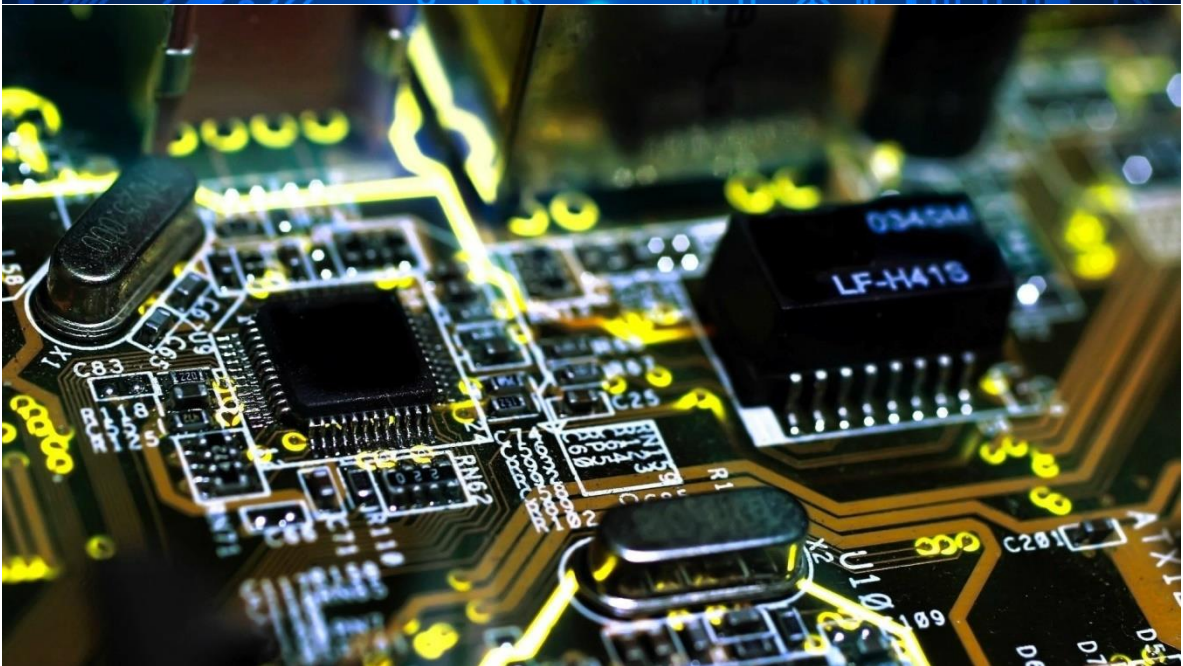
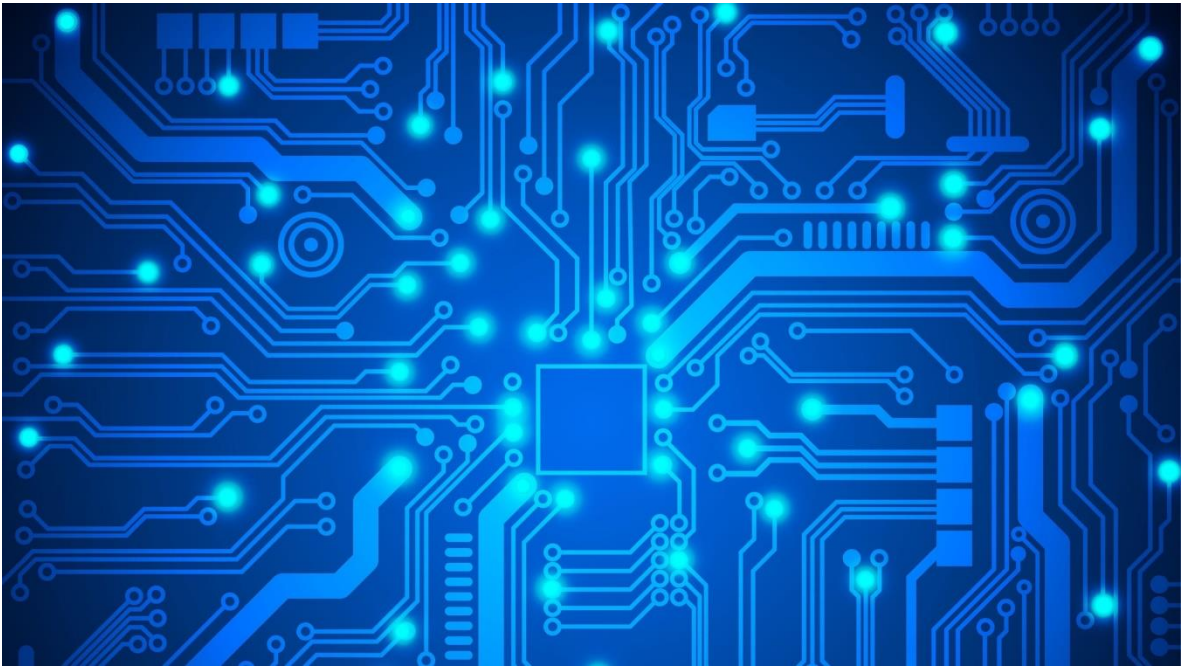




## **National Competency Standards Level -5 for “Electronics Technology”**



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

## ACKNOWLEDGEMENTS

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

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

NAVTTTC team under the leadership of Dr. Muqeeem 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 equipped 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, NAVTTTC, whose patronage and support remain there throughout the development process and lastly to thanks specially to Syed Javed Hassan Chairman NAVTTTC and Raja Saad Khan, Deputy Team Lead TSSP-GIZ who made it happened in this challenging time.

