** Perform DC test to find the value of armature resistance and field resistance **P2.** Run the motor at rated voltage without load. **P3.** Adjust the value of shunt regulator to attain rated speed. **P4.** Measure Field current and No load current with ampere meter. **P5.** Calculate total copper losses and iron losses. **P6.** Calculate input and output power. **P7.** Calculate efficiency from calculated power.
CU10.	Perform Regenerative / Hopkinson/ Back to back Test	**P1.** Identify two shunt machines. **P2.** Couple the shafts of both machines. **P3.** Connect the machines electrically in such a way that one machine work as a motor and other as a generator. **P4.** Connect external power supply to the machines to overcome the machine losses. **P5.** Run the both machine at no load. **P6.** Reduce the field excitation of one machine which work as a motor. **P7.** Increase the field excitation of one machine which work as a generator. **P8.** Adjust the field winding so that voltage of generator becomes equal to the applied voltage which result the machines runs in parallel **P9.** Calculate the efficiency by using reading of voltmeter and ammeter.

Knowledge and Understanding:

- How many winding in compound generator?
- Why series winding having low turns.
- Explain the effect of field current changes on motor speed.
- Explain the effect of load changes on motor speed.
- Why we never start DC series motor without load.
- Why series winding having low turns and shunt winding having high number of turns?
- What is the different between shunt, series and compound motor load characteristics?
- Explain speed control of DC motor with applied voltage.
- Why we control the speed of DC motor.
- How many techniques to control the speed of DC shunt motor?
- What is 3-point starter?
- Why we never start DC shunt motor without starter.
- Explain generator action in motor.
- What is back EMF?
- Explain the effect of motor speed on back EMF
- How to measure the RPM of the motor?
- What is shaft torque?
- How to calculate BHP from shaft torque?
- What is iron loss?
- What is copper loss?
- Why we find copper loss at full load.
- Which loss having maximum value and why.
- Why we connect external source with motor generator set.
- What is mean by field excitation?

Tools and Equipment

SN	Tools
1	DC shunt motor
2	Tachometer
3	Voltmeters
4	Ammeters
5	Connecting wire
6	DC shunt generator
12	Spring balance
17	Rope
22	DC series motor
25	Belt
26	Electro dynamo meter
36	Ohm mete
38	DC compound motor

Critical Evidence(s) Required

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

Calculate efficiency of the motor by Swinburne Test

0713E&E104 Repair/ Maintenance and Service of DC Motors and Generators.

Overview

This Competency Standard identifies the competencies required to. Diagnose Fault in DC Motor, carry out Service/Repair in Electric Motor, and carry out Preventive Service / Maintenance of Generators and Diagnose and Repair Electric Generator carry out repair and maintenance of DC motors and generators in accordance with the manufacturer's instructions. The underpinning knowledge regarding repair and maintenance of electrical DC motor & generators will be sufficient to provide the basis for your work.

Competency Units	Performance Criteria
CU1. Diagnose Fault in DC Motor	**P1.** Identify the type of electric motor from data / name plate or manual and motor ratting. **P2.** Perform Methods of dismantling and assembling DC motor **P3.** Inspect visual mechanical defect such as, tight bearings, bent shaft, noisy running, short circuit, and temperatures. **P4.** Check the motor by using specified test instruments to detect electrical defects such as loose/or burnt electrical connections, defective capacitors, burnt windings, low insulation resistance. **P5.** Test short circuit, circuit break, earth fault, wiring fault, bearing fault. **P6.** Perform replacing of bearing **P7.** Identify the faults of a DC motor and repair them according to procedures. **P8.** Rewind a DC motor **P9.** Check the tripping of protective device using specified test instruments, while the motor is running with power supply connected with suitable control and protective device, the difficulty in starting/low RPM/ unusual noises/ excessive heat/ / grounded winding etc.
CU2. Carry out Service/Repair in Electric Motor	**P1.** Repair the motor as per diagnosed fault **P2.** Assemble the electric motor for internal tests/servicing/repairs according to manufacturer's

	instructions **P3.** Clean the parts of the motor with specified cleaning agents/tools & material **P4.** Check the windings insulation resistance with insulation tester **P5.** Rewind the motor as per requirement **P6.** Check the insulation resistance of repaired motor as per standard **P7.** Carry out the No load and load tests as per standard practices
CU3. Carry out Preventive Service/ Maintenance of Generators	**P1.** Carry out routine maintenance of the generator as specified in the manufacturer's manual **P2.** Check out the switch/ timer, relay, protective device and wire connection **P3.** Update the maintenance/service records
CU4. Diagnose and Repair Electric Generator	**P1.** Dismantle the electric Generator for internal tests/servicing/repairs according to manufacturer's instructions **P2.** Clean the parts of the generator with specified cleaning agents/tools & material **P3.** Check the control equipment of generators. **P4.** Find out the root cause of fault according to the signs of fault by applying the working principles of control equipment of generators**:** Speed controller, Magnetic field control circuit and equipment of the generator. **P5.** Check Load regulator of the generator and its control circuit. **P6.** Control circuit of the auxiliary generator. **P7.** Check Control circuit of the battery unit **P8.** Check Circuit breaker and relay. **P9.** Repair the fault after finding out the faulty equipment or component **P10.** Check the windings insulation resistance with insulation tester as per standard **P11.** Repair the generator as per diagnosed fault. **P12.** Carry out the No load and load tests as per standard

	practices

Knowledge & Understanding

- Explain type and construction and working principal of DC motors, DC Series Motor, DC shunt Motor, D.C. compound motor,
- Discuss working principal of D.C generator.
- What is dis-assembling & re-assembling of electric motors.
- Discuss common faults found in electric motors/generators and troubleshooting methods
- Explain the method preventive maintenance on motors and stand by generators.

Tools and Equipment

SN	Tools
1	Voltmeters
2	Wire Striper
3	Vernier Caliper
5	Thermometer
7	Test lamp
8	Soldering wire
10	DC Motors
11	Soldering Iron
12	Set of Nose Plier
13	Set of Screw Drivers
16	DC generators
19	Tachometer
20	Ring Spanner Set
21	Philips Screw drivers Set
22	Phase Sequence Meter
24	Magger (Insulation Tester)
25	Hammer

Critical Evidence(s) Required

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

- Troubleshooting of starting system of DC motor and generator
- Replacement of bearings of motor and generator

0713E&E105 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**:** Identify IC's Packages

0713E&E106 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 anode and cathode of diode. **P2.** Check the diode for specification (Current, Voltage, and power rating) using data sheet. **P3.** Connect the Diode in forward and Revers bias condition **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.** Record the data.
CU2. Construct half wave and Full Wave center tapped Rectifier	**P1.** Identify the required components for Full Wave and half wave Rectifier circuits. **P2.** Construct circuit Diagram of half wave Rectifier **P3.** Construct circuit Diagram of Full Wave Rectifier **P4.** Connect the circuit with the AC supply **P5.** Observe the input and Output wave form on oscilloscope **P6.** Calculate the ripple Factor **P7.** Calculate output voltage using proper formulas
CU3. Construct Full Wave Rectifier using Diode Bridge	**P1.** Identify the required components for Full Wave Bridge Rectifier circuit. **P2.** Construct circuit Diagram of Full Wave Bridge Rectifier **P3.** Connect the circuit with the AC supply **P4.** Observe the input and Output wave form on oscilloscope

	P5. Calculate the ripple Factor **P6.** Calculate output voltage using proper formulas

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 multi-meter
- 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 multi-meter
- 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**:** Construct Full Wave Rectifier using Diode Bridge.

0713E&E107 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.** Install the components for voltage regulator circuits. **P4.** Connect the circuit with DC supply. **P5.** Vary the input voltage and note down the effects on output.
CU2. Make Seven Segment display Using Light Emitting Diode	**P1.** Draw the Seven Segment Display Circuit **P2.** Select required components for seven segment display **P3.** Install the components for Seven Segment Display Circuit **P4.** Verify the numeric digits on Seven Segment Display by providing proper input to its terminal

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**:**

Make Seven Segment display Using Light Emitting Diode.

0713E&E108 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 type of transistor. P2. Identify the base collector & Emitter of transistors. P3. Insert the transistor on bread board. P4. Perform the standard Biasing of PNP & NPN Transistor
CU2. Implement Transistor as an amplifier using CB Configuration.	**P1.** Draw the Circuit of amplifier using CB configuration of transistor **P2.** Select the components for CB configurations. **P3.** Insert the components for CB configuration amplifier. **P4.** Calculate the gain of transistor in CB modes. **P5.** Draw VI characteristics curve for CB configuration.
CU3. Implement Transistor as an amplifier using CC Configuration.	**P1.** Draw the Circuit of amplifier using CC configuration of transistor **P2.** Select the components for CC configurations. **P3.** Insert the components for CC configuration amplifier. **P4.** Calculate the gain of transistor in CC modes. **P5.** Draw VI characteristics curve for CC configuration.
CU4. Implement Transistor as an amplifier using CE Configuration.	**P1.** Draw the Circuit of amplifier using CE configuration of transistor **P2.** Select the components for CE configurations. **P3.** Insert the components for CE configuration amplifier. **P4.** Calculate the gain of transistor in CE modes. **P5.** Draw VI characteristics curve for CE configuration.

CU5. Construct the circuit of Class A Power Amplifier	**P1.** Identify the required components for Class A Power Amplifier. **P2.** Select the component for Class A Power Amplifier **P3.** Construct the circuit of class A power amplifier using PNP OR NPN transistor. **P4.** Analyze the different parameter of Class A Power Amplifier **P5.** Monitor the Output waveform on oscilloscope **P6.** Draw the characteristic curves of Class A Power Amplifier **P7.** Calculate the Voltage gain and Power Gain of Class A Power Amplifier **P8.** Generate the Lab report
CU6. Implement BJT as a switch.	**P1.** Draw transistor switching circuit. **P2.** Select the components for switching circuits **P3.** Insert the components on bread board. **P4.** Verify switching operation of transistor using LED.

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**:**

Construct the circuit of Class a Power Amplifier

0713E&E109 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 type of FET. P2. Identify the Gate, Drain & Source of FET. P3. Insert the FET on bread board. P4. Perform the standard Biasing of (N-Channel, P-Channel) FET. P4. Measure the Gate-Source voltage (Veg's) & Threshold Voltage (Vth)
CU2. Implement MOSFET as a switch.	**P1.** Draw switching circuit of MOSFET. **P2.** Select the components for switching circuits **P3.** Insert the components bread board. **P4.** Verify switching operation of MOSFET using LED.
CU3. Draw the VI characteristics curves for FETs	P1. Construct an amplifier circuit using FETs P2. Apply Vds & Vgs P3 Measure the drain current P4. Draw VI characteristic curves
CU4. Construct the circuit of Common Drain (CD) Amplifier	**P1.** Draw the Circuit of amplifier using CD configuration of FET **P2.** Select the components for CD configurations. **P3.** Insert the components for CD configuration amplifier On breadboard **P4.** Perform standard biasing for CD configuration

	P5. Apply the input signal and observe the output on oscilloscope. **P6.** Observe and Record the difference between input and output.
CU5. Construct the circuit of Common Gate (CG) amplifier	**P1.** Draw the Circuit of amplifier using CG configuration of FET **P2.** Select the components for CG configurations. **P3.** Install the components for CG configuration amplifier. **P4.** Perform standard biasing for CG configuration **P5.** Apply the input signal and observe the output on oscilloscope. **P6.** Observe and Record the difference between input and output.
CU6. Construct a Low voltage transistor based regulated power supply	**P1.** Draw the Schematic diagram of power supply **P2.** Select the components for power supply **P3.** Install the power supply circuit. **P4.** Connect the circuit with DC supply. **P5.** Vary the input voltage and note down the effects on output.

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**:** Construct the circuit of Common Gate (CG) amplifier.

0713E&E110 Implement Thyristor Family (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. Construct relaxation oscillator using UJT	**P1.** Draw the Schematic diagram of relaxation oscillator using UJT. **P2.** Select the components for relaxation oscillator. **P3.** Construct the relaxation oscillator circuit on bread board. **P4.** Connect the circuit with DC supply. **P5.** Observe the output wave shape on oscilloscope. **P6.** Vary the value of input resistor and record the effect on output.
CU2. Construct switching circuit using SCR	**P1.** Draw the Schematic diagram of switching circuit using SCR. **P2.** Select the components for SCR switching circuit. **P3.** Construct the SCR switching circuit on bread board **P4.** Connect the circuit with DC supply. **P5.** Verify switching operation by triggering the SCR
CU3. Construct the dimmer circuit using DIAC & TRIAC	**P1.** Draw the Schematic diagram of dimmer circuit using TRIAC & DIAC. **P2.** Select the components for dimmer circuit. **P3.** Construct the dimmer circuit. **P4.** Connect the circuit with AC supply. **P5.** Vary the potentiometer and record the effect on load (Fan or Lamp)

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**:** Construct the dimmer circuit using DIAC & TRIAC

0713E&E111 Implement Operational Amplifier in Different Applications

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 Non-inverting amplifier using operational amplifier	**CU1.** Draw the circuit of non-inverting amplifier using operational amplifier. **CU2.** Select the components for non-inverting operational amplifier. **CU3.** Insert the components of non-inverting operational amplifier. **CU4.** Connect the circuit to DC supply. **CU5.** Apply input voltage to the circuit and measure the output voltage. **CU6.** Calculate the gain for non-inverting operational amplifier.
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	**P1.** Draw the Schematic diagram of differentiator circuit using Op-Amp.

circuit using operational amplifier	**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**:**

Construct an Inverting amplifier using operational amplifier

0713E&E112 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.

Tools 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**:**

Verify the truth table of XNOR gate

0713E&E113 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	**P1.** Place (Encoder 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.
CU9. Verify multiplexer and DE- multiplexer	**P1.** Implement following function with multiplexer F(ABC)=∑ (0,2,3,4,5,6)**:** **P2.** Implement 4-to-1 mux and one 2-to-1 mux. **P3.** 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.

Tools 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**:**

Operate seven segment display with seven segment decoder.

0713E&E114 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

Tools 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**:** Verify function of JK/T flip flop

0713E&E115 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, non-stable & beatable Multivibrator and observe their outputs.

Competency Units	Performance Criteria
CU1. Construct 555 IC as Astable Multivibrator	**P1.** Draw circuit diagram for Astable Multivibrator **P2.** Place 555 IC on bread board/trainer **P3.** Make connection as per diagram. **P4.** Apply voltage to circuit. **P5.** Record 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.** Recod 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

Tools 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**:**

Construct 555 IC as Bi-stable Multivibrator and verify its set and reset conduction

0713E&E116 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.** Record 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. Troubleshoot different combinational logic circuits.	**P1.** Identify faults in different combinational logic circuits IC's. **P2.** Find the faults. **P3.** Troubleshoot the 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.

Tools 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**:**

Troubleshoot different combinational logic circuits

0713E&E117 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	**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

SCR.	gate of SCR. **P4.** Connect oscilloscope across the load resistor and record the output wave shape
CU5. Build full wave converter and observe natural commutation.	**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 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

Tools 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**:**

Build full wave converter and observe natural commutation

0713E&E118 Implement Single Phase and Three Phase Inverter

Overview:

This competency standard covers the skills and knowledge required toConstruct single phase half bridge inverter and observe its output, construct single phase full bridge inverter and observe its output and Construct three phase bridge inverter and observe its output Construct single phase half bridge inverter, single phase full bridge, three phase bridge inverter and observe their outputs.