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## 1. 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 Electronics engineers, Supervisors, Operators and Technicians is now increasing day by day in the industry. This qualification is designed so as to inculcate the competencies of basic design and construction of electronic circuits, identification and implementation of certain electronic components, linkage between the components and their industrial workability. The fundamental concepts of digital systems, the practical aspects of digital system design will be covered using hardware which is widely used in industry. Students will gain hands on experience in designing, Servicing and implementing a number of digital systems.

Electronics Diploma is further sub-divided into many other fields including 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.

The National Skills Strategy (NSS) aims at achieving a paradigm shift from time-bound and supply led to competency-based and demand driven training in Pakistan. Competency-based training approach focuses on the demonstration of actual skills required in the workplace/industry. To achieve this strategy, NAVTTC in collaboration with GIZ is involved in the development process of CBT program to ensure competent skilled labor in demand driven vocational trades.

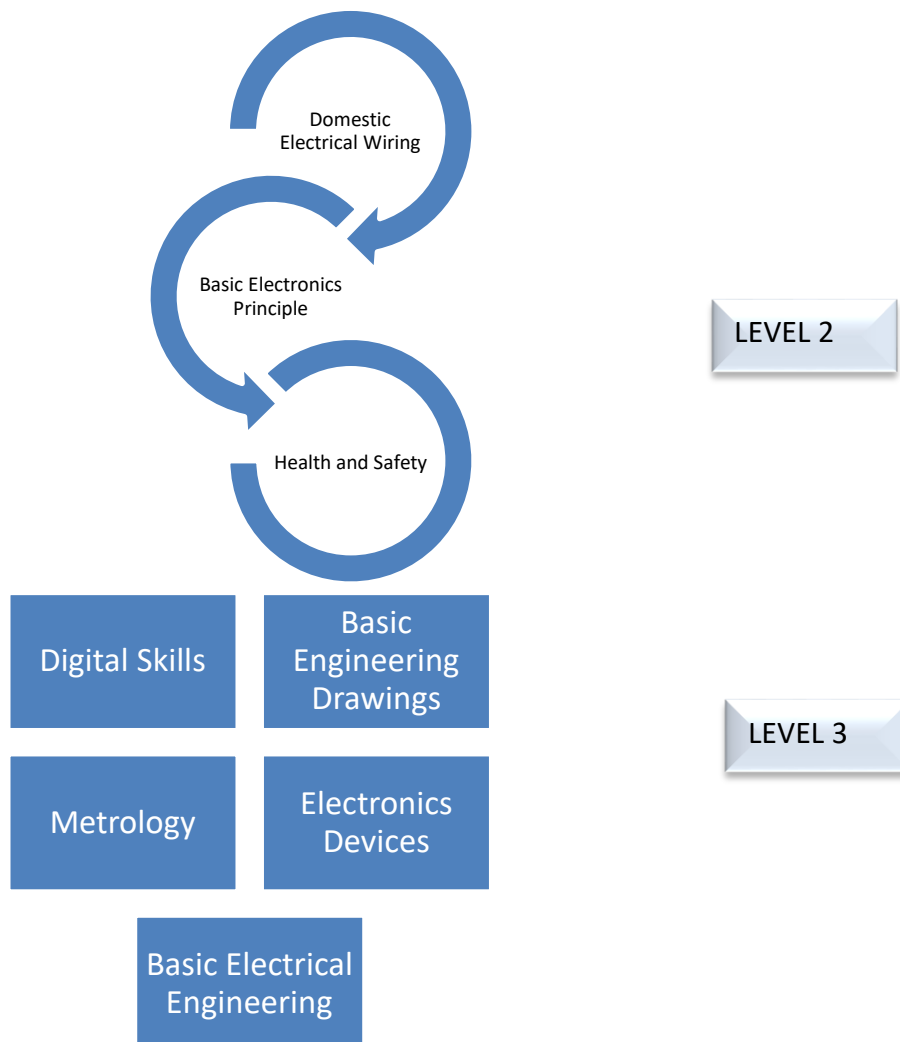
National Vocational Qualification Framework (NVQF) as designed in consultation with the stakeholders including academia, researchers, industry, chambers and TEVTAs. Its aim is to identify knowledge & skills required for a qualification, determine equivalence, provide guidelines for Recognition of Prior Learning (RPL) and assure quality of training. NVQF designed for the Vertical and horizontal progression for learners, recognition of qualification, meeting with the national and international standards, facilitate conversion of informal training to formal training through RPL, improvement in quality of training and increased options for learners for selecting training programs in different trades. Competency Standards are performance specification that identify the knowledge and competencies an individual need to succeed in the workplace.

## 2. PURPOSE OF THE QUALIFICATION

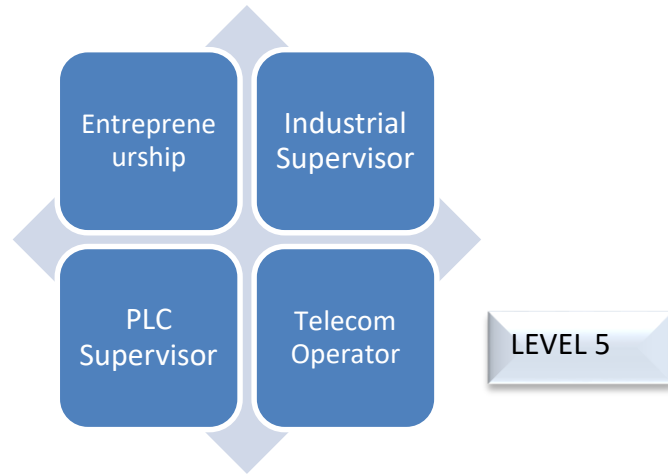
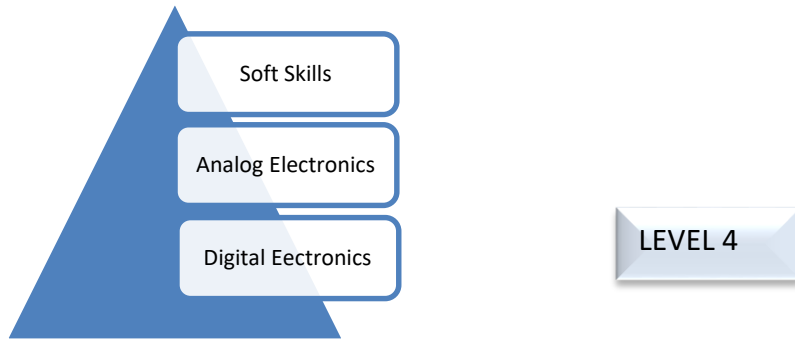
This qualification will equip the students with knowledge of how the industry works, as well as giving them the technological knowledge and technical skills which are needed to design, assess and improve electrical and electronic systems.

This qualification will help candidate to design and construct the electronic circuits, identify and implement certain electronic components, elaborate linkage between the components and their industrial workability & maintenance of various electronic devices.

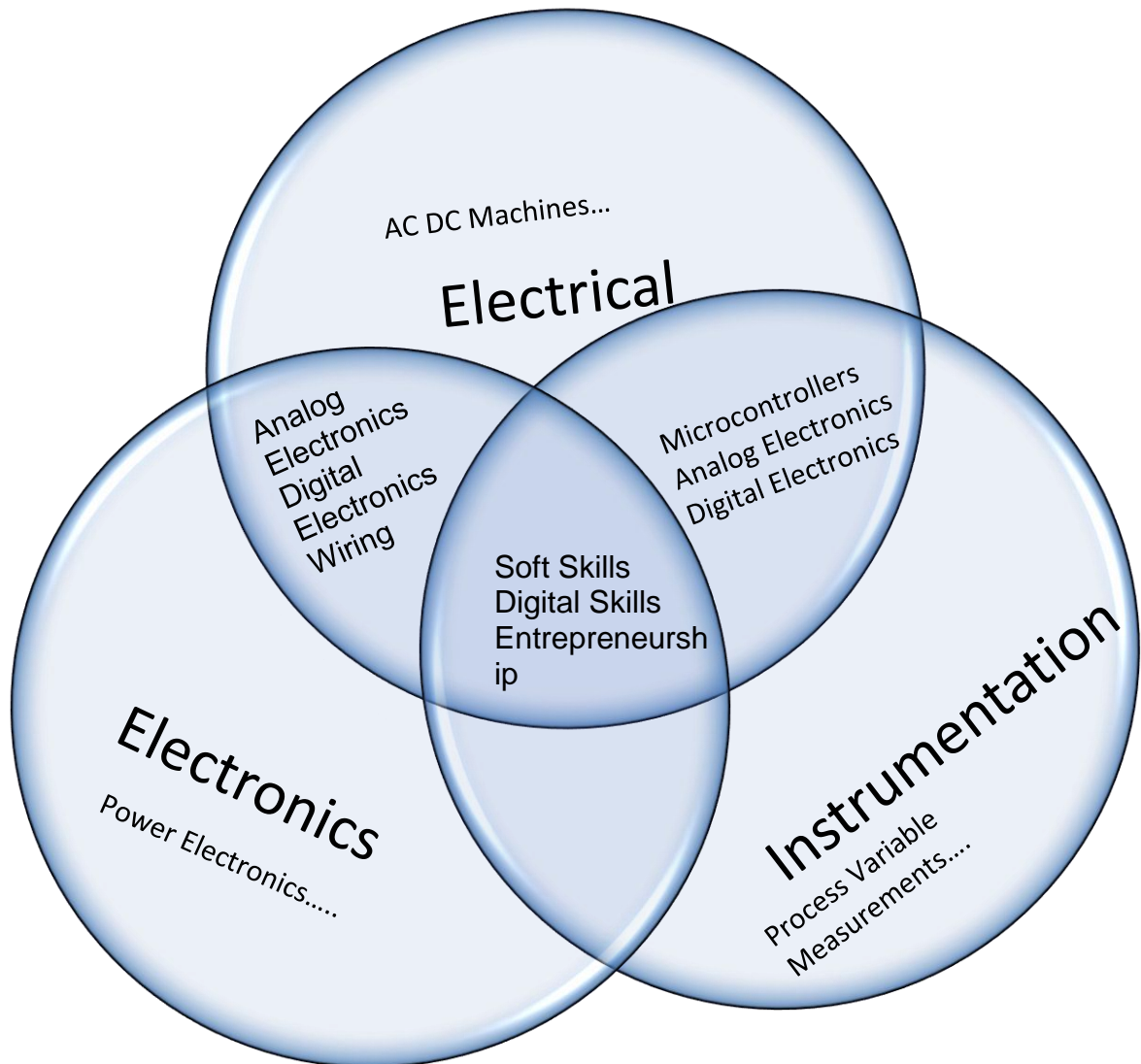
## 3. COMMON COURSES WITH RESPECTIVE LEVELS