Competency Units	Performance Criteria
CU1. Construct single phase half bridge inverter and observe its output	**P1.** Draw circuit diagram of single-phase half bridge inverter. **P2.** Make connection as per diagram. **P3.** Apply triggering pulses to circuit with the help of signal generator. **P4.** Connect oscilloscope across the load resistor and record the output wave shape
CU2. Construct single phase full bridge inverter and observe its output	**P1.** Draw circuit diagram of single-phase full bridge inverter. **P2.** Make connection as per diagram. **P3.** Apply triggering pulses to circuit with the help of signal generator. **P4.** Connect oscilloscope across the load resistor and record the output wave shape
CU3. Construct three phase bridge inverter and observe its output	**P1.** Draw circuit diagram of three-phase bridge inverter. **P2.** Make connection as per diagram. **P3.** Apply output of controller IC to the gates of MOSFET's for triggering pulses. **P4.** Connect oscilloscope across the load resistor and record the output wave shape

Knowledge & Understanding

- Define Inverter
- Enlist different types of inverter
- Define half bridge inverter

- Define Full bridge inverter
- Define 3 phase bridge inverter
- Describe the use of function generator.
- Define use of controller IC.

Tools and Equipment

SN	Tools
1	Power MOSFET IRF 840
2	Power Diode 1N4007
3	DC Source 12V
4	Resistor 10K
5	Function Generator
6	IC 7404
7	Controller IC
8	Oscilloscope
9	Connecting leads

Critical Evidence(s) Required

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

Construct three phase bridge inverter and observe its output.

0713E&E119 Control Speed of AC/DC Motor

Overview:

This competency standard covers the skills and knowledge required to. Implement armature control method to control the speed of DC motor with 3 phase control bridge rectifier and Bridge rectifier, Implement Field control method to control the speed of DC motor with 3 phase bridge rectifier and control Bridge rectifier, Implement Field control method & armature control method to control the speed of DC motor with 3 phase bridge rectifier, Implement AC to AC converter to control the speed of 3 phase AC motor, Implement single phase cycle-converter with center tapped transformer and SCR's and change the frequency of output AC signal and Implement synch's to transmit torque Implement armature control method, field control method & both armature and field control methods to control the speed of DC motor with 3 phase control bridge rectifier and Bridge rectifier and implement AC to AC converter to control the speed of 3 phase AC motor.

Competency Units	Performance Criteria
CU1. Implement armature control method to control the speed of DC motor with 3 phase control bridge rectifier and Bridge rectifier.	**P1.** Draw circuit diagram of armature control method to control the speed of DC motor. **P2.** Make connection as per diagram. **P3.** Apply output of controller IC to the gates of all SCR's **P4.** Now change the triggering of SCR's and record the effect on speed of DC motor.
CU2. Implement Field control method to control the speed of DC motor with 3 phase bridge rectifier and control Bridge rectifier.	**P1.** Draw circuit diagram of field control method to control the speed of DC motor. **P2.** Make connection as per diagram. **P3.** Apply output of controller IC to the gates of all SCR's **P4.** Now change the triggering of SCR's and record the effect on speed of DC motor.
CU3. Implement Field control method & armature control	**P1.** Draw circuit diagram of field control & armature control method to control the speed of DC motor. **P2.** Make connection as per diagram.

method to control the speed of DC motor with 3 phase bridge rectifier.	**P3.** Apply output of controller IC to the gates of all SCR's **P4.** Now change the triggering of SCR's and record the effect on speed of DC motor.
CU4. Implement AC to AC converter to control the speed of 3 phase AC motor.	**P1.** Draw circuit diagram of AC to AC converter to control the speed of AC motor. **P2.** Make connection as per diagram. **P3.** Apply output of controller IC to the gates of all SCR's **P4.** Now change the triggering of SCR's and record the effect on speed of AC motor.
CU5. Implement single phase cycle-converter with center tapped transformer and SCR's and change the frequency of output AC signal.	**P1.** Draw circuit diagram of single phase cycle-converter to produce variable frequency AC signal. **P2.** Make connection as per diagram. **P3.** Apply output of controller IC to the gates of all SCR's **P4.** Apply Triggering to SCR's 1 & 3 for 1st 25 cycles to get positive half cycle and apply triggering for remaining 25 half cycle to SCR's 2 & 4 to get the negative half cycle with controller IC. **P1.** Connect the oscilloscope across the load and record the output
CU6. Implement synchros's to transmit torque	**P1.** Place synchrony transmitter and synchrony receiver at two different places. **P2.** With help of cord establish connection between corresponding terminal of TX& Rx i.e. S1 to S1, S2 to S2 and S3 to S3 respectively. **P3.** Give single phase AC supply to the rotor of both TX and Rx. **P4.** Rotate the rotor of TX in step to 30 degrees and observe the new position of rotor of Rx. **P5.** Enter the input angular position & output angular position in the table.

Knowledge & Understanding

- .Define DC motor
- Enlist parts of DC motor

- Enlist the methods to control the speed of DC motor.
- Describe armature control method.
- Describe field control method.
- What is range of firing angle of SCR's
- Define use of controller IC.
- Define AC to AC conversion
- .Define cycle-converter.
- Enlist types of cycle-converter
- Define single phase cycle-converter.
- Define three phase cycle-converter.
- . Define synchs.
- Define synchrony generator or TX
- Define synchrony receiver or Rx

Tools and Equipment

SN	Tools
1	Multimeter
2	Connecting leads
3	Synchrony Transmitter & Receiver
4	Supply
5	Power supply
6	Connecting leads
7	CRO
8	Firing Circuit
9	SCR's
10	Power Electronics Trainer Kit
11	Power Diode 1N4007
12	Controller IC
13	DC Motor
14	AC motor
15	Connecting leads
16	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

Implement armature control method to control the speed of DC motor with 3 phase control bridge rectifier and Bridge rectifier.

0713E&E120 Program PLC Using Ladder Logic

Overview:

This competency standard covers the skills and knowledge required to Install PLC software and Simulator and Program apply using simulator. After this competency standard, the trainee will be able to get basic knowledge and competence to program and understand ladder logic.

Competency Units	Performance Criteria
CU1. Install PLC software and Simulator	**P1.** Install the PLC Programming **P2.** Software as per PLC manufacturer such as PRs Logic 5000 and PRs links classic etc. **P3.** Select the best and most frequently used Simulator for programming **P4.** Select the module **P5.** Input the generic value as per universal settings (check from internet/helped) **P6.** Start The Simulator. **P7.** Open PLC programming software
CU2. Program a PLC using simulator	P1. Open the programming software as per PLC manufacturer P2. Ensure that the Simulator is connected and is in ON condition P3. Create a basic ladder logic program for ON/OFF of a bulb using Examine ON and Examine OFF switch P4. Create a basic ladder logic program for Simple Start/Stop Ladder Logic Relay P5. Create a basic ladder logic program for Single Push Button On/Off Ladder Logic P6. Create a basic ladder logic program for with On Delay Timer P7. Create a basic ladder logic program for with Off Delay

Timer P8. Create a basic ladder logic program for Traffic signal lights P9.Create a basic ladder logic program for Elevator Control.

Knowledge & Understanding

- Describe the advantages of the PLC
- Describe the major components and
- Describe the applications of PLC.
- Describe the types of input and output signals.
- Define Piping and instrumentation diagram/drawing (P&ID)
- List down the PLC, DCS programming software
- List Down the SCADA, HMI development software
- Knowledge of Relevant documents and documentation procedures
- Define Ladder Logic
- Explain the Examine ON and Examine OFF switch
- How to use ladder logic to create basic programs?
- What is push button?
- Define the types of Timers.
- What is the working of traffic light?
- Describe the working of an elevator.

Tools and Equipment

SN	Tools
1	PLC Software
2	Helping Manual
3	Simulator
4	User guide
5	Page
6	Pen

Critical Evidence(s) Required

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

Program a PLC using simulator

0713E&E121 Carry out Industrial Automation and PLC Installation

Overview:

This competency standard covers the skills and knowledge required to Analyse user requirements and specification, prepare work plan, Design and program PLC, Test the PLC, ensure quality and productivity standards, Installation and Commissioning and Carry out maintenance of PLC. After this competency the candidate will be able to design, develop, install and maintain the automation and control system needed for Automation and Control.

Competency Units	Performance Criteria
CU1.Analyze user requirements and specifications for PLC installation	**P1.** Draw the general value chain of the end user industry **P2.** Highlight the set of activities that a firm operating in a specific industry performs in the value chain drawing **P3.** Enlist the equipment/gauges/sensors/actuators/transducers used in different stages of the process **P4.** Identify critical stages in the process **P5.** Identify the safety aspect required in the critical stages of the process **P6.** Analyse the possible automation in the existing processes and global trends in automation **P7.** Analyse the client requirement at broad level from the proposal **P8.** Generate a report of various industrial processes involved in industry **P9.** Collect the required specification of the equipment (if already prepared by the user) and clarify the technical specification.

CU2.Prepare work plan for PLC Installation	**P1.** Suggest globally practiced and accepted automation systems if the user is not aware of the technical specifications **P2.** List down the sub systems that are involved in the process **P3.** List down sensors and actuators requirement. **P4.** Collect information on process logic **P5.** Collect information for operator station screens **P6.** Decide on whether the system can be developed as per the user requirement **P7.** Support the project manager in calculating the time required for each stage to ensure completion of project **P8.** Assist in preparing the work plan with deliverables and timelines **P9.** Explain the expected output to the user **P10.** Calculate the number of days needed for commissioning of the panel at site **P11.** Summarize the user requirement.
CU3.Design and program PLC	**P1.** Develop PLC application as per user requirement by following the standard operating procedure (SOP) of the organization **P2.** Apply approved engineering concepts, processes and principles in developing the PLC application **P3.** Install organization approved software (system and application software) to develop the system **P4.** Identify the requirement of indications, switchgears and accessories **P5.** Develop the control circuit drawing **P6.** Prepare wiring plans **P7.** Integrate the main process system with the sub-systems as per the user requirement (e.g., using communication

	protocol) **P8.** Ensure that safety aspect of the process is captured in the design plan **P9.** P9. Program PLC as per FDF Program SCADA Application **P10.** PLC-SCADA Communication **P11.** P12. Create backup copies of all designs developed for control panel and store in a secure location **P12.** Prepare a product manual and store them for future references
CU4. Test the PLC	**P1.** Locate field devices and their interface to PLC **P2.** Test the system in off line mode using simulator **P3.** Test the gauges independently for integration of main system with the sub-systems (if applicable) **P4.** Verify that the system conforms with all the user specifications during testing **P5.** Rework if there are any issues found and fix them **P6.** Send the test report for review to the customer **P7.** Perform Factory Acceptance Test (FAT) **P8.** Perform site acceptance test plan
CU5. Ensure quality and productivity standards	**P1.** Ensure timely delivery of the control panel design as per agreed timeline **P2.** Ensure that total cost and man hours spent is as per the budget planned **P3.** Ensure compliance with relevant regulations, standards and codes of practices **P4.** Ensure compliance of the application with manufacturing requirements and process capabilities analysis of the organization **P5.** Ensure that the design conforms with normal safety standards **P6.** Develop reliable panels so that the system does not fail during the usage

CU6.Installation and Commissioning	**P1.** Check availability of panel and tools required for installation **P2.** Check the internal panel wiring and ensure that it is in accordance with the design drawing **P3.** Carry out insulation check of internal panel wiring and devices within the panel **P4.** Check if batteries and chargers have been assembled in accordance with the manufacturers recommended procedures **P5.** Identify the conductors size and capacity for installation **P6.** Ensure that the panel is positioned as prescribed, following safety norms **P7.** Make connections to socket outlets, switches and protective conductors **P8.** Perform settings as per customer requirements on the equipment in each of the panels **P9.** Test all control system interlocks **P10.** Check each digital control point by comparing the command at the control panel and status of the device that it controls **P11.** Ensure that fuses, switches and other protective devices are labelled correctly **P12.** Follow the grounding and earthling procedures while commissioning **P13.** Put danger and warning notices, (if necessary) **P14.** Test continuity, insulation resistance, functions of all devices, etc., after completion of installation
CU7. Carry out maintenance of PLC	**P1.** Select and use required tools and equipment as per the job requirement **P2.** Identify the faults as per the LED indications on module **P3.** Identify different signal modules (DI, DO, AI, AO) and take necessary action as per job requirement **P4.** Identify & Check the terminals inside IO panels and take necessary action as per the job requirement **P5.** Check & test the condition of input power supply to IO

	panel, input/output power of SMPS and take necessary action as per job requirement **P6.** Check the conditions of breakers and fuses and take necessary action as per the job requirement

Knowledge and Understanding:

- Define the term ‘value chain’ of industry.
- Define human machine interface (HMI)
- Define the Standard operating procedure (SOP) of the organization for control panel development process.
- How to prepare a General arrangement drawing?
- Define IEC standards
- Knowledge of Relevant documents and documentation procedures used in the process
- Define formula for Electrical load calculations
- Explain the Piping and instrumentation diagram/drawing (P&ID)
- Describe the Safety aspects to be inbuilt
- n the control system as per the process requirement
- Describe the advantages of the PLC
- Describe the major components and
- Describe the applications of PLC.
- Describe the types of input and output signals.
- Define Piping and instrumentation diagram/drawing (P&ID)
- How to prepare wiring diagram
- DCS programming software
- P8. List Down the SCADA, HMI development software
- P9. Knowledge of Relevant documents and documentation procedures used in the process
- What are the Testing process and parameters involved in the testing?
- Define the use of Emulator(Simulator)
- Panel?

- How to troubleshoot frequently occurring errors.
- Describe the Safety aspects to be inbuilt in the control panel system as per the process requirement
- Define IEC standards
- Define Relevant regulations, standards and codes of practice and their implications on the
- panel
- What are the safety norms in handling electrical/electronic components?
- Describe the Operation of PLCs, relays, contactors, circuit breakers, solenoids, actuators, controllers etc.
- Describe the various tools used during the installation process
- How to troubleshoot Frequently occurring errors, causes and preventive measures
- repairing/replacement of various components in a PLC
- What are safety precautions while working in an electronic assembly unit

Tools and Equipment

SN	Tools
1	Psychometrics Chart, Tables, and Other References
2	Charts
3	Psychometrics Chart, Tables, and Other References
4	Clipboard
5	MultiMate
6	Data loggers
7	Electronic Hygrometer
8	Tachometer
9	Anemometer
10	Site Visit
11	Budget Sheet
12	International Safety Standards
13	Protective gear such as helmets, goggles
14	Electronic Pressure Gauge
15	Power Supply
16	Simulating software(Emulator)
17	Connecting Cables

18	PLC Software
19	Protective gear such as helmets, goggles, gloves, rubber shoes, etc
20	Psychometric Charts and Tables
21	Calculator
22	Calculation Sheet
23	Clipboard
24	Reference Material
25	Sensors/Transducers
26	Anemometer
27	Tachometer
28	Electronic Hygrometer
29	Protective gear such as helmets, goggles, gloves
30	rubber shoes, etc.
31	Flashlight
32	Tool box
33	Calculator

Critical Evidence(s) Required

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

Design and program PLC

0713E&E122 Install PLC Software and Simulator

Overview:

This competency standard covers the skills and knowledge required toinstall PLC software and Simulator, Program a PLC using simulator and analyse user requirements and specifications.