## 4. MAPPING OF THE QUALIFICATION



## 5. DATE OF VALIDATION

These national qualifications have been validated by the Qualification Development Committee (QVC) on 27-29 May, 2019 in Lahore and will remain valid till **29-May-2029**.

## 6. DATE OF REVIEW

These national qualifications shall be reviewed by the validation committee on **30-May-2022**.

## 7. CODE OF QUALIFICATION

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
<b>0714E&amp;A(1)</b>	1st Level D.A. E National Certificate of level-5, in “ Electronics Technology”
<b>0714E&amp;A(2)</b>	2nd Level D.A. E National Certificate of level-5, in “Electronics Technology”
<b>0714E&amp;A(3)</b>	3rd Level D.A. E National Certificate of level-5, in “Electronics Technology”
<b>0714E&amp;A(4)</b>	4th Level D.A. E National Certificate of level-5, in “Electronics Technology”
<b>0714E&amp;A(5)</b>	5th Level D.A. E National Certificate of level-5, in “Electronics Technology”

## 8. QUALIFICATIONS DEVELOPMENT COMMITTEE

The Qualifications Development Committee consisted of following members

<b>Name &amp; Designation</b>	<b>Organization</b>
Mr. Muhammad Yasir, AD NAVTTC	NAVTTC
Mr. Ayub Nasir	DACCUM Facilitator
Mr. Raheel Ahmed, Lecturer	COMSATS University Islamabad
Mr. Muhammad Aleem, Researcher	PAEC, DG Khan
Mr. Noman Khan, Senior Engr	COMCEPT Electronics
Mr. Adeel Iqbal, Lecturer	COMSATS University Islamabad
Mr. Tahir Muhammad Khan, Design Engineer	CARE , Islamabad
Mr. Hamza Ikhlaq, Lecturer	ISRA University, Islamabad
Mr. Imran Ahmed, Instructor	GCT Rawalpindi
Mr. Mudassar Ali, Instructor	Swedish Group of Colleges
Mr. Sardar Hussain, Instructor PLC	PITAC, Peshawar
Mr. Abdul Basit Taj, Instructor	NIE Islamabad
Mr. Shehzad Raza, Lab Designer	NSETS Pvt. LTD
Ms. Siqa, Instructor	P-TEVTA
Mr. Ali Anwer Shah, assistant Professor	S-TEVTA

## 9. QUALIFICATION VALIDATION COMMITTEE

The following members participated in the qualification's development workshop 27-29 May 2019 in Lahore.

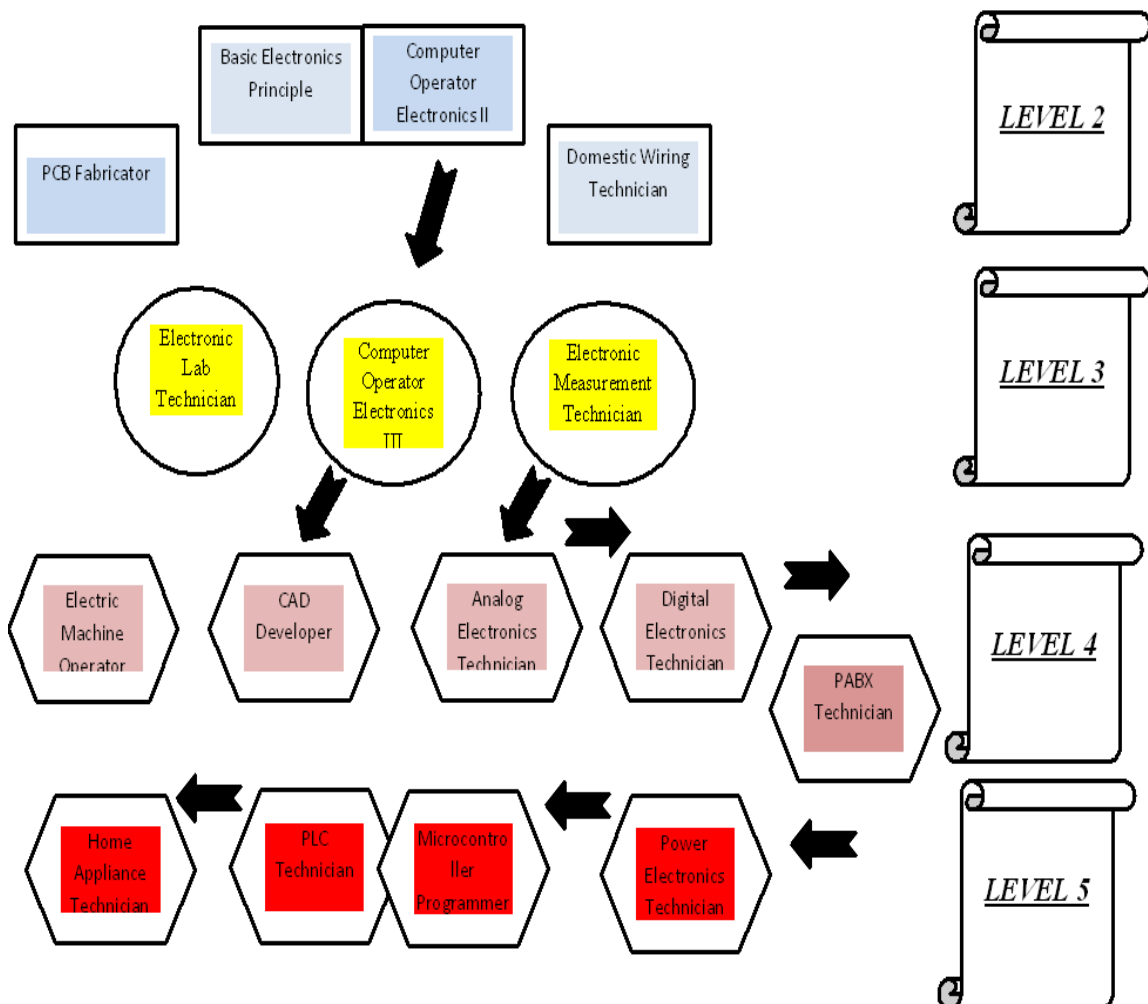
Name & Designation	Organization
Ms. Bushra Asghar DACCUM Facilitator	P-TEVTA
M. Hamza Akhlaq, Lecturer	Isra University, Islamabad.
Eng. Syed Ali Anwar Shah, Assistant Professor	S-TEVTA
Mst.Saiqa Ijaz, Instructor (GCT)	P-TEVTA
F.M.Kayfi, Chairman	PBTE
Fazal-E-Elahi,Asst.prof.	KP-TEVTA
Amir Amin, HOD Electrical.	City Poly Tech. Inst.
Aamir Ali Khan, Asst. Director, NAVTTC	NAVTTC
Muhammad Yasir, Asst. Director, NAVTTC	NAVTTC

## 10. ENTRY REQUIREMENTS

Entry requirements of this qualification are **Matric Science or level 4 or matric equivalent**

## 11. OCCUPATION PROFILE LEVEL PACKAGING CHART

### OCCUPATION PROFILE LEVEL PACKAGING CHART



## 12. PACKAGING OF QUALIFICATION

The national vocational qualifications are packaged as per following:

Competency Standards	NVQF Level	Category	Estimated Contact Hours			Credit Hours
			Theory	Practical	Total	
<b>Level 2</b>						
<b>Occupational health and Safety(Safety Supervisor)</b>						
Maintain Occupational Health and Safety	Level 2	Functional	10	30	40	4
Adopt Safety Regulations, Labour Protection Laws, Environmental Protection Laws at Workplace	Level 2	Functional	10	30	40	4
Develop Professionalism.	Level 2	Generic	15	30	45	4.5
			35	90	125	12.5
<b>Computer Fundamentals (Computer Operator II- Electronics)</b>						
Identify Main Components of Computer	2	Allied	3	18	21	2.1
Process data using the Microsoft Office	2	Allied	12	45	57	5.7
Carryout Basic Programming	2	Allied	21	63	84	8.4
Perform basic Mathematical calculations in C++	3	Allied	9	30	39	3.9
			45	156	201	20.1
<b>Electrical Wiring (Domestic Electric Wiring Technician)</b>						
Carryout basic Electrical Wiring Installation	2	Technical	6	18	24	2.4
Make & Solder the Joints	2	Technical	3	18	21	2.1
Install Single Phase Electrical Wiring	2	Technical	6	18	24	2.4
Install Single Phase Complex Electrical Wiring	2	Technical	6	18	24	2.4
Install Three Phase Electrical Wiring	3	Technical	6	24	30	3
Install Three Phase Complex Electrical Wiring	3	Technical	6	24	30	3
			33	120	153	15.3
<b>PCB Fabrication (PCB Fabricator)</b>						
Use PCB Layout software for designing the circuits	2	Technical	6	18	24	2.4
Design & Assemble the Printed Circuit Board	2	Technical	20	120	140	14
			26	138	164	16.4
<b>TOTAL</b>			139	504	643	64.3