Competency Units	Performance Criteria
CU1. Install PLC software and Simulator	**P1.** Install the PLC Programming **P2.** Software as per PLC manufacturer such as Rs Logic 5000 and Rs links classic etc. **P3.** Select the best and most frequently used Simulator for programming **P4.** Select the module **P5.** Input the generic value as per universal settings (check from internet/helped) **P6.** Start The Simulator. **P7.** Open PLC programming software
CU2. Program a PLC using simulator	P1. Open the programming software as per PLC manufacturer P2. Ensure that the Simulator is connected and is in ON condition P3. Create a basic ladder logic program for ON/OFF of a bulb using Examine ON and Examine OFF switch P4. Create a basic ladder logic program for Simple Start/Stop Ladder Logic Relay P5. Create a basic ladder logic program for Single Push Button On/Off Ladder Logic P6. Create a basic ladder logic program for with On Delay Timer P7. Create a basic ladder logic program for with Off Delay Timer P8. Create a basic ladder logic program for Traffic signal

	lights P9.Create a basic ladder logic program for Elevator Control.
CU3. Analyse user requirements and specifications	**P1.** Draw the general value chain of the end user industry **P2.** Highlight the set of activities that a firm operating in a specific industry performs in the value chain drawing **P3.** Enlist the equipment/gauges/sensors/actuators/transducers used in different stages of the process **P4.** Identify critical stages in the process **P5.** Identify the safety aspect required in the critical stages of the process **P6.** Analyse the possible automation in the existing processes and global trends in automation **P7.** Analyse the client requirement at broad level from the proposal **P8.** Generate a report of various industrial processes involved in industry **P9.** Collect the required specification of the equipment (if already prepared by the user) and clarify the technical specification.

Knowledge & Understanding

- Describe the advantages of the PLC
- Describe the major components and
- Describe the applications of PLC.
- Describe the types of input and output signals.
- Define Piping and instrumentation diagram/drawing (P&ID)
- List down the PLC
- DCS programming software
- List Down the SCADA, HMI development software
- Knowledge of Relevant documents and documentation procedures
- Define Ladder Logic
- Explain the Examine ON and Examine OFF switch

- How to use ladder logic to create basic programs?
- What is push button?
- Define the types of Timers.
- What is the working of traffic light?
- Describe the working of an elevator.
- Define the term ‘value chain’ of industry.
- Define human machine interface (HMI)
- Define the Standard operating procedure (SOP) of the organization for control panel development process.
- How to prepare a General arrangement drawing?
- Define IEC standards

Tools and Equipment

SN	Tools
1	PLC Software
2	Protective gear such as helmets, goggles, gloves, rubber shoes, etc
3	Psychometric Charts and Tables
4	Calculator
5	Calculation Sheet
6	Clipboard
7	Site Visit
8	Pen
9	Reference Material
10	Helping Manual
11	User guide
12	Simulator
13	Page

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard**:** Program a PLC using simulator.

0713E&E123 Design and Test the PLC.

Overview:

This competency standard covers the skills and knowledge required toPrepare work plan, design and program PLC and Test the PLC.

Competency Units	Performance Criteria
CU1. Prepare work plan	**P1.** Suggest globally practiced and accepted automation systems if the user is not aware of the technical specifications **P2.** List down the sub systems that are involved in the process **P3.** List down sensors and actuators requirement. **P4.** Collect information on process logic **P5.** Collect information for operator station screens **P6.** Decide on whether the system can be developed as per the user requirement **P7.** Support the project manager in calculating the time required for each stage to ensure completion of project **P8.** Assist in preparing the work plan with deliverables and timelines **P9.** Explain the expected output to the user **P10.** Calculate the number of days needed for commissioning of the panel at site **P11.** Summarize the user requirement.
CU2. Design and program PLC	**P1.** Develop PLC application as per user requirement by following the standard operating procedure (SOP) of the organization **P2.** Apply approved engineering concepts, processes and principles in developing the PLC application **P3.** Install organization approved software (system and application software) to develop the system **P4.** Identify the requirement of indications,

	switchgears and accessories **P5.** Develop the control circuit drawing **P6.** Prepare wiring plans **P7.** Integrate the main process system with the sub-systems as per the user requirement (e.g., using communication protocol) **P8.** Ensure that safety aspect of the process is captured in the design plan **P9.** Program PLC as per FDF Program SCADA Application **P10.** PLC-SCADA Communication **P11.** Create backup copies of all designs developed for control panel and store in a secure location **P12.** Prepare a product manual and store them for future references
CU3. Test the PLC	**P1.** Locate field devices and their interface to PLC **P2.** Test the system in off line mode using simulator **P3.** Test the gauges independently for integration of main system with the sub-systems (if applicable) **P4.** Verify that the system conforms with all the user specifications during testing **P5.** Rework if there are any issues found and fix them **P6.** Send the test report for review to the customer **P7.** Perform Factory Acceptance Test (FAT) **P8.** Perform site acceptance test plan

Knowledge and Understanding:

- Knowledge of Relevant documents and documentation procedures used in the process
- Define formula for Electrical load calculations
- Explain the Piping and instrumentation diagram/drawing (P&ID)

- Describe the Safety aspects to be inbuilt in the control system as per the process requirement
- Describe the advantages of the PLC
- Describe the major components and
- Describe the applications of PLC.
- Describe the types of input and output signals.
- Define Piping and instrumentation diagram/drawing (P&ID)
- How to prepare wiring diagram
- List down the PLC, DCS programming software
- P8. List Down the SCADA, HMI development software
- P9. Knowledge of Relevant documents and documentation procedures used in the process
- What are the Testing process and parameters involved in the testing
- Define the use of Emulator(Simulator)
- What are the Relevant regulations, standards and codes of practice and their implications on the panel

Tools and Equipment

SN	Tools
1	PLC Software
2	Protective gear such as helmets, goggles, gloves, rubber shoes, etc.
3	Psychometric Charts and Tables
4	Calculator
5	Calculation Sheet
6	Clipboard
7	Site Visit
8	Pen
9	Reference Material
10	Helping Manual
11	User guide
12	Simulator
13	Page
14	Reference Material
15	Psychometric Charts and Tables

16	Calculator
17	Clipboard
18	Protective gear such as helmets, goggles, gloves, rubber shoes etc.
19	Calculation Sheet

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard**:** Test the PLC.

0713E&E124 Installation, Commissioning and Maintenance of PLC

Overview:

This competency standard covers the skills and knowledge required to ensure quality and productivity standards, installation and Commissioning and carry out maintenance of PLC.

Competency Units	Performance Criteria
CU1. Ensure quality and productivity standards	**P1.** Ensure timely delivery of the control panel design as per agreed timeline **P2.** Ensure that total cost and man hours spent is as per the budget planned **P3.** Ensure compliance with relevant regulations, standards and codes of practices **P4.** Ensure compliance of the application with manufacturing requirements and process capabilities analysis of the organization **P5.** Ensure that the design conforms with normal safety standards **P6.** Develop reliable panels so that the system does not fail during the usage
CU2. Installation and Commissioning	**P1.** Check availability of panel and tools required for installation **P2.** Check the internal panel wiring and ensure that it is in accordance with the design drawing **P3.** Carry out insulation check of internal panel wiring and devices within the panel **P4.** Check if batteries and chargers have been assembled in accordance with the manufacturers recommended procedures **P5.** Identify the conductors size and capacity for installation **P6.** Ensure that the panel is positioned as prescribed, following safety norms **P7.** Make connections to socket outlets, switches and protective conductors

	P8. Perform settings as per customer requirements on the equipment in each of the panels **P9.** Test all control system interlocks **P10.** Check each digital control point by comparing the command at the control panel and status of the device that it controls **P11.** Ensure that fuses, switches and other protective devices are labelled correctly **P12.** Follow the grounding and earthling procedures while commissioning **P13.** Put danger and warning notices, (if necessary) **P14.** Test continuity, insulation resistance, functions of all devices, etc., after completion of installation
CU3. Carry out maintenance of PLC	**P1.** Select and use required tools and equipment as per the job requirement **P2.** Identify the faults as per the LED indications on module **P3.** Identify different signal modules (DI, DO, AI, AO) and take necessary action as per job requirement **P4.** Identify & Check the terminals inside IO panels and take necessary action as per the job requirement **P5.** Check & test the condition of input power supply to IO panel, input/output power of SMPS and take necessary action as per job requirement **P6.** Check the conditions of breakers and fuses and take necessary action as per the job requirement

Knowledge and Understanding:

- Describe the Safety aspects to be inbuilt in the control panel system as per the process requirement
- Define IEC standards
- Define Relevant regulations, standards and codes of practice and their implications on the panel
- What are the safety norms in handling electrical/electronic components?

- Describe the Operation of PLCs, relays, contactors, circuit breakers, solenoids, actuators, controllers etc.
- Describe the various tools used during the installation process
- How to troubleshoot Frequently occurring errors, causes and preventive measures
- Describe the procedure followed for repairing/replacement of various components in a PLC

Tools and Equipment

SN	Tools
1	Charts
2	Psychometrics Chart, Tables, and Other References
3	Anemometer
4	Tachometer
5	Data logger
6	Electronic Hygrometer
7	MultiMate
8	Electronic Pressure Gauge
9	Protective gear such as helmets, goggles, gloves, rubber shoes, etc.
10	International Safety Standards
11	Calculator
12	Clipboard
13	Flashlight
14	Tool box
15	Budget She
16	Psychometrics Chart, Tables, and Other References
17	Protective gear such as helmets, goggles, gloves, rubber shoes, etc.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard**:** Carry out maintenance of PLC.

0713E&E125 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 analog 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	**P1.** Connect the telephone set to telephone line. **P2.** Dial the telephone No. which is connected to line, form any

Telephone buzzer	mobile/telephone. **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 pad dialer on the telephone set. **P3.** Press different numbers from key pad dialer. **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?

Tools 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**:** Identify the parts of digital dial & verify its function.

0713E&E126 Carry Out Modulation, 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 $$USB = f_c + f_m \quad , \quad LSB = f_c - f_m$$
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 and De-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. **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

Tools 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**:**

Calculate band width and modulation index

0713E&E127 Install Cord Less Telephone, PABX & Satellite Dish System.

Overview:

This competency standard covers the skills and knowledge required toInstall cord less telephone system, Install and Configure of Private Automatic Branch Exchange (PABX) and Install Home satellite dish system.

Competency Units	Performance Criteria
CU1. Install cord less telephone system.	**P1.** Chose proper location to install the base station **P2.** Connect the phone line to the base the base station of cord less telephone. **P3.** Connect the supply to the base station. **P4.** Pic-up the Mobile unit from cordless telephone and make a call to ensure the working functionality.
CU2. Install and Configure 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. **P7.** 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
CU3. Install Home satellite dish	**P1.** Perform dish assembly as per SOP **P2.** Perform dish installation on roof top as per SOP.

system.	**P3.** Route coaxial cable and connect dish receiver to dish antenna. **P4.** Connect dish receiver output to TV receiver input. **P5.** Turn on the supply of both receivers, enter the frequency of required channel. **P6.** Adjust the antenna with the help of satellite locator chart till required channel is observed on TV screen.

Knowledge & Understanding

- Function and operating procedure of cordless telephone.
- Installing RJ-11 Connectors on cable.
- Function and operating procedure
- of PABX
- Function & operating procedure of satellite
- dish system

Tools and Equipment

SN	Tools
1	Cordless telephone
2	Telephone wire
3	Supply
4	Installation kit.
5	Telephone Sets
6	PBX
7	Coaxial cable.
8	Dish antenna
9	Dish receiver
10	RJ-11 Connectors
11	Knife Installation kit
12	2-Pair Cable
13	Crimping Tool
14	TV receiver

Critical Evidence(s) Required

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

Install and Configure of Private Automatic Branch Exchange (PABX)

0713E&E128 Install Power Supply

Overview:

This competency standard covers the skills and knowledge required to Construct full wave rectifier/Bridge Rectifier, Construct filtered power supply, Construct Zener diode regulated power supply, Installation and Commissioning of Telecom Rectifier /UPS system, Installation of Valve Regulated Lead Acid Battery (VRLA) / Sealed Lead Acid Batteries (SLA) for Telecom Equipment, conduct different Tests of VRLA/SLA Battery and Perform Maintenance of Valve regulated lead Acid Battery

Competency Units	Performance Criteria
CU.1 Construct full wave rectifier/Bridge Rectifier.	**P1.** Identify the Diodes and center 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
CU.2 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.
CU.3 Construct Zener diode regulated power supply	**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. **P7.** Measure and Note the results
CU.4 Installation and Commissioning of Telecom Rectifier /UPS system.	**P1.** Installation of Rectifier/ UPS Cabinet as per Design. **P2.** Connect AC supply with Rectifiers from main distribution board (MDB). **P3.** Connect surge protection device (SPD) with rectifiers. **P4.** Connect with DC as per requirement. **P5.** Perform rectifier system commissioning. **P6.** Perform boost charging setting of batteries. **P7.** Perform AC over voltage setting. **P8.** Perform AC under voltage setting. **P8.** Perform DC under voltage setting.
CU.5 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.
CU.6 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.
CU.7 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. **P10.** Measure and record AC ripple current and/or voltage imposed on the battery

Knowledge & Understanding

- Knowledge about Centre tape transformers
- Knowledge about working center tape transformer. Find input and output windings.
- Knowledge about Working of Full wave rectifier.
- Knowledge about Input and
- Output wave forms of full wave rectifier.
- Knowledge about Diodes, filters and transformer.
- Knowledge about working of diodes, filters and transformers.
- Knowledge about Use of resistor and capacitor as filter.
- Knowledge about Filter power supply working and applications.
- Knowledge about Ripple. Ripple factor.
- Knowledge about Input and output voltage levels. Wave forms.
- Knowledge about the difference between filter and simple power supply.
- Knowledge about the Working principle and use of Zener Diodes.
- Knowledge about Zener Diode Regulated Power Supplies.
- Regulation Methods
- Knowledge about Zener Regulated power supply working and applications.
- Knowledge about Input and output voltage levels.
- Knowledge about the Line regulation and load regulation
- Knowledge about Rectifier working.
- Knowledge about rectifier input and output power connections.
- Knowledge about SPD connection with rectifier.

- Knowledge about commissioning of rectifier system.
- Knowledge about boost charging, under and over AC voltage setting.
- Knowledge about Valve regulated batteries.
- Knowledge about installation of VRLA batteries
- Knowledge about battery connection
- Knowledge about Inter Row, Inter Rack, Inter battery String Connections.
- Knowledge about battery rack installation.
- Knowledge about the battery charger/ load.
- Knowledge about battery Performance test
- Knowledge about battery without load and on load test.
- Knowledge about Battery resistance/conductance/impedance.
- Knowledge about battery maintenance.
- Knowledge about ambient temperature, ventilation, float voltage, terminal corrosion, negative terminal temperature, battery resistance, Ripple current and voltage

Tools and Equipment

SN	Tools
1	Box end wrench, insulated
2	Electrical tool kit.
3	Multi Meter
4	Impedance Meter
5	Rubber gloves.
6	Battery lifting equipment (handles) and fork lift to lift pallets of batteries.
7	Box end wrench, insulated.
8	Torque wrench calibrated in inch-pounds, insulated.
9	Socket wrench, insulated.
10	Diodes
11	Transformers
12	Power Supply
13	Trainer
14	Digital Oscilloscope
15	Multi meter
16	Connecting wire

17	Zener Diodes
18	Power Supply
19	Diodes
20	Resistors
21	Transformer
22	Complete Electrical Toolkit
23	Toolkit of spanners and wrenches
24	Digital voltmeter.
25	RCL Meter

Critical Evidence(s) Required

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

Perform Maintenance of Valve regulated lead Acid Battery.

0713E&E129 Maintain Lead Acid Batteries and Implement Their Series Parallel Combination.

Overview:

This competency standard covers the skills and knowledge required to construct series combination of batteries, Construct Parallel combination of batteries, Prepare Electrolyte for battery, check specific gravity of Electrolyte, determine internal resistance of cell, and Charge the battery with the help Charger.

Competency Units	Performance Criteria
CU1. Construct series combination of batteries.	**P1.** Select the specific quantity cells. **P2.** Connect them in series with proper polarity. **P3.** Measure the voltage of series combined cell. **P4.** Increase the number of cells and note the voltage. **P5.** Interpret the effect.
CU2. Construct Parallel combination of batteries.	**P1.** Select the specific quantity cells. **P2.** Connect them in parallel with proper polarity. **P3.** Measure the voltage of parallel combined cell. **P4.** Increase the number of cells and note the voltage. **P5.** Interpret the effect.
CU3. Prepare Electrolyte for battery	**P1.** Select the proper container & and use proper safety equipment to prepare electrolyte **P2.** Pour H_2SO4 in the container as per specification. **P3.** Put the water as per specification into the container and slowly **P4.** Mix the mixture with wooden/glass rod so that two solutions mix completely.
CU4. Check specific gravity of Electrolyte.	**P1.** Open the vent plug of battery **P2.** Fill the hydrometer with electrolyte **P3.** Keep the hydrometer vertical and take reading form hydrometer
CU5. Determine internal resistance of cell	**P1.** Adjust the apparatus as per diagram. **P2.** Turn the switch off and take the reading of voltmeter and note its value as “E”.

	P3. Turn on the switch and again take the reading of voltmeter and note its value as "V". **P4.** Note the reading of ammeter as well. **P5.** Use above measured values and find out internal resistance using appropriate formula.
CU6. Charge the battery with the help of Charger.	**P1.** Set proper voltage and current setting of charger. **P2.** Connect the battery at the output terminal of charger. **P3.** Turn on the supply and note the current reading of ammeter from charger. **P4.** Remain connect the battery with charger till the ammeter show minimum or zero reading. **P5.** Disconnect the battery and check its specific gravity with hydrometer

Knowledge & Understanding

- Define series combination of cell
- Define parallel combination of cell
- Define Electrolyte.
- Define specific gravity.
- What is hydrometer describe its use.
- What is the value of specific gravity of lead acid battery
- Define internal resistance of cell.
- What is the difference between "E" and "V" of cell?
- Enlist the parts of a charger.
- Describe the function of charger.
- Why ammeter shows minimum or zero reading at full charging.
- What is the specific gravity of battery at full charge condition

Tools and Equipment

SN	Tools
1	Connecting leads
2	Battery Charger
3	Ammeter
4	Battery
5	Voltmeter

6	Switch
7	Resistance
8	Ammeter
9	Cells
10	Container
11	Battery
12	Hydrometer
13	Water
14	Wooden/glass rod
15	Change over switch
16	Volt meter.
17	H_2SO4
18	Connecting leads.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard**:** Prepare Electrolyte for battery.

0713E&E130. Operate Hydro Power Plant

Overview

This competency standard covers the skills and knowledge required to Inspect Hydropower Plant equipment, operate plant equipment, respond to equipment emergencies and alarms, and perform maintenance activities and Generate Report. Operate and monitor plant generating equipment and take appropriate actions to ensure safe, efficient and reliable operation of the Hydropower plant.

Competency Units	Performance Criteria
CU1. Inspect Hydropower Plant equipment.	**P1.** Adopt health and safety measures, as per standards. **P2.** Identify Generator, Turbine and other Auxiliary equipment. **P3.** Identify Control Panel. **P4.** Identify measurement Gauges (Rpm meter, Pressure Gauges, Temperature Gauges and flow valves). **P5.** Monitor readings of gauges and meters regularly **P6.** Perform calibration check for scale accuracy. **P7.** Carryout Generator inspection including its bearing and lubrication. **P8.** Ensure that all sensors operate correctly. **P9.** Ensure that all controller functions correctly. **P10.** Carryout Turbine functional checks and bearing lubrication inspection. **P11.** Perform Gearbox bearing inspection and analyze oil condition. **P12.** Examine the sounds, smells and vibrations of equipment. **P13.** Report Problem (If any) and take appropriate preventive measures.

CU2. Operate plant equipment.	**P1.** Follow safety measures, as per standards. **P2.** Performs pre start Inspections. **P3.** Turn on Power switch of the equipment safely. **P4.** Conduct post startup inspection. **P5.** Turn OFF Power switch of the equipment safely. **P6.** Analyze its smooth and efficient operation **P7.** Generate a report of switching operations and loads on generators, electrical lines and transformers.
CU3.Respond to equipment emergencies and alarms.	**P1.** Identify emergency alarms and switches. **P2.** Response to alarm in emergency. **P3.** Turn OFF power in emergency. **P4.** Take timely corrective measures. **P5.** Turn ON power when fault is removed. **P6.** Use of fire extinguisher and emergency exit.
CU4.Perform maintenance activities.	**P1.** Follow safety measures, as per standards **P2.** Investigate malfunction in accordance with company policies and procedures **P3.** Identify nature of fault by carrying out various tests. **P4.** Carryout Electrical inspection and testing. **P5.** Perform Sensor replacement and calibration **P6.** Perform Controller optimization / reprogramming. **P7.** Carryout Internal (endoscopic) inspections of turbines and gearboxes **P8.** Carryout Hydraulic accumulator testing and recharging. **P9.** Test the equipment after it's repaired and ready to be placed back. **P10.** Generate a document and mention the fault and the measures taken, for future use.
CU5. Generate Report	**P1.** Follow safety measures, as per standards. **P2.** Generate Hydro system performance and operational reviews / optimization **P3.** Prepare Visit Report as per technical specifications of the plants

Knowledge and Understanding:

- Define Hydropower Plant.
- Selection of site
- Types of hydropower plant
- Describe the schematics diagrams and symbols used in a power plant.
- Describe parts
- Describe other types of Power Plant.
- Compare Hydropower plant with other power plants.
- Describe Control Gauges, Pressure Gauges, Temperature Gauges and Electric Meters and their various measuring units
- Turbine and Gearbox.
- Basic Knowledge of personal and industrial safety standards.
- Describe the steps of generating a report
- Define SCADA.
- Describe pre start Inspections.
- Describe Switching procedure of the equipment.
- Knowledge of high voltage switching and use of hot sticks substation components, and circuit breakers.
- Describe Purpose of safety alarms and Switches
- Define the procedure followed in emergency to shut down power and save life
- Describe the purpose of fire extinguisher and emergency exist and its use.
- Define maintenance procedure.
- Describe the basic tools used for repairing.
- Describe the maintenance areas.
- Describe the procedure of testing the equipment.
- Knowledge of the operation and service/maintenance manuals.
- Define a visit report.
- Describe the procedures involved in preparing a report.

Tools and Equipment

SN	Tools
1	Visit to Hydropower Plant
2	Tool Box

4	Emergency Switch
5	Fire Extinguisher
6	Safety helmet, gloves, goggles and shoes
8	Notepad
10	Visit Report

Critical Evidence(s) Required

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

Identify various plant equipment and define their purpose

0713E&E131 Operate Thermal Power Plant

Overview:

After this competency standard, the trainee will be able to Carry out General Inspection of the Thermal power plant, Operate Steam Turbine, Inspect and Monitor Boiler Operation, Inspect and Operate Ash handling plant, Inspect and Operate Coal Handling plant, Respond to equipment emergencies and alarms, Perform maintenance activities and Generate Report operate and monitor plant generating equipment and take appropriate actions to ensure safe, efficient and reliable operation of the Thermal Power Plant.

Competency Units	Performance Criteria
CU1.Carry out General Inspection of the Thermal power plant	**P1.** Adopt health and safety measures, as per standards. **P2.** Identify boiler, turbine, alternator or generator, condenser and feed pump and other auxiliary equipment. **P3.** Recognize different major areas in thermal power plant. Boiler, Turbine, Ash handling, and Coal Handling **P4.** Identify Control Panel. **P5.** Identify measurement Gauges (Pressure Gauges, Temperature Gauges, vacuum gauge and flow gauge). **P6.** Monitor readings of gauges and meters regularly **P7.** Check the scale accuracy of meters. **P8.** Examine the sounds, smells and vibrations of equipment. **P9.** Report Problem (If any) and take appropriate preventive measures.
CU2. Operate Steam Turbine	**P1.** Implement the Controls for identified hazards and potential hazards in work area consistent with appropriate standards **P2.** Confirm the Availability of quality steam from upstream provider **P3.** Perform Pre-operational safety checks of steam turbine **P4.** Perform Start-up checks upon ancillary plant **P5.** Start the Steam turbine and placed on line safely, according to procedures, including performance of start-

	up checks **P6.** Monitor Steam turbine according to required procedures, including performing of operational checks and fault finding **P7.** Follow energy isolation procedures **P8.** Routine shutdown of steam turbine is performed according to operational and manufacturer s requirements and procedures, including performing shutdown checks **P9.** Generate a report of switching operations and loads on generators, electrical lines and transformers.
CU3.Inspect and Monitor Boiler Operation	**P1.** Follow safety measures, as per standards. **P2.** Check production requirements at start of shift and plan to carry out daily work activities following workplace health and safety and standard operating procedures (SOP) **P3.** Confirm operational status by inspection and routine observation **P4.** Adjust boiler controls to maintain operation within specifications **P5.** Monitor and record temperature controller display **P6.** Monitor and maintain steam pressure and steam distribution systems to meet production requirements **P7.** Complete routine preventative maintenance in line with maintenance schedules
CU4. Inspect and Operate Ash handling plant.	**P1.** Follow safety measures, as per standards. **P2.** Monitor vacuum levels, vacuum leakage, checking of hopper (empty, partially full, full) and clearing of choked. **P3.** Start and stop pumps, line up discharge lines, change over pumps **P4.** Operate pumps for series and parallel operations **P5.** Operate ash evacuation vacuum pumps **P6.** Operate dry ash loading plant for dust collection. **P7.** Handle operations of bottom ash handling equipment such as scrapper **P8.** Ensure smooth working of conveyor, clinker grinder, their line-up and change over identifying normal defects etc.

	P9. Continuously monitor and inspect ash handling equipment before and during operations
CU5.Inspect and Operate Coal Handling plant	**P1.** Follow safety measures, as per standards. **P2.** Operate the safety equipment/instruments installed in the unloading plant **P3.** Manage coal handling plant right from arrival of wagon, unloading and transportation to appropriate locations. **P4.** Ensure proper electrical operations of equipment such as conveyors, crushers, dozers and loaders **P5.** Operate coal sampler **P6.** Ensure removal of unwanted particulates from coal
CU6. Respond to equipment emergencies and alarms.	**P1.** Identify emergency alarms and switches. **P2.** Response to alarm in emergency. **P3.** Turn OFF power in emergency. **P4.** Take timely corrective measures. **P5.** Turn ON power when fault is removed. **P6.** Use of fire extinguisher and emergency exit.
CU7. Perform maintenance activities.	**P1.** Follow safety measures, as per standards **P2.** Investigate malfunction in accordance with company policies and procedures **P3.** Identify nature of fault. **P4.** Identify correct tool for repairing. **P5.** Inform higher authority for major fault (on time) **P6.** Test the equipment after it's repaired and ready to be placed back. **P7.** Generate a document and mention the fault and the measures taken, for future use.
CU8. Generate Report	**P1.** Follow safety measures, as per standards. **P2.** Prepare Visit Report as per technical specifications of the plants

Knowledge and Understanding:

- Define Thermal Power Plant.
- Describe other types of Power Plant.
- Compare Thermal Power Plant with other generation plants.

- Describe Control Gauges, Pressure Gauges, Temperature Gauges and Electric Meters.
- Define SCADA.
- Describe the schematics diagrams and symbols used in a power plant.
- Selection of site
- Basic Knowledge of personal and industrial safety standards
- Define Steam Turbine.
- Describe pre start Inspections.
- Describe Switching procedure of the equipment.
- Knowledge of upstream and downstream.
- Knowledge of high voltage switching and use of hot sticks substation components, and circuit breakers.
- Describe the Boiler Operation.
- What are the major Inspections being carried out in a Boiler Operation?
- Describe the Occupational Health and Safety standards.
- Describe the types of maintenances.
- What parameters are required for the smooth operation of the plant?
- Describe the Ash Handling Plant.
- What are the major operations being carried out in an ash handling plant?
- What are the inspection methods in an ash handling plant?
- Describe the Coal Handling Plant.
- What are the major operations being carried out in a coal handling plant?
- What are the inspection methods in a coal handling plant?
- What parameters are required for the smooth operation of the plant?
- Describe Purpose of safety alarms and Switches
- Define the procedure followed in emergency to shut down power and save life
- Describe the purpose of fire extinguisher and emergency exist and its use
- Define maintenance procedure.
- Describe the basic tools used for repairing.
- Describe the maintenance areas.
- Define a visit report.

Tools and Equipment

SN	Tools
1	Visit to Thermal Power Plant
2	Fire Extinguisher
3	Emergency Switch
4	Visit to Ash handling plant
5	Safety helmet, gloves, goggles and shoes
6	Tool Box
7	Notepad
8	Report

Critical Evidence(s) Required

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

Identify various plant equipment and define their purpose

0713E&E132 Operate Diesel Power Plant

Overview:

This competency standard covers the skills and knowledge required to inspect plant equipment, operate plant equipment, respond to equipment emergencies and alarms, and perform maintenance activities and Generate Report. Operate and monitor plant generating equipment and take appropriate actions to ensure safe, efficient and reliable operation of the Diesel power plant.

Competency Units	Performance Criteria
CU1. Inspect plant equipment.	**P1.** Adopt health and safety measures, as per standards. **P2.** Identify Generator, Boiler, and Turbine and other Auxiliary equipment. **P3.** Identify Control Panel. **P4.** Identify measurement Gauges (Pressure Gauges, Temperature Gauges and flow valves). **P5.** Ensure that the fuel oil system is activated **P6.** Monitor and maintain the pre heating and pressure as per requirement. **P7.** Ensure that the lube oil system is activated and is operational. **P8.** Make sure that the pre lube pump has been in operation for at least 15 min's. **P9.** Activate the engine air system is activated. **P10.** Ensure that the charge air system and exhaust gas system are activated **P11.** Monitor and maintain the temperature of the cooling system. **P12.** Examine the sounds, smells and vibrations of equipment. **P13.** Report Problem (If any) and take appropriate preventive measures.