Level 3						
Digital Skills						
Install Computer Operating Systems And Hardware	Level 3	Generic	6	24	30	3
Operate Word-Processing Applications	Level 3	Generic	6	24	30	3
Operate Spreadsheet Applications	Level 3	Generic	6	24	30	3
Operate Presentation Packages	Level 3	Generic	6	24	30	3
Perform Writing And Editing Tasks	Level 3	Generic	6	24	30	3
Perform Computer Operations	Level 3	Generic	6	24	30	3
Use Computer Applications	Level 3	Generic	6	15	21	2.1
Create User Documentation	Level 3	Generic	6	15	21	2.1
Create Technical Documentation	Level 3	Generic	6	24	30	3
Create Basic Databases	Level 3	Generic	6	24	30	3
Operate Digital Media Technology	Level 3	Generic	6	24	30	3
Use Social Media Tools For Collaboration And Engagement	Level 3	Generic	6	24	30	3
E-Commerce	Level 3	Generic	6	24	30	3
Use Digital Devices	Level 3	Generic	6	24	30	3
			84	318	402	40.2
<b>Computer Applications (Computer Operator III-Electronics)</b>						
Develop & Analyze electrical circuit with MULTISM	3	Allied	9	27	36	3.6
Develop & Analyze Filters in MULTISM	3	Allied	6	30	36	3.6
Develop & Analyze Rectifier in MULTISM	3	Allied	6	27	33	3.3
Develop & Analyze Filters in PSPICE	3	Allied	9	27	36	3.6
Perform electrical analysis using C++	3	Allied	9	30	39	3.9
Develop & Analyze Amplifier circuits	3	Allied	3	15	18	1.8
Program a PLC using Ladder Logic	4	Allied	9	27	36	3.6
			51	183	234	23.4
<b>Electrical Instruments &amp; Measurements (Electronics Measurement Technician)</b>						
Convert galvanometer into ammeter, voltmeter, Ohm meter	3	Technical	9	27	36	3.6



& calibrate them						
Use different instruments to measure the parameters of electrical signals & components	3	Technical	12	30	42	4.2
Use digital instruments to test the logic signal	3	Technical	3	14	17	1.7
			24	71	95	9.5
<b>Electronic Devices (Electronics Lab Technician III)</b>						
Identify Basic Electronics Components	Level 3	Technical	9	21	30	3
Design a Rectifier using Diode	Level 4	Technical	9	21	30	3
Carry out Diode Application	Level 3	Technical	9	21	30	3
Implement Bipolar Junction Transistor (BJT) in Different Applications	Level 3	Technical	9	21	30	3
Implement Field Effect Transistor (FET) in Different Applications	Level 3	Technical	9	21	30	3
Implement Thyristor Family in Various Application	Level 3	Technical	9	21	30	3
Applications of Operation Amplifier	Level 4	Technical	9	21	30	3
			63	147	210	21
<b>Electrical Circuits (Basic Electronics Concept)</b>						
Verify Ohm's law & Kirchhoff's law by implementing their series and parallel circuits	Level 3	Technical	6	18	24	2.4
Overhaul the Lead acid batteries & Implement their series & Parallel circuits	Level 3	Technical	6	18	24	2.4
Measure Electrical power, Energy & Power Factor	Level 3	Technical	6	18	24	2.4
Implement Electromagnet to observe various effects & verify Faraday's law	Level 3	Technical	6	18	24	2.4
Measure different parameters of AC signal & Components	Level 3	Technical	6	18	24	2.4
			30	90	120	12
<b>TOTAL</b>			252	809	1061	106.1
<b>Level 4</b>						
<b>Analog Electronics (Analog Electronics Technician)</b>						
Identify the Semiconductor Devices	4	Technical	9	21	30	3
Construct The RF & AF Amplifiers	4	Technical	9	21	30	3
Design the Oscillators	4	Technical	9	21	30	3
Analyze operational Amplifier circuits	4	Technical	9	21	30	3

Design the Multi-Vibrators	4	Technical	9	21	30	3
Construct Ramp Generator circuits	4	Technical	9	21	30	3
Design Function Generator & Comparator circuits	4	Technical	9	21	30	3
			63	147	210	21
<b>Engineering Drawing &amp; Computer Aided Design (CAD developer Electronics')</b>						
Install CAD Software	3	Technical	6	18	24	2.4
Design & Simulate the Electronic Circuits using CAD software	4	Technical	30	100	130	13
			36	118	154	15.4
<b>Electrical Machines (Electrical Machines Operator)</b>						
Identify the types of DC Generators & draw load characteristics for DC shunt Generator	4	Technical	10	30	40	4
Identify the types of DC Motors & draw load characteristics of DC series motor	4	Technical	10	30	40	4
Identify the three phase motors & their starting methods	4	Technical	10	30	40	4
Operate an Alternator	4	Technical	6	24	30	3
Operate a Single phase, special purpose motor	4	Technical	6	24	30	3
			42	138	180	18
<b>Communication Systems (PABX Technician)</b>						
Identify the parts of Analog & digital telephone set & verify their functions	Level 5	Technical	8	18	26	2.6
Construct the AM / FM Transmitter & Receiver & verify their functionality	Level 5	Technical	8	18	26	2.6
Demonstrate modulation, demodulation, multiplexing & de-multiplexing	Level 5	Technical	8	18	26	2.6
Install Chord less telephone, PABX, Fax machine & satellite dish system	Level 5	Technical	8	18	26	2.6
Apply different concepts of propagation of waves	Level 5	Technical	8	15	23	2.3
			40	87	127	12.7
<b>Digital Electronics (Digital Electronics Technician)</b>						
Manipulate The Number Systems	3	Technical	6	18	24	2.4
Verify the Truth Tables for Logic Gates	3	Technical	9	21	30	3
Construct & Verify the Logic Circuits	4	Technical	9	27	36	3.6