CU2. Operate plant equipment.	**P1.** Follow safety measures, as per standards. **P2.** Ensure all the responsibilities related to start and stop of the plant. **P3.** Communicate with relevant authority for regulating power evacuation to the grid. **P4.** Co-ordinate with local 220kv /110 kv substations for load monitoring. **P5.** Monitor plant parameters and take corrective action. **P6.** Ensure data logging and operational schedules. **P7.** Assist the HOD in maintaining the all relevant documents **P8.** Analyze its smooth and efficient operation **P9.** Generate a report of switching operations and loads on generators, electrical lines and transformers. **P10.** Start and stop the equipment as per the instruction of control room. **P11.** Monitor the parameters periodically and observe gauges and leakages.
CU3. Respond to equipment emergencies and alarms.	**P1.** Identify emergency alarms and switches. **P2.** Response to alarm in emergency. **P3.** Turn OFF power in emergency. **P4.** Take timely corrective measures. **P5.** Turn ON power when fault is removed. **P6.** Use of fire extinguisher and emergency exit.
CU4. Perform maintenance activities.	**P1.** Follow safety measures, as per standards **P2.** Carryout scheduled operational/ maintenance activities as per the instruction **P3.** Investigate malfunction in accordance with company policies and procedures **P4.** Identify nature of fault. **P5.** Identify correct tool for repairing. **P6.** Inform higher authority for major fault (on time) **P7.** Test the equipment after it's repaired and ready to be placed back. **P8.** Generate a document and mention the fault and the

	measures taken, for future use.
CU5. Generate Report	**P1.** Follow safety measures, as per standards. **P2.** Prepare Visit Report as per technical specifications of the plants

Knowledge and Understanding:

- Define Diesel Power Plant.
- Describe other types of Power Plant.
- Compare Diesel power plants with other generation plants.
- Describe Control Gauges, Pressure Gauges, Temperature Gauges and Electric Meters.
- Describe the schematics diagrams and symbols used in a power plant.
- .Basic Knowledge of personal and industrial safety standards
- Describe pre start Inspections.
- Describe Switching procedure of the equipment.
- Knowledge of schematics and diagrams and symbols.
- Knowledge of high voltage switching and use of hot sticks substation components, and circuit breakers.
- Basic Knowledge of personal and industrial safety standards.
- Describe Purpose of safety alarms and Switches
- Define the procedure followed in emergency to shut down power and save life
- Describe the purpose of fire extinguisher and emergency exist and its use.
- Define maintenance procedure.
- Describe the basic tools used for repairing.
- Describe the maintenance areas.
- Describe the procedure of testing the equipment.
- Define a visit report

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Tools and Equipment

SN	Tools
1	Visit to Thermal Power Plant
2	Fire Extinguisher
3	Emergency Switch
4	Visit to Ash handling plant
5	Safety helmet, gloves, goggles and shoes
6	Tool Box
7	Visit to Power Plant.
8	Notepad

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard**:** Identify various plant equipment and define their purpose

0713E&E133 Operate Nuclear Power Plant

Overview:

After this competency standard, the trainee will be able to operate and monitor plant generating equipment and take appropriate actions to ensure safe, efficient and reliable operation of the Nuclear Power Plant.

Competency Units	Performance Criteria
CU1. Carry out General Inspection of the equipment in Nuclear Power Plant	**P1.** Adopt health and safety measures, as per standards. **P2.** Identify Nuclear reactor, Steam turbine, Generator, Cooling system, Safety valves, Main condenser, Feed water pump, Emergency power supply **P3.** Recognize different major areas in nuclear power plant(Reactor vessels, Turbine/Generator, fuel waste handling, Cooling tower) **P4.** Identify Control Panel. **P5.** Identify measurement Gauges (Pressure Gauges, Temperature Gauges, vacuum gauge and flow gauge). **P6.** Monitor readings of gauges and meters regularly **P7.** Examine the sounds, smells and vibrations of equipment. **P8.** Report Problem (If any) and take appropriate preventive measures.
CU2. Operate Nuclear Reactor	**P1.** Ensure the continuous supply of the fuel in Control reactor **P2.** Confirm the Availability of quality steam from upstream provider **P3.** Perform Pre-operational safety checks of steam turbine **P4.** Perform Start-up checks upon ancillary plant **P5.** Start the Steam turbine and placed on line safely, according to procedures, including performance of start-up checks **P6.** Monitor the equipment according to required procedures, including performing of operational checks and fault finding. **P7.** Generate a report of switching operations and loads on generators, electrical lines and transformers.

CU3.Inspect and Monitor Water Cooling System in Nuclear Power Plant	**P1.** Follow safety measures, as per standards. **P2.** Confirm operational status by inspection and routine observation **P3.** Monitor and record temperature/pressure controller display **P4.** Monitor and maintain steam pressure and steam distribution systems to meet production requirements **P5.** Ensure proper cooling operation. **P6.** Complete routine preventative maintenance in line with maintenance schedules
CU4. Inspect Emergency power supply	**P1.** Follow safety measures, as per standards. **P2.** Inspect the Emergency transformers and generators **P3.** Ensure at least two distinct sources of offsite power for redundancy **P4.** Generate a report of backup emergency supply.
CU5. Generate Report	**P1.** Follow safety measures, as per standards. **P2.** Prepare Visit Report as per technical specifications of the plants

Knowledge and Understanding:

- Define Nuclear Power Plant.
- Selection of site
- Schematic diagram
- Reactor and other main parts
- Discuss the fuels used in Nuclear power plant and its half-life.
- Describe chain reactions.
- Describe other types of Power Plant.
- Compare Nuclear Power Plant with other generation plants.
- Waste handling, cooling tower.
- Describe pre start Inspections.
- Describe Switching procedure of the equipment.
- Knowledge of upstream and downstream.
- Knowledge of high voltage switching and use of hot sticks substation components, and circuit breakers.
- personal and industrial safety standards
- Describe the Water Cooling System.
- What are the major Inspections being carried out in a Water Cooling System?

- Describe the Occupational Health and Safety standards.
- What parameters are required for the smooth operation for the cooling system?
- Describe the Emergency power
- supply
- What are the inspection methods in Emergency power supply
- What parameters are required for the smooth operation of the plant
- Define a visit report.
- Describe the procedures involved in preparing a report

Tools and Equipment

SN	Tools
1	Visit to Nuclear Power Plant
2	Fire Extinguisher
3	Emergency Switch
4	Visit to Ash handling plant
5	Safety helmet, gloves, goggles and shoes
6	Tool Box
7	Notepad

Critical Evidence(s) Required

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

Identify various plant equipment and define their purpose.

0713E&E134 Design Solar System.

Overview:

This competency standard covers the skills and knowledge required toEnsure Personal safety, calculate load for solar PV system design, Plan for installation of solar panel, Install the solar panel, Install the solar panel, perform testing and Diagnose and remove the fault. Carry out electrical operations, including installation and commissioning of off-grid solar PV systems. In addition, they will be able to**:** Plan and prepare for installation; mount a photovoltaic array on a roof; install and commission solar photovoltaic array; carry out maintenance on off-grid solar PV system; and complete work.

Competency Units	Performance Criteria
CU1.Ensure Personal safety	**P1.** Arrange PPEs as per requirements **P2.** Wear proper PPE as per nature of job **P3.** Store PPEs at appropriate place after use **P4.** Ensure availability of first aid box
CU2.Calculate load for solar PV system design	**P1.** Enlist the No. of appliances to be operated **P2.** Calculate the PV system load **P3.** Record the PV system load.
CU3.Plan for installation of solar panel	**P1.** Identify and obtain safety and other regulatory requirements for installation **P2.** Choose suitable location for the PV array and other components **P3.** Obtain tools, equipment and testing devices **P4.** Specify installation requirements for all system components to ensure correct operation, long life, safety and ease of Maintenance
CU4. Install the solar panel frame	**P1.** Interpret and confirm installation in terms of roof construction and suitable mounting methods **P2.** Choose appropriate array frame for the roof type and determine and set correct tilt angle adjustments **P3.** Ensure the frame is properly fitted, eliminating vibration in

	the frame **P4.** Place flashing and other waterproofing measures.
CU5.Install the solar panel	**P1.** Install system components in suitable location **P2.** Connect PV panels and electrical components and minimize cable route length to minimize power loss **P3.** Perform Earthling **P4.** Make connections of wires **P5.** Confirm installation
CU6.Perform testing	**P1.** Test and adjust component and/or parts **P2.** Confirm operation of PV system **P3.** Check the voltage and current at receiver end.
CU7.Diagnose and remove the fault	**P1.** Check invertor for fault code **P2.** Verify safety circuits **P3.** Check status of wiring **P4.** Verify status of battery **P5.** Check status of PV Panels **P6.** Identify nature of the fault (if any) **P7.** Remove the fault

Knowledge and Understanding:

- How to wear Personal Protective Equipment (PPE
- How to measure voltage and current by digital multi-meter?
- Basic knowledge of load calculation
- Basic knowledge of AC/DC operations
- Safety requirements; Specifications; Hazard identification
- Factors influencing the efficiency of solar panels; Physical structure
- Summer and winter requirements
- Aesthetical aspects
- Roof constructions
- Azimuth inclination
- Relation of sun rays to a tilted surface
- Fixing methods and waterproofing measure
- Installation requirements
- Series and parallel circuit setup; Cable sizing; Forward and reverse diodes

- Requirements for properly bonded earthling
- Supervisor and/or client communication
- How to connect proper wire by connector.
- Functional tests and adjustments of instrument.
- Basic knowledge and
- calculation of open circuit voltage, on load voltage, short circuit current, maximum current load; Basic function of relay change over
- Basic operation of PV system and settings to adjust performance
- How to diagnose the fault?
- How to check wiring status?
- Method of verifying the status of battery

Tools and Equipment

SN	Tools
1	First Aid box
2	Bench vice
3	Hand drill machine
4	Battery charger
5	Ceiling
6	Batteries
7	AVO meter analog
8	AVO meter digital
9	Amp meter
10	Multi-meter
11	Personal protective equipment
12	First aid box
14	Calculator
15	Blank paper

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard**:** Install Solar Panel.

0713E&E135 Operate Solar Power Plant

Overview:

This competency standard covers the skills and knowledge required toCarry out General Inspection of the power plant, Operate Solar plant equipment, respond to equipment emergencies and alarms, perform maintenance activities and Generate Report. Operate and monitor plant generating equipment and take appropriate actions to ensure safe, efficient and reliable operation of the Solar Power Plant.

Competency Units	Performance Criteria
CU1. Carry out General Inspection of the power plant	**P1.** Adopt health and safety measures, as per standards. **P2.** Identify PV Cells, Inverter Batteries, Circuits and other Auxiliary equipment. **P3.** Ensure the PV cells are clean and placed at a maximum absorption position. **P4.** Identify Control and Switching Panel. **P5.** Identify voltage meter, load indicator, battery gravity indicator, charging/discharging meter. **P6.** Monitor readings of indicator gauges and meters regularly **P7.** Perform calibration check for scale accuracy. **P8.** Examine the sounds, smells and vibrations of equipment. **P9.** Report Problem (If any) and take appropriate preventive measures.
CU2. Operate Solar plant equipment.	**P1.** Follow safety measures, as per standards. **P2.** Perform switching as per requirement **P3.** Carry out shifting of the load according to the load management requirement at the time of peak load and base load. **P4.** Switch to alternative source during unfavorable weather conditions. **P5.** Analyze its smooth and efficient operation **P6.** Generate a report of switching operations and loads on generators, electrical lines and transformers.

CU3. Respond to equipment emergencies and alarms.	**P1.** Identify emergency alarms and switches. **P2.** Response to alarm in emergency. **P3.** Turn OFF power in emergency. **P4.** Take timely corrective measures. **P5.** Turn ON power when fault is removed. **P6.** Use of fire extinguisher and emergency exit.
CU4. Perform maintenance activities.	**P1.** Follow safety measures, as per standards **P2.** Investigate malfunction in accordance with company policies and procedures **P3.** Identify nature of fault. **P4.** Check the charging and gravity level of the battery **P5.** Ensure there is no breakage in the circuit. **P6.** Ensure that the PV cells are clean. **P7.** Inform higher authority for major fault (on time) **P8.** Test the equipment after it's repaired and ready to be placed back. **P9.** Generate a document and mention the fault and the measures taken, for future use.
CU5. Generate Report	**P1.** Follow safety measures, as per standards. **P2.** Prepare Visit Report as per technical specifications of the plants

Knowledge and Understanding:

- Define Solar Power Plant.
- Describe other types of Power Plant.
- Describe the role of PV Cells, Inverter Batteries, Circuit
- Describe the schematics diagrams and symbols used in a power plant.
- Basic Knowledge of personal and industrial safety standards.
- Describe pre start Inspections.
- Describe Switching procedure of the load.
- Knowledge of schematics and diagrams and symbols.
- Basic Knowledge of personal and industrial safety standards.
- Describe Purpose of safety alarms and Switches
- Life & efficiency

- Describe the purpose of fire extinguisher and emergency exist and its use.
- Define maintenance procedure.
- Describe the basic tools used for repairing.
- Describe the maintenance areas.
- Describe the procedure of testing the equipment.
- Define a visit report.

Tools and Equipment

SN	Tools
1	Visit to solar Power Plant
2	Fire Extinguisher
3	Emergency Switch
4	Safety helmet, gloves, goggles and shoes
5	Tool Box
6	Notepad

Critical Evidence(s) Required

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

Identify various plant equipment and define their purpose

0713E&E136 Operate Wind Power Plant

Overview:

This competency standard covers the skills and knowledge required to inspect plant equipment, operate plant equipment, respond to equipment emergencies and alarms, and perform maintenance activities and Generate Report. Operate and monitor plant generating equipment and take appropriate actions to ensure safe, efficient and reliable operation of the Wind power plant.

Competency Units	Performance Criteria
CU1. Inspect plant equipment.	**P1.** Adopt health and safety measures, as per standards. **P2.** Identify Generator, Turbine, Blades, Gearbox, transformer, transmission lines and other Auxiliary equipment. **P3.** Identify the type of Generator. **P4.** Monitor the speed of turbine at regular intervals. **P5.** Identify Control Panel and remote monitoring system. **P6.** Monitor readings of gauges and meters regularly **P7.** Perform calibration check for scale accuracy. **P8.** Examine the sounds, smells and vibrations of equipment. **P9.** Report Problem (If any) and take appropriate preventive measures.
CU2. Operate plant equipment.	**P1.** Follow safety measures, as per standards. **P2.** Perform switching as per requirement **P3.** Carry out shifting of the load according to the load management requirement at the time of peak load and base load. **P4.** Switch to alternative source during unfavorable weather conditions. **P5.** Analyze its smooth and efficient operation **P6.** Generate a report of switching operations and loads on generators, electrical lines and transformers.
CU3. Respond to equipment	**P1.** Identify emergency alarms and switches. **P2.** Response to alarm in emergency.

emergencies and alarms.	**P3.** Turn OFF power in emergency. **P4.** Take timely corrective measures. **P5.** Turn ON power when fault is removed. **P6.** Use of fire extinguisher and emergency exit.
CU4. Perform maintenance activities.	**P1.** Follow safety measures, as per standards **P2.** Investigate malfunction in accordance with company policies and procedures **P3.** Inspect the wind turbine periodically. **P4.** Monitor through SCADA and trace the fault. **P5.** Check and remove Operational errors (such as yaw error, pitching errors, excessive vibrations etc.) **P6.** Check and remove human based error **P7.** Carry out Routine checkups **P8.** Carry out Periodic Maintenance **P9.** Perform higher voltage equipment maintenance. **P10.** Determine the nature of the fault. **P11.** Identify correct tool for repairing. **P12.** Inform higher authority for major fault (on time) **P13.** Test the equipment after it's repaired and ready to be placed back. **P14.** Generate a document and mention the fault and the measures taken, for future use.
CU5. Generate Report	**P1.** Follow safety measures, as per standards. **P2.** Prepare Visit Report as per technical specifications of the plants

Knowledge and Understanding:

- Define Wind Power Plant.
- Describe types of Power Plant.
- Compare the Wind power plant with other generation plants
- Describe the role of Generator, Turbine, Blades, Gearbox, transformer, transmission lines and other Auxiliary equipment.
- Describe the schematics diagrams and symbols used in a power plant.

- Basic Knowledge of personal and industrial safety standards
- Define SCADA
- Describe pre start Inspections.
- Describe Switching procedure of the equipment.
- Knowledge of schematics and diagrams and symbols.
- Knowledge of high voltage switching and use of hot sticks substation components, and circuit breakers.
- Describe Purpose of safety alarms and Switches
- Define the procedure followed in emergency to shut down power and save life
- Describe the purpose of fire extinguisher and emergency exist and its use.
- Define maintenance procedure.
- Describe the basic tools used for repairing.
- Describe the maintenance areas.
- Describe the procedure of testing the equipment.
- Define a visit report.