Construct the Flip Flops	4	Technical	9	27	36	3.6
Use 555 Timer IC as a Multi-Vibrator	4	Technical	9	24	33	3.3
Construct Shift Registers and Counters	4	Technical	9	24	33	3.3
			51	141	192	19.2
<b>Manage Soft Skills</b>						
Develop Workplace Policy and Procedures for Sustainability	Level 4	Generic	6	24	30	3
Manage Meetings	Level 4	Generic	6	24	30	3
Manage Recruitment Selection and Induction Processes	Level 4	Generic	6	24	30	3
Manage Personal Work Priorities and Professional Development	Level 4	Generic	6	24	30	3
Manage Workforce Planning	Level 4	Generic	6	24	30	3
Perform Undertaking of Project Work	Level 4	Generic	6	24	30	3
Prepare and Implement Negotiation	Level 4	Generic	6	24	30	3
Maintain Professionalism in the Workplace	Level 4	Generic	6	24	30	3
Maintain Professional Development and Career Professionalism	Level 4	Generic	6	24	30	3
Organize Schedules	Level 4	Generic	6	24	30	3
Work Safely in an Office Environment	Level 4	Generic	6	24	30	3
Develop Workplace Documents	Level 4	Generic	6	24	30	3
Identify and Communicate Trends in Career Development	Level 4	Generic	6	24	30	3
Apply Specialist Interpersonal and Counseling Interview Skills	Level 4	Generic	6	24	30	3
			84	336	420	42
			316	967	1283	128.3
<b>Level 5</b>						
<b>Microcontroller Programming and Applications (Microcontroller Programmer)</b>						
Classify Microcontroller Types and Architectures	4	Technical	9	15	24	2.4
Carryout various Microcontroller Applications.	5	Technical	3	30	33	3.3
Apply Microcontroller to build Control System.	5	Technical	10	33	43	4.3
			22	78	100	10
<b>Power Electronics (Power Electronics Technician)</b>						

Design the Electronic Control circuits	5	Technical	15	38	53	5.3
Design Single Phase & Three Phase Converters.	5	Technical	27	54	81	8.1
Design the Inverters	5	Technical	9	27	36	3.6
			51	119	170	17
<b>Industrial Automation (PLC Technician)</b>						
Carryout System Automation using Sensors & Transducers	5	Technical	12	30	42	4.2
Carryout Industrial Automation Using PLC	5	Technical	14	30	44	4.4
Carryout System Automation using Linear Controls	5	Technical	12	30	42	4.2
			38	90	128	12.8
<b>Equipment Maintenance and Servicing (Home Appliances Technician)</b>						
Repair/service different Electronics Home Appliance	5	Technical	12	30	42	4.2
			12	30	42	4.2
<b>Develop Entrepreneur Skills (Entrepreneur)</b>						
Develop Entrepreneurial Skills	Level 5	Generic	6	18	24	2.4
Apply Project Information Management and Communication Techniques	Level 5	Generic	9	15	24	2.4
Apply Project Human Resources Management Approaches	Level 5	Generic	9	15	24	2.4
Direct Human Resources Management of a Project Program	Level 5	Generic	9	15	24	2.4
Develop A Project Management Plan	Level 5	Generic	6	15	21	2.1
Maintain Business Resources	Level 5	Generic	6	15	21	2.1
Develop A Sales Plan	Level 5	Generic	6	24	30	3
Plan and Implement Business-To-Business Marketing	Level 5	Generic	6	24	30	3
Address Customer Needs	Level 5	Generic	9	21	30	3
Manage Personal Finances	Level 5	Generic	9	15	24	2.4
Solve Problems Which Jeopardize Safety and Security	Level 5	Generic	6	24	30	3
Coordinate A Work Team	Level 5	Generic	6	24	30	3
Lead Small Teams	Level 5	Generic	6	24	30	3
Plan and Organize Work	Level 5	Generic	6	24	30	3

Develop Teams and Individuals	Level 5	Generic	6	24	30	3
Apply Problem Solving Techniques in the Workplace Using Critical Thinking	Level 5	Generic	6	24	30	3
Manage Human Resource Services	Level 5	Generic	6	24	30	3
			117	345	462	46.2
Semester Project		Technical		150	150	15