Tools and Equipment

SN	Tools
1	Visit to wind Power Plant
2	Fire Extinguisher
3	Emergency Switch
4	Safety helmet, gloves, goggles and shoes
5	Tool Box
6	Notepad

Critical Evidence(s) Required

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

Identify various plant equipment and define their purpose

0713E&E137 Utilize Electrical Energy in Building

Overview:

This competency standard covers the skills and knowledge required to specify the requirements and characteristics of electrical heating systems specify the requirements and characteristics of lighting systems and specifies the requirements and characteristics of ventilation and air-conditioning systems. Gain knowledge and develop competence related to the specification of services required for the utilization of electrical energy in buildings. The unit provides candidates with the opportunity to understand the concepts of heating, lighting, ventilation and air-conditioning systems and to develop the skills necessary to solve and design problems on these systems.

Competency Units	Performance Criteria
CU1. Specify the requirements and characteristics of electrical heating systems.	**P1.** Calculate specific heat capacity. **P2.** Calculate conduction heat loss through building **P3.** Calculate radiation heat loss through building **P4.** Choose the appliance with the ratings based on calculations.
CU2. Specify the requirements and characteristics of lighting systems.	**P1.** Calculate room index. **P2.** Calculate maintenance factor **P3.** Calculate Utilization Factor **P4.** Calculate space to height ratio **P5.** Select the quantity of illumination sources and their power accordingly.
CU3.Specify the requirements and characteristics of ventilation and air-conditioning systems.	**P1.** Determine thermal comfort level, using psychometric charts **P2.** Calculate heat loss through building **P3.** Identify the type of ventilation system (Natural or Mechanical) **P4.** Select ventilation and air-conditioning system according to given specifications

Knowledge and Understanding:

- Describe the term 'heat transfer'
- Describe conduction, convection and radiation
- Define Formula for calculating loss through conduction, convection and radiation
- Understanding of basic characteristics of space heating appliances
- Selection of space heating appliances to meet specific application
- Understands basic formula of room index (R.I) =(l*b)/hawk(l+b)
- M.F = (lumen output of lamp after sometimes)/ (lumen output of lamp after new)
    - Typical used values**:**
    - 0.8 – For offices/classroom
    - 0.7 – For clean Industry
    - 0.6 – For dirty Industry
- Describe Utilization factor (i.e. the ratio of effective luminous flux to the total luminous flux of light sources)
- Understands that height ration is the ratio of distance between adjacent luminaires (center to center) to their height above the working plane.
- Define Power.
- Define Thermal Comfort level
- Knowledge of reading psychometric chart
- Describe Reasons for heat loss in buildings
- Natural and mechanical ventilation systems
- Differentiate between ventilation and air-conditioning
- Define Humidifiers and de-humidifiers

Tools and Equipment

SN	Tools
1	Wiring
2	Psychometric chart
3	Calculator
4	Calculation Sheet
5	Visit to the site of installation (or reference location)
6	Measuring tape
7	Dimensions of the premises(already calculated by authorized person)

8	Owner manual of the appliance
9	Digital Thermometer
10	Lamps

Critical Evidence(s) Required

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

Specify the requirements and characteristics of lighting systems.

0713E&E138 Utilize Natural Energy in Building

Overview:

This competency standard covers the skills and knowledge required toDesign Natural lightning system, Design Natural Cooling and ventilation system and Design Natural heating system after this competency standard, the trainee will be able to develop knowledge and competence to utilize natural energy in efficient way for lighting, heating and cooling system. The unit provides candidates with the opportunity to create an eco-friendly building that not only benefits the consumer but helps in balancing the load on the national grid during power crises

Competency Units	Performance Criteria
CU1. Design Natural lightning system.	**P1.** Determine the direction of Sunrise and Sunset. **P2.** Choose the color scheme of the interior **P3.** Select the quality of glass for windows **P4.** Design a Sun tunnel (skylight) **P5.** Calculate the size of skylight for ceilings. **P6.** Select the reflectors wisely.
CU2. Design Natural Cooling and ventilation system	**P1.** Determine the direction of Air **P2.** Select the type of paint used for external walls and roof. **P3.** Identify the type of coating used for tilting glass of window. **P4.** Select the type of shades required to block heat **P5.** Locate the position for natural vent based on the phenomenon of conduction and convection **P6.** Identify the location for construction of water tanks **P7.** Determine the excessive heat producing sources **P8.** Select energy efficient devices for heating, lighting, cooling and home appliances. **P9.** Choose the Sun vent according to requirement of the premises. **P10.** Choose the cooling system from variety of Solar Powered Inverter AC/heating system.

CU3.Design Natural heating system	**P1.** Select the type of solar cell(heating) **P2.** Choose the angle of placing solar cell. **P3.** Identify the location for installation of solar tank. **P4.** Design a solar heating system. **P5.** Identify the location for Boiler. **P6.** Make suitable connections based on drawings. **P7.** Identify the place for blocking air inside room(airtight)

Knowledge and Understanding:

- Knowledge of using earth compass
- Describe the heat conduction and radiation properties of different colors.
- Describe the phenomenon of Skylight
- Describe the procedure adopted for the design of Sun Tunnel
- Define the properties of reflection Glass.
- Knowledge of using wind vane.
- Describe the properties of paints with respect to its heat conduction
- Define Geo-Thermal Energy
- Describe Reflective window coatings
- Describe the types of shades (indoor and outdoor)
- What are the advantages of using underground tanks over sun exposed tanks?
- Describe the advantage of LED over tungsten bulb
- Describe the phenomenon of Sun vent
- fans based on reliability and efficiency
- Define the natural heat sources.
- Define fossil fuels
- Explain the terms Solar Energy, Geothermal energy, biomass, fossil fuels.
- Explain ‘Greenhouse’ effect.
- Knowledge of drawing of the solar heating system.

Tools and Equipment

SN	Tools
1	Solar Cell
2	Boiler
3	Insulation film
4	Wind vane
5	Reflection glass
6	Skylight
7	Pipe like steel structure for construction of sun tunnel
8	Paint
9	Solar plate(Small)
10	Earth Compass
11	Glass for windows and entry sources
12	Sun Shades
13	Drawing sheet

Critical Evidence(s) Required

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

Design Natural lightning system.

0713E&E139 Calculate Tariffs and Economics

Overview:

This competency standard covers the skills and knowledge required to Calculate Tariff for Hyde Power Plant, Calculate Tariff for Solar Power Plant, Calculate Tariff for Thermal Power Plant and Comparative Analysis. After this competency standard, the trainee will be able to gain knowledge required to calculate tariffs of various power plants, their economy and merits/demerits.

Competency Units		Performance Criteria	
CU1.	Calculate Tariff for Hydro Power Plant	**P1.**	Determine factors influencing cost (Types of Load, Maximum demand, the power factor of the load as per Go tariff regulation).
		P2.	Check the latest Tariff (per unit cost), imposed by regulatory authority
		P3.	Calculate per unit cost of hydro power plant.
CU2.	Calculate Tariff for Solar Power Plant	**P1.**	Determine the efficiency of PV cell
		P2.	Calculate the per unit cost of Generation (neglecting losses)
CU3.	Calculate Tariff for Thermal Power Plant	**P1.**	Calculate the running cost of the plant
		P2.	Calculate the operational cost of the plant
		P3.	Calculate the per unit cost of Generation
CU4.	Comparative Analysis	**P1.**	Compare the efficiency of Hydel, Solar and Thermal Power Plant
		P2.	Compare the minimum and maximum generation capacity of Hydro, Solar and Thermal Power Plant
		P3.	Compare the per unit generation cost of Hydel, Solar and Thermal Power Plant
		P4.	Analyze sustainable and environment-friendly power generation system.

Knowledge and Understanding:

- Knowledge of searching the required statistics from the official reports.
- Describe power factor, types of load, maximum demand
- Describe Power Factor Improvement Methods
- Define Merits and Demerits of Hydro Power Plant
- Determine the factors effecting efficiency of PV Cell (15-19%)
- Performance ratio= Real energy yield/theoretical energy yield (in %)
- Real output=kWp*number of peak un hours*performance ratio=kWh
- Basic Power(P)=VI
- Formula for finding per unit cost
- Define the cost of operations in running cost of power plant

- thermal power plant
- Define the payback period
- Formula for finding per unit cost
- Describe the merits and demerits of thermal power plant
- Understands the term comparative analysis
- Knowledge of construction of flow charts and tables for analysis
- Efficient in calculations
- Describe the procedure of preparing a report based on final conclusion.

Tools and Equipment

SN	Tools
1	Internet
2	Calculator
3	Calculation Sheet

Critical Evidence(s) Required

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

Perform Comparative Analysis

0713E&E140 Carryout Transmission of Electrical Power

Overview:

This Competency standard deals with the skills and knowledge required to select the conductor for transmission line, sort different effects on Transmission lines during conduction, select the right insulator from different types according to the requirement, make foundation and erect poles and towers, perform stringing work and sag of transmission lines, install lightning arrester in a transmission system as per requirement.

Competency Units	Performance Criteria
CU1. Select the Conductor for Transmission line.	**P1.** Select the appropriate voltage level for transmission. **P2.** Select the conductor in accordance with current (A) value.
CU2. Sort different effects on transmission lines during conduction	**P1.** Verify Ferranti effect, Skin effect and corona effect. **P2.** Apply method to correct losses.
CU3. Select the right insulator from different types according to the requirement	**P1.** Select appropriate insulator according to utility. **P2.** Separate healthy, punctured and broken disk. **P3.** Calculate number of disks according to voltage level of transmission lines
CU4. Make Foundation and Erect poles and towers	**P1.** Select the foundation type according to the nature of soil. **P2.** Select the foundation type according to ground clearance and circuit requirement. **P3.** Supervise foundation and erection of tower.
CU5. Perform stringing work and sag of Transmission lines	**P1.** Calculate sag and bring it in accordance with clearance standards of WPADA/NTDCL. **P2.** Ensure to remove effects of wind and ice on Transmission Line. **P3.** Adjust sag according to present temperature.

CU6.	Install lightning arrester in a transmission system as per requirement	**P1.**	Select appropriate Lightening Arrestors for Substation/Grid station with respect to the current.
		P2.	Install the lightning arrestor.
		P3.	Carryout connections for grounding.

Knowledge & Understanding

- Describe the Current carrying capacity of different conductors
- Describe the benefits/cost of high voltage Transmission
- Define Ferranti effect
- Define Skin effect
- Define corona effect
- Define the types of insulator
- Define suspension type and string
- Define Cree page distance
- Define tower and pole type
- Define Foundation type
- Describe tower assembly
- Elaborate Standards for erection and foundation
- Define hazards and safety codes.
- Describe Sag calculation
- Explain Effect of weather condition on sag
- Explain Effect of sag on insulator assembly
- Define Lightning arrester with respect its types according to the
- Requirements.
- Define usage of Lightning Arrester
-

Tools and Equipment

SN	Tools
1	Lightning Arrester
2	Chain block
3	Temperature gage
4	Safety material
5	Theodolite

6	Torque
7	Dipole
8	Transmission system
9	Conductors.
	Insulators.
	Poles
	Crane

Critical Evidence(s) Required

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

As Instructed by the Teacher, in accordance with the available conditions.

0713E&E141 Carryout Distribution of Electrical Power

Overview:

This Competency standard deals with the skills and knowledge required to select he conductor for distribution of power, Improve the Power factor, Separate the correct insulator from different types according to the requirement, Make Foundation and Erect poles and structures, Supervise construction of Trenches Cable try and select appropriate cable, Perform stringing work and sag of distribution lines, Measure performance of distribution lines and take steps to improve Primary and secondary distribution, Install the equipment for grounding of Substation/Transmission lines, Select and justify the use of reactor in a system, Install Lightning Arrester in a Distribution system as per requirement, Install Lightning Arrester in a Distribution system as per requirement.

Competency Units	Performance Criteria
CU1. Select the Conductor for Distribution of power.	P1. Select the appropriate voltage level for Distribution. P2.Select the conductor in accordance with current (A) value.
CU2. Improve the Power factor	**P1.** Check the power factor. **P2.** Measure the difference between apparent power and real power. **P3.** Apply the appropriate method to improve power factor.
CU3. Select the correct insulator from different types according to the requirement	**P1.** Select appropriate insulator according to utility. **P2.** Separate healthy, broken and punctured disk. **P3.** Calculate number of disks according to voltage level of transmission lines
CU4. Make Foundation and Erect poles and structures	**P1.** Select foundation type according to the nature of soil. **P2.** Select the type according to ground clearance and circuit requirement. **P3.** Supervise foundation and erection of structures
CU5. Supervise construction of	**P1.** Choose the right cable among belted, screamed and pressure cable

Trenches ,Cable try and select appropriate cable	**P2.** Select and supervise appropriate trench among direct laying and draw solid system **P3.** Select appropriate Cable tray
CU6. Perform stringing work and sag of distribution lines	**P1.** Calculate sag and bring it in accordance with clearance standards of WPADA/NTDCL **P2.** Calculate effect of wind and ice on Distribution Line **P3.** Adjust sag according to current temperature
CU7. Measure performance of distribution lines and take steps to improve Primary and secondary distribution.	**P1.** Calculate the power losses. **P2.** The voltage drops on a reaction of line **P3.** Identify different methods to regulate the voltage and minimize the losses.
CU8. Install the equipment for grounding of Substation/Trans mission lines	**P1.** Carryout different types of grounding (Resistance, Reactance, solid) **P2.** Supervise the grounding in accordance with WAPDA Standards **P3.** Select appropriate copper conductor depending on the capacity of grid **P4.** Test the resistance of ground using Magger meter. **P5.** Carry out the jointing of copper conductor
CU9. Select and justify the use of reactor in a system	**P1.** Select the appropriate reactor among the generator reactor, feeder reactor, bas bar reactor depending on the short circuit current in a system **P2.** Carryout the appropriate location for installation of reactor
CU10. Install Lightning Arrester in a Distribution system as per requirement	**P1.** Select appropriate LA for Substation/Grid station with respect to the current **P2.** Carryout line connection

Knowledge & Understanding

- Describe the Current carrying capacity of different conductors.
- Explain the benefits/cost of high voltage Transmission
- Define the power Factor
- Define the types of insulator
- Define suspension type and string.
- Define Cree page distance.
- Define tower and pole type
- Define Foundation type
- Describe structure assembly
- Understand Standards
- Define hazards and follow safety codes
- Explain Cable sizing
- Describe Cable tray types
- Describe Trenches
- standards
- Explain Importance of insulation material for selection of appropriate cables
- Calculate Sag.
- Explain effect of weather condition on sag
- Explain effect of sag on insulator assembly
- Describe voltage drop, voltage regulation and power loses in a distribution system
- Explain the reasons of voltage drop on a line.
- Explain Concepts of grounding
- Describe Necessity of grounding
- Describe Types of grounding
- Describe Resistance Requirement for grounding
- Explain WAPDA standards
- Explain types and working principal of reactors.
- Explain Advantages and disadvantages of different types of reactors.
- Define Lightning arrester with respect it's types according to the requirements
- Define usage of Lightning Arrester

Tools and Equipment

SN	Tools
1	Distribution system
2	Power factor improvement panel
3	Voltmeter
4	Temperature gage
5	Chain block
6	Theodolite
7	Magger
8	Megger
9	Insulation tester
10	Earthling equipment
11	Insulators
12	Poles
13	Crane
14	Safety material

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard**:** Install Lightning Arrester in a Distribution system as per requirement, as Instructed by the Teacher, in accordance with the available conditions

0713E&E142 Carryout Protection of Distribution and Transmission System

Overview:

This Competency standard deals with the skills and knowledge required to Install the equipment for grounding of Substation/Transmission lines, Categorize and rectify the symmetrical and asymmetrical faults, Install Circuit breaker in a distribution system (Substation/Grid station), Install an isolator at grid station/substation, install appropriate relays for the protection of power system, Carry out Bus Bar protection, Carry out time graded protection of feeder, Install a fuse in a circuit (Transformer and Distribution panels), Supervise Protection of power transformer, Carryout protection arrangement for alternator.

Competency Units	Performance Criteria
CU1. Categorize and rectify the symmetrical and asymmetrical faults	**P1.** Identify different type of faults on power system and categorize them in symmetrical and asymmetrical **P2.** Carryout remedial measure to rectify the faults **P3.** Plan to avoid faults in future
CU2. Install Circuit breaker in a distribution system (Substation/Grid station)	**P1.** Select appropriate C.B for a substation or grid station among oil, gas, air, vacuum circuit breaker **P2.** Purpose required for a grid station/ substation. **P3.** Carryout connection of breaker.
CU3. Install an isolator at grid station/sub station	**P1.** Select an appropriate type of isolator **P2.** Supervise connections according to the arrangement of an isolator **P3.** Trace the appropriate position of an isolator from single line diagram
CU4. Install appropriate relays for the protection of power system	**P1.** Make selection of requisite proportion among different relays available **P2.** Make connection of respective relays (Current relay, distance relay, impedance relay etc.)
CU5. Carry out Bus Bar	**P1.** Supervise arrangement for frame leakage protection.

protection	**P2.** Supervise arrangement for circuiting current protection.
CU6. Carry out time graded protection of feeder	**P1.** Make settings for time graded protections. **P2.** Make a system to isolate smaller part on a feeder when fault arise **P3.** Ensure to minimize the losses arising due to the fault by biasing appropriate section of timing and isolation type.
CU7. Install a fuse in a circuit (Transformer and Distribution panels)	**P1.** Select among circuit breaker and fuse provided given circumstances **P2.** Calculate the current carrying capacity of fuse **P3.** Install fuse according to rating for 25KVA, 50KVA, 100KVA… Transformer **P4.** Carryout fuse arrangement for housing building after load
CU8. Supervise Protection of power transformer	**P1.** Identify the need for protection of transformer. **P2.** Calculate the phase displacement in a transformer and identify the connection type's i.e. star-star-star **P3.** Star-delta-delta **P4.** Delta-Delta-star
CU9. Carryout protection arrangement for alternator	**P1.** Carry out protection against stator faults, balanced earthling fault protection and stator in-turn protection. **P2.** Select appropriate rating and settings for protections.

Knowledge & Understanding

- Explain Type of faults in power system
- Explain the problems arising due to short circuit on power line
- Describe Necessity of Circuit breaker
- Explain Working principal for fault.
- Explain different types of circuit breaker
- Define different types of relays
- Define the working principal of relays of different type respectively
- Explain the purpose of relays and the need of relays
- Describe the Selection criteria.
- Describe working of frame protection

- Explain concept of time graded protection.
- Define Buss Bar protection
- Describe rating of circuit breaker
- Explain Using principal of an isolator
- Describe Usage of isolator
- Describe Types of isolator
- Describe working principal
- Explain rating parameters
- Explain fuse materials
- Define types of fuse
- Define advantages and disadvantages.
- Define faults on transformer
- Describe Merz-prize system
- Explain protection for different types of connection.
- Explain Alternators faults
- Describe Protection against stator faults
- Explain Balanced earth fault protection
- Explain stator in-turn protection

Tools and Equipment

- Relays
- Insulator
- Circuit breakers
- Protection equipment
- Fuse
- Transformer
- Protection equipment of transformer.
- Protection equipment of alternator

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard: Carryout protection arrangement for alternator, as Instructed by the Teacher, in accordance with the available conditions

0713E&E143 Investigate Micro Business Opportunities

Overview:

This competency describes the performance outcomes, skills and knowledge required to develop business ideas, and to investigate market needs and factors affecting potential markets.

Competency Unit	Performance Criteria
CU-1. Describe business ideas	P1. Gather information for business ideas from appropriate sources P2. List details of business ideas and opportunities P3. Research alternative business ideas in light of the resources available P4. Specify and list products and services to match business ideas P5. .Identify and research potential customer information for business ideas P6. Identify and take into account financial, business and technical skills available when researching business opportunities

CU-2. Identify market needs	P1. Collect information regarding market size and potential from appropriate sources P2. Investigate market trends and developments to identify market needs relative to business ideas P3. Gather market information from primary and secondary sources to identify possible market needs in relation to business ideas P4. Identify ethical and cultural requirements of the market and their impact on business ideas P5. Identify new and emerging markets and document their features P6. Identify and organise information on expected market growth or decline and associated risk factors
CU-3. Investigate factors affecting the market	P1. Identify projected changes in population, economic activity and the labour force that may affect business ideas P2. Identify movements in prices and projected changes in availability of resources P3. Review trends and developments and identify their potential impact on business ideas

Knowledge and 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**:**

- Define entrepreneurship.
- Explain the concept of entrepreneurship
- Explain the various types of enterprise that exist in the community
- Identify and interpret the terms and elements involved in the concept of enterprise
- Appreciate that the advancement of individual and society in general when entrepreneurship is adopted
- Explain various motivational factors that entrepreneurs possess and utilize.
- Exhibit the skills needed to assess and evaluate a risk
- Describe the outline of small enterprise
- Describe the creativity and innovation

- Apply the techniques for developing creative abilities
- Explain the resources of business idea
- Explain the collective and creative thinking
- Explain how to generate a business idea
- Appreciate the importance of, and possess techniques for identifying and assessing business opportunities.
- Identify the various entrepreneurial characteristics
- Access personal potential for becoming future entrepreneurs.
- Identify leadership qualities which are essential to the success of entrepreneurs
- Identify self- management skills and how they are important to be enterprising
- Apply a rational approach to make personal and business decisions
- Explain the steps for decision making and rating of decision making skills
- Apply the rules of negotiation for resolving business issues

Tools and Equipment

S No.	Tools
1	Calculator
2	Ruler
3	Papers and Pencil

Critical Evidence(s) Required

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

Evidence of the following is essential**:**

•Thorough investigation of business opportunities and ideas

•Clearly identified products/services and customer information for each business idea

•Thorough collection and analysis of market information and associated factors relating to business ideas

•Knowledge of ethical and cultural requirements.

0713E&E144 Develop a Micro Business Proposal

Overview:

This competency describes the performance outcomes, skills and knowledge required to develop an identified business idea, to research the feasibility of the business opportunity and to present a business idea in formats that suit a range of stakeholders

Competency Unit	Performance Criteria
CU1.Evaluate business opportunities	P1. Identify and research key factors that influence viability of business ideas P2. Analyse business ideas in terms of personal or family needs and commitments P3. Evaluate impacts of emerging or changing technology, including e-commerce, on the business P4. Determine viability of business opportunity in line with perceived risks, resources available, financial returns and other outcomes sought P5. Assess and match personal skills/attributes against those perceived as necessary for a particular business opportunity P6. Identify and assess business risks according to resources available and personal preferences
CU2.Detail the business idea	P1. .Develop an accurate description of the business idea for key stakeholders P2. Develop an accurate summary of the major products and/or services required to suit personal needs and requirement
CU3.Prepare the business Overview to suit different stakeholders	P1. Present an accurate list of key stakeholders and their information requirements P2. Determine an acceptable method of presentation of information for each stakeholder P3. Provide accurate customised information to target audiences

Knowledge and 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**:**

- State and local government legislative requirements relating to business operation, especially in regard to occupational health and safety (OHS) and environmental issues,
- Income and expenditure costing •
- Principles of risk assessment relevant to the business opportunity

Tools and Equipment

S No.	Tools
1	Calculator
2	Ruler
3	Papers and Pencil

Critical Evidence(s) Required

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

Evidence of the following is essential**:**

- accurate and complete outline of the business idea that considers the major elements of**:**
  - products/services
  - customers
  - operations and processes
  - income and expenditure
  - resources
  - marketing
  - location

0713E&E145 Develop a Marketing Plan

Overview: This competency describes the performance outcomes, skills and knowledge required to research, develop and present a marketing plan for an entrepreneurship business

Competency Unit	Performance Criteria

CU-1.	Devise marketing strategies	P1.Evaluate *marketing opportunity options* that address organisational objectives, and evaluate their risks and returns in the selection process P2.Develop *marketing strategies* that address strengths and opportunities within the organisation's projected capabilities and resources P3. Develop strategies which increase resources or organisational expertise where gaps exist between current capability and marketing objectives P4.Develop feasible marketing strategies and communicate reasons that justifies their selection P5. Ensure strategies align with organisation's strategic direction P6.Develop a *marketing performance review strategy*, incorporating appropriate marketing metrics to review of organisational performance against marketing objectives
CU-2.	Plan marketing tactics	P1. Detail tactics to implement each marketing strategy in terms of scheduling, costing, accountabilities and persons responsible P2. Identify coordination and monitoring mechanisms for scheduled activities P3.Ensure tactics are achievable within organisation's projected capabilities and budget P4. Ensure tactics meeting *legal and ethical requirements* P5.Ensure tactics provide for ongoing review of performance against objectives and budgets, and allow marketing targets to be adjusted if necessary
CU-3.	Prepare and present a marketing plan	P1.Ensure marketing plan meets organisational, as well as marketing, objectives and incorporates *marketing approaches* and a strategic *marketing mix* P2. Ensure marketing plan contains a rationale for objectives and information that supports the choice of strategies and tactics P3. Present marketing plan for approval in the required format and timeframe P4. Adjust marketing plan in response to feedback from key stakeholders and disseminate for implementation within the

	required timeframe

Knowledge and 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**:** Culturally appropriate communication skills to relate to people from diverse backgrounds and people with diverse abilities

- Describe the market & marketing
- Differentiate between sellers and buyers' market
- Describe the five 'w' of market
- Explain the procedure for assessing the market size and demand
- Explain the major factors to be considered when selecting a location for a business
- Describe the basic types of business ownership and the limitation of each
- Explain the computation of initial and working capital needed to start an enterprise
- Identify the advantages and disadvantages of using various sources of capital to start an enterprise
- Explain the component of cost of product
- Explain the breakeven analysis for a new business
- Calculate the breakeven point for various new business

Tools and Equipment

S No.	Tools
1	Calculator
2	Ruler
3	Papers and Pencil

Critical Evidence(s) Required

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

- Devising, documenting and presenting a marketing plan
- Detailing approaches and
- The marketing mix to achieve organisational marketing objectives.

0713E&E146 Develop and Review a Business Plan.

Overview: This competency standard covers the process of developing and reviewing business for a small business enterprise. It requires the application of knowledge and skills to determine the scope of the business plan, prepare a business plan, determine goals, trial systems, and document, monitor and review the business plan.

Competency Unit	Performance Criteria
CU-1. Determine scope of business	**P1.** Determine scope of the business plan and associated systems is determined in consultation with specialist personnel. **P2.** Access accurate information for inform business plan development **P3.** Account for and incorporate trends and seasonal variations into the business plan. **P4.** Account for strategic goals, targets and directions of the enterprise in the development of the business plan **P5.** Comply Legal obligations in developing the business plan.
CU-2. Prepare business plan	**P1.** Develop operational goals and targets to meet the enterprise strategic plan. **P2.** Identify and incorporate supply chains into the business plan. **P3.** Identify risk management needs are within the business plan. **P4.** Incorporate trial systems in order to test budgetary impact and operational potential prior to full implementation of the business plan. **P5.** Set clear and measureable indicators of operational performance to allow for realistic analysis of performance.
CU-3. Document and review business plan	**P1.** Include fiscal and operational systems that enhance performance management and suit enterprise requirements. **P2.** Incorporate resource considerations the business plan. **P3.** Document accurately and clearly communicate business

	Plan to all relevant parties. **P4.** Monitor to identify strengths, weaknesses and areas for improvement performance against the business plan **P5.** Make recommendations to improve the business plan and associated systems as required.

Knowledge and 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**:**

- Appreciate the importance of business plan
- Explain the process of writing a business plan
- Develop feasibility for a business idea
- Realize the problem that may be encountered when starting a small business/Enterprise
- Develop a business plan for a small business on the standard format
- Evaluate the business plan in a real market satiation
- The knowledge requirements for this competency standard are listed below**:**
- budgeting
- forecasting
- operational systems
- relevant industrial awards and agreements
- communication techniques
- logical and analytic methods
- profit and loss and cash flow systems
- working knowledge of environmental, OHS, industrial relations, taxation, corporate and industry legislation as they relate to the enterprise

Tools and Equipment

S No.	Tools
1	Construction Lab Tools
2	Rule tape, square, hammer, hand saw, hand plane,

	chisel, shovel, wheelbarrow, sledge hammer, pick, mattock and crow bar and pinch bar for given tasks.

Critical Evidence(s) Required

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

The skills and knowledge required to develop and review a business plan must be transferable to a different work environment. For example, if competence is demonstrated in developing a business plan for a small enterprise, it must also be evident in reviewing a business plan in medium or large enterprise environment.

0713E&E147 Organize Finances for the Micro Business

Overview: This competency standard describes the performance outcomes, skills and knowledge required to investigate the financial capacity to enter into a micro business, to determine the projected cash flow, to source finances and to monitor the profitability of the business.

Competency Unit	Performance Criteria
CU-1. Ascertain own financial position and the ability to provide capital/equity for the business	P1.Realistically detail personal, family or community financial situation in terms of funds available and commitments already incurred P2.Determine equity finance and assets available for micro business from personal, family or community sources
CU-2. Determine projected cash flow for the business	P1. Determine the level of forecast business activity over a year and the business mix P2. Estimate establishment costs for the business and repayment schedule for borrowings P3. Calculate the monthly variable and fixed costs needed to conduct business activity over a year P4. Estimate personal drawings needed to be taken from the business P5.Estimate the monthly income generated by the business for a year based on price per unit item or hourly charge rate for labor P6. Develop a cash flow budget for the first year of business operation P7. Seek professional advice to estimate goods and services tax and operating finance required for the business
CU-3. Source the required funds to establish the business	P1. Estimate required funding to establish and run the business based on expected sales and activity levels, available finances and commitments P2. Investigate methods of accessing alternative sources of finance

	P3. Identify strategies for meeting financial obligations P4. Implement plans to access available funds as required
CU-4. Monitor profitability of the business	P1. Maintain and review monthly expenditure and income records P2. Compare equity at beginning and end of a year to estimate business performance P3. Assess the financial viability of the business after a year of operation P4. Seek professional advice on depreciation, insurance and tax implications of the business

Knowledge and 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 budgeting
- basic costing for the business
- financial commitments and requirements
- financial reports and terminology
- methods and relative costs of obtaining finance
- own financial position
- Sources of advice and assistance.

Critical Evidence(s) Required

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

- investigation of projected cash flow for the business
- estimation of the funding needed to establish and operate the business
- assessment of the financial viability of the business
- Knowledge of basic budgeting.

0713E&E148 Manage Human Resources

Overview: This competency standard covers the skills and knowledge required to manage human resources and to manage and develop human resources to achieve organization's operational objectives

Competency Unit	Performance Criteria
CU-1. Lead and motivate people	P1.Establish goals for people and teams to optimise achievement in work tasks. P2.Take into account the capabilities of people and teams. P3. Provide advice and support sensitive to the individual's needs to people in the performance of their duties. P4. Undertake activities to achieve commitment to common goals. P5. Recognise and encourage initiative and innovation P6. Recognise and communicate achievements within the organisation.
CU-2. Undertake human resource planning	P1. Determine human resource needs within the anticipated operational needs and allocated budget. P2. Analyse alternatives to staffing levels which clearly demonstrate returns to the organisation. P3. Develop contingency plans for staffing which meet key provisions of the human resources plan. P4. Compare existing competencies of staff with the needs of the work group. P5. Plan staffing levels and negotiate with *stakeholders* within the organisational framework to achieve maximum efficiency of operations.
CU-3. Develop and facilitate performance	P1.Negotiate Performance Criteria individuals, teams and work groups. P2. Review Performance Criteria as circumstances change. P3. Conduct p*erformance appraisal* based on clearly established and agreed Performance Criteria.

	P4.Identify and propose the total performance development system strategies to rectify performance shortfalls and recognise success. P5. Address performance problems confidentially and in a constructive and timely manner, in line with relevant organisational procedures. P6. Make *selections*, *transfers and promotions* in accordance with organisation policies and supported with documented information. P7. Develop and implement mechanisms for the identification of human resource development needs within the work group taking account of the strategic plan for the organisation.
CU-4. Facilitate training, education and development opportunities	P1.Make information on planned training events widely available throughout the organisation. P2. Include training, education and development plans as part of individual/team performance plans. P3. Facilitate individual/team access to, and participation in, training, education and development opportunities. P4.Contribute coaching and mentoring effectively to the training, education and development of personnel in an environment of change. P5.*Enhance training*, *education and development opportunities* of individual, team and organisational performance. P6. Create workplace environment is which facilitates training, education and development

Knowledge and 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**:**

- Describe the hiring method/Procedures
- Describe the term & conditions of services and job description for various employments
- Describe the characteristics of successful sales personals
- communication principles
- conflict resolution principles and practice
- Equal Employment Opportunity
- grievance procedures
- interpersonal relations
- leadership theory and principles
- management principles and practice
- Occupational Health and Safety
- training and education principles
- training need analysis

Critical Evidence(s) Required

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

It is essential that competence be demonstrated in the application of human resource management in a wide range of contexts in achieving the organisation's objectives.

- Evidence should be gathered over a period of time in a range of actual or simulated workplace environments.
- Evidence of competent performance should be obtained by observing an individual in a management role within the workplace or exercise or operational environment. Knowledge may be assessed through written assignments, project reports, debriefings and action learning projects.

0713E&E149 Market Products and Services

Overview: This competency standard covers the skills and knowledge required to market products and services

Competency Unit	Performance Criteria
CU-1. Analyze market information	P1. Identify, research and analyse existing or new markets for existing or new products or services using techniques to ensure reliable data P2. Analyse past trends and developments to determine market variability and associated risks P3. Develop gross margin budgets to account for market variability P4.Identify and evaluate competing products to determine strengths and weaknesses of own products P5. Monitor market environment to ensure information is current and reliable P6. Identify the legal, ethical and environmental constraints of the markets and their effect on the enterprise P7. Identify product specifications that suit market requirements and price advantage at the time P8. Present clear and concise information to the enterprise management team.
CU-2. Identify and evaluate factors to include in a marketing plan	P1. Identify and evaluate production processes to ensure required product specifications are met P2. Identify and assess alternative selling strategies and techniques to identify marketing targets and methods P3. Identify and assess distribution channels and their role in your marketing strategies P4. Ensure the data used is reliable and the market environment and trends are substantiated P5. Evaluate the role of marketing professionals in providing advice
CU-3. Develop a	P1. Establish marketing objectives based on current and

marketing plan for your products and services	potential product specifications P2.Select appropriate production processes to ensure product specifications are met P3. Select selling strategies to ensure required prices are achieved P4. Select appropriate distribution channel options to ensure access to target markets is achieved efficiently and appropriately P5.Establish time-frames for production, distribution and selling activities P6.Develop a gross margin budget to demonstrate the cost effectiveness of the marketing plan P7.Develop partial gross margin budgets to account for market variability
CU-4. Determine promotional strategies	P1. Prepare and record detailed plans for promotional activities P2. Outline objectives, level of exposure and available markets P3. Ensure strategies take account of time management and scheduling issues, and resource constraints P4. Create promotional materials that enhance the product and commercial presentation P5.Record and communicate priorities, responsibilities, timelines and budgets for promotional activities.
CU-5. Implement marketing activities	P1. Schedule planned marketing activities within appropriate timeframes P2. Develop measurable performance targets that meet business plan objectives P3. Organise distribution channels and ensure product and service information is accurate and readily available to clients P4. Implement marketing activities within budgetary constraints to meet legal, ethical and enterprise requirements
CU-6. Evaluate marketing performance.	P1. Review the established marketing objectives to ensure they remain viable P2. Make an objective assessment of the marketing plan and

	its implementation by a comparison of valid and reliable data against the established objectives P3.Assess product, pricing and distribution policies in relation to market changes, marketing objectives and enterprise requirements P4. Identify areas of positive marketing performance and take corrective action to remedy poor marketing performance areas P5. Document and distribute information for continual analysis and effective planning management

Knowledge and 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**:**

- Describe the life cycle of product
- Identify the various ways of selecting suppliers,
- Explain the inventory management of stock, raw material and finished goods etc.
- Appreciate the importance of financial record keeping in a small business
- Explain techniques to keep cost as low as possible
- Develop balance sheet for a small enterprise
- Explain the operating cycle concept
- Explain the income tax computation procedure for a small business
- Explain the basic scheme of sales tax
- Explain the assessment procedure for returns and filling of returns.

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
- identify the marketable features of the product and potential markets
- develop a range of marketing alternatives
- collect and analyses data to assess alternatives in a marketing plan
- evaluate performance targets and recommend modifications or improvements
- implement and evaluate a marketing plan
- Plan to manage promotional activities.

0713E&E150 Monitor and Review Business Performance

Overview: This competency standard covers the skills and knowledge required tomonitor and review business performance

Competency Unit	Performance Criteria
CU-1. Evaluate commercial performance	P1. Gather and analyse data relating to enterprise performance to identify historical and current performance. P2. Review and analyse operational structures to determine the suitability of organisational processes to enterprise objectives. P3. Evaluate enterprise strengths and weaknesses against market conditions to determine current and future capacities. P4. Evaluate enterprise objectives are to identify variations and scope for future development.
CU-2. Allocate and co-ordinate business resources	P1. Identify and communicate roles and responsibilities of personnel. P2. Identify resource requirements for enterprise and cost them using standard financial analysis techniques. P3. Calculate costs of ensuring sustainability of enterprise operations and factor into business planning for the enterprise.
CU-3. Identify performance requirements	**P1.** Develop realistic performance indicators within available timeframes and resources **P2.** Identify and minimize factors inhibiting performance against objectives. **P3.** Monitor and assess market conditions based on relevant data. **P4.** Prepare and incorporate strategies and programs to promote the sustainability of operations into enterprise

	procedures.
CU-4. Review business performance	**P1.** Review regularly enterprise operations to identify opportunities for improvements in performance. **P2.** Monitor and anticipate impact of natural conditions on enterprise to assess sustainability of resource use. **P3.** Compare costs and estimates with resource allocation. **P4.** Determine operational plans to determine schedule of activities

Knowledge and 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**:**

- rates of return for products and/or services
- financial analysis techniques
- structure and operation of small businesses relevant State/Territory Occupational Health and Safety (OHS)
- legislative requirements
- environmental conditions, positive environmental practices and negative impact minimisation measures
- human resource requirements for the enterprise
- transport requirements for the enterprise
- Enterprise/property improvement requirements.
- market performance in commodities
- Statutory marketing requirements.

Critical Evidence(s) Required

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

- review operational structures to determine effectiveness
- identify available resources to assess capacity
- develop realistic performance indicators
- review enterprise operations against performance indicators
- Plan to improve business performance by addressing results of review.

0713E&E151 Negotiate for Resolving Business Issues

Overview: This competency standard covers the skills and knowledge required to negotiate for resolving business issues

Competency Unit	Performance Criteria
CU-1. Develop and implement issue resolution and grievance procedures	P1. Establish problem solving/issue resolution procedures within legislative requirements and organisation's guidelines. P2. Manage grievances and complaints are in a timely and caring way to optimise likelihood of a favourable outcome for all parties and in line with organisational objectives and procedures. P3.Document and communicate individual's rights and obligations under industrial awards/agreements and legislation are in a clear and concise manner and in appropriate language. P4. Conduct hearings, interviews and meetings within the principles of industrial democracy and participative, consultative processes. P5. Identify and invite all relevant industrial parties to participate in the resolution process.
CU-2. Manage disciplinary matters	P1.Implement disciplinary matters ***in*** accordance with organisation's procedures. P2. Conduct investigations in a caring and confidential manner to maintain performance and morale. P3. Provide feedback promptly. P4.Institute appeals processes in accordance with organisational procedures. P5. Recognize and recommend deficiencies in procedures for changes made

Knowledge and 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**:**

- Communication Skills
- Interpersonal skills
- Business letter writing
- Forecasting techniques

Critical Evidence(s) Required

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

0713E&E152 Manage Personal Finances

Overview: This Unit of Competency describes the outcomes required to develop, implement and monitor a personal budget in order to plan regular savings and manage debt effectively.

Unit of Competency		Performance Criteria
CU1	Develop a personal budget	**P1** Calculate current living expenses using available information to prepare a personal budget. **P2** Keep a record of all income and expenses for a short period of time to help estimate ongoing expenses. **P3** Subtract total expenses from total income to determine a surplus or deficit budget for the specified period. **P4** Find reasons for a deficit budget and ways to reduce expenditure identified. **P5** Identify ways to increase income, if possible
CU2	Develop longer term personal budget	**P1** Analyze income and expenditure and set longer term personal, work and financial goals. **P2** Develop a longer-term budget based on the outcomes of short-term budgeting, and adjust to meet living, work and future career requirements. **P3** Identify obstacles that might affect finances such as job loss, sickness or unexpected expenses contingency savings **P4** Formulate a regular savings plan based on budget, using secure savings products and services. **P5** Monitor expenditure against budget and identify areas of possible expenditure saving
CU3	Identify ways to maximize future finances	**P1** Determine sources and ways to maximize personal income, including from work, investments or available government payments/allowances. **P2** Get further education or training to maintain or improve future income. **P3** Identify the need for debt to finance living and other expenses, and determine the appropriate levels of debt and repayment.

	P4 Consolidate existing debt, where possible, to minimize interest costs and fees. **P5** Seek professional money management services, where available, to ensure financial plans are effective and achievable.

Knowledge and 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**:**

- .Explain the abilities to plan and organize to keep records and monitor a personal budget
- .Describe abilities to set and review goals
- Explain basic financial management and record keeping to enable development and management of a personal budget
- Describe benefits of financial goal setting and personal budgeting to enable effective management of personal finances
- Outline numeracy skills to compare income and expenditure

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to manage personal finances. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to**:**

- develop a personal budget based on analysis of expenditure and income;
- formulate goals and identify financial contingency plans; and
- Monitor expenditure for a period of up to 2 weeks

0713E&E153 Coordinate a Work Team

Overview: This unit is concerned with the competencies required to achieve operational outcomes and effective working relationships through managing and developing individuals and teams.

Unit of Competency		Performance Criteria
CU1	Develop and maintain a cooperative work group	**P1** Work contributions and suggestions from staff are **P2** continually sought and encouraged **P3** Contributions to work group operations are acknowledged and suggestions are dealt with constructively **P4** Develop staff skills according to work requirements **P5** Implement new work practices **P6** Address conflict between staff members in accordance with current personnel practices.
CU2	Communicate objectives and required standards	**P1** Inform the staff of the objectives and standards **P2** required **P3** Commit to objectives and standards **P4** Practices of safe, fair and participative work principals are and promote to staff
	Provide feedback on Performance	**P1** Give constructive feedback on all aspects of work performance provided to individuals and team **P2** Access and address performance in a fair and timely manner in accordance with relevant guidelines, procedures and natural justice
CU3	Support and participate in development activities	**P1** Assess training needs of all staff, implemented and promoted **P2** Devise an action plan to meet individual and group training **P3** and development needs is collaboratively developed, **P4** agreed to and implemented **P5** Identify specific training needs of individuals **P6** Encourage staff in applying skills and knowledge in the

		workplace **P7** Provide training to the required standard on the job **P8** Support and encourage staff to attend training courses and to take up other development opportunities.
CU4	Provide leadership. direction and guidance to the work group	**P1** Link between the function of the group and the **P2** goals of the organization **P3** Participate in decision making routinely to develop, implement and review work of the group and to allocate responsibilities where appropriate **P4** Give opportunities and encouragement to others to develop new and innovative work practices and strategies **P5** Identify conflict and resolve with minimum disruption to work group function **P6** Provide staff with the support and supervision necessary to perform work safely and without risk to health **P7** Allocate tasks within the competence of staff and support with appropriate authority, autonomy and training **P8** Supervise appropriately the changing priorities and situations and takes into account the different needs of individuals and the requirements of the task

Knowledge and 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**:**

- Explain the principles of effective team operation
- Explain the principles of human resource management
- Describe the training delivery processes in the workplace
- Outline the industry assessment guidelines.

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to coordinate a work team. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Evidence of the following is essential**:**

- assessing and evaluating skills
- working effectively in a team environment
- achievement of work outcomes

0713E&E154 Lead Small Teams

Overview: This unit describes the outcomes required to lead small teams including setting and maintaining team and individual performance standards

Unit of Competency	Performance Criteria
CU1 Facilitate team Development	**P1** Identify work requirements, standards and purpose to team members. **P2** Assist team to develop objectives, targets and key performance indicators relevant its purpose and workplace goals. **P3** Allocate duties regard to the skills required to properly **P4** undertake the assigned task and according to company policy **P5** Identify roles, responsibilities and expectations of each team member **P6** Disseminate and discuss performance expectations to individual team members.
CU2 Motivate and build the Team	**P1** Develop positive and constructive relationships with and between team members **P2** Facilitate team communication processes **P3** Involve team members in the process of examining risks and options and making decisions, to ensure acceptance and support. **P4** Encourage individual and team efforts and contributions **P5** Strengths and weaknesses of team members are determined and sharing of work tasks is promoted to up skill team members. **P6** Recognize team members' queries and discuss and deal with it.
CU3 Facilitate and monitor team	**P1** Monitor the implementation of work plan and team and individual performance against agreed strategies, targets and standards, according to workplace policies

effectiveness	and procedures. **P2** Monitor performance against defined Performance Criteria and/or assignment instructions and corrective action taken if required. **P3** Support team in identifying and resolving problems that may impede performance and to suggest improvements in team Performance. **P4** Consult team members in any review and revision of team objectives and goals. **P5** Address performance issues which cannot be rectified within the team to appropriate personnel according to employer policy. **P6** Refer concerns of a team and individual are referred to next level of management or appropriate specialist and conduct negotiations on their behalf. **P7** Keep team members inform of any changes in the priority allocated to assignments, or tasks which might impact on client/customer needs and satisfaction. **P8** Monitor team operations to ensure that internal or external employer/client needs and requirements are met. **P9** Provide follow-up communication on all issues affecting the team **P10** Conduct team meetings to review work operations and address issues according to workplace policies and procedures. **P11** Support team in identifying and resolving problems that may impede performance and to suggest improvements in team performance. **P12** Consult team members in any review and revision of team objectives and goals. **P13** Raise any inappropriate values and standards exhibited in the workplace with the person concerned.

Knowledge and 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**:**

- Explain conflict resolution techniques
- Explain management styles
- Describe methods of monitoring performance
- Outline the relevant legal requirements
- Outline strategies for dealing effectively with team member complaints or grievances and
- Explain team dynamics and facilitation processes
- Describe communication skills
- State workplace policies and procedures

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard
A person who demonstrates competency in this unit must be able to provide evidence of the ability to lead small teams. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Evidence of the following is essential**:**

- demonstrate the ability to build positive team spirit and effectively manage overall team
- performance within a workplace context;
- demonstrate the ability to coordinate a work team in a range of contexts or occasions; and
- Show knowledge of leadership, motivation and teamwork principles.