## 13. SUMMARY OF COMPETENCY STANDARDS

### 0714E&A1 Maintain Occupational Health and Safety

#### Overview:

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

Competency Units	Performance Criteria
<b>Ensure use of personal protective equipment (PPE)</b>	<ul style="list-style-type: none"> <li>P1. Arrange the required personal protective equipment</li> <li>P2. Check functional condition of PPE's</li> <li>P3. Wear personal protective equipment</li> <li>P4. Store PPE at appropriate place after use.</li> </ul>
<b>Maintain First-aid Box</b>	<ul style="list-style-type: none"> <li>P1. Ensure availability of first aid box</li> <li>P2. Check first aid box for requisite emergency</li> <li>P3. Check expiry of medicines</li> <li>P4. Perform first aid treatment against electric shocks</li> <li>P5. Perform first aid treatment/bandages against minor injuries.</li> </ul>
<b>Maintain Fire Extinguisher</b>	<ul style="list-style-type: none"> <li>P1. Check expiry of fire extinguisher</li> <li>P2. Operate fire extinguisher</li> <li>P3. Replace fire extinguisher</li> <li>P4. Ensure that the fire brigade is at stand by(for major emergency)</li> </ul>
<b>Ensure Safeguard of Machines</b>	<ul style="list-style-type: none"> <li>P1. Maintain radiator shield</li> <li>P2. Maintain alternator fan shield</li> <li>P3. Maintain heat resister material on silencer</li> <li>P4. Cover main circuit breaker</li> <li>P5. Lock canopy doors</li> </ul>
<b>Adopt company policies and procedures</b>	<ul style="list-style-type: none"> <li>P1. Ensure company's safety policy</li> <li>P2. Adopt company safety procedure</li> <li>P3. Advocate worker with company safety policy</li> <li>P4. Implement Safety sign board as per standard</li> </ul>
<b>Attain health &amp; safety training</b>	<ul style="list-style-type: none"> <li>P1. Take required health and safety training</li> <li>P2. Implement work hazardous material information system (WHMIS)</li> <li>P3. Adopt first aid cardio respiratory, resuscitation and CPR</li> </ul>
<b>Prepare for emergencies</b>	<ul style="list-style-type: none"> <li>P1. Take emergency response training</li> <li>P2. Ensure practice of emergency exercises</li> <li>P3. Check the emergency alarms</li> <li>P4. Ensure regular practice of gathering the workers in assembly area during the emergency.</li> </ul>
<b>Respond to emergencies</b>	<ul style="list-style-type: none"> <li>P5. Follow emergency plan</li> <li>P6. Communicate instructions to co workers</li> <li>P7. Assess risk and determine course of action</li> <li>P8. Operate emergency equipment and supplies</li> </ul>

### 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.



**0714E&A2 Adopt Safety Regulations, Labour Protection Laws, Environmental Protection Laws at Workplace**

**Overview :**

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

Competency Units	Performance Criteria
<b>CU1: Implement International Safety Standards in your work environment</b>	<p><b>P1.</b> Recognize Electrical Safety hazards as per International Electro- Technical Commission (IEC) Standards</p> <p><b>P2.</b> Determine Environmental Pollution risk factors as per Protection Agency (EPA) standards</p> <p><b>P3.</b> Identify Electrical Safety Hazards as per Institute of Electrical and Electronics Engineers (IEE) standards</p> <p><b>P4.</b> Categorize the Electrical Safety Hazards as per Electrical Safety Foundation International(ESFI) standards</p> <p><b>P5.</b> Identify Labor Protection Laws as per International Labor Organization(ILO) rules</p> <p><b>P6.</b> Identify the steps to minimize the Electrical hazards and Environmental Pollution.</p> <p><b>P7.</b> Prepare a report for all the above activity.</p>
<b>CU2: Implement National Safety Standards in your work environment</b>	<p><b>P1.</b> Identify Factory associated hazard as per Chapter 3 of Factories Act, 1934</p> <p><b>P2.</b> Determine Environmental Pollution factors as per Pakistan Environmental Protection Act, 1997</p> <p><b>P3.</b> Recognize the Labor protection laws as per Labor Protection Policy 2006</p> <p><b>P4.</b> Identify the workplace hazards as per Occupational health and safety (OHS) standards</p> <p><b>P5.</b> Identify the steps to minimize the Electrical hazards, Environmental Pollution and Labor Safety</p> <p><b>P6.</b> Prepare a report for all the above activity.</p>
<b>CU3: Implement International and National Labor Protection Laws</b>	<p><b>P1.</b> Identify Labor Protection Laws as per International Labor Organization(ILO) rules</p> <p><b>P2.</b> Recognize the Labor protection laws as per Labor Protection Policy 2006</p> <p><b>P3.</b> Identify the Bonded Labor and Child Labor policy.</p> <p><b>P4.</b> Determine the leaves policy and compensation policy for the Labor.</p> <p><b>P5.</b> Recognize the minimum wage for the Labor</p> <p><b>P6.</b> Identify the remedial steps for protection and prosperity of Labor.</p> <p><b>P7.</b> Prepare a report for all the above activity.</p>
<b>CU4: Implement National and International Environmental protection laws</b>	<p><b>P1.</b> Determine Environmental Pollution risk factors as per Protection Agency (EPA) standards</p> <p><b>P2.</b> Identify the steps to minimize the Electrical hazards and Environmental Pollution.</p> <p><b>P3.</b> Determine Environmental Pollution factors as per Pakistan Environmental Protection Act, 1997</p>

	<p><b>P4.</b> Identify the requirements for Initial Environmental Examination (IEE)</p> <p><b>P5.</b> Identify the requirements for Environmental Impact Assessment (EIA)</p> <p><b>P6.</b> Prepare a report for all the above activity.</p>
<b>CU5: Prepare for emergencies</b>	<p><b>P1.</b> Take emergency response training</p> <p><b>P2.</b> Ensure practice of emergency exercises</p> <p><b>P3.</b> Ensure the availability of first aid box and fire extinguisher</p> <p><b>P4.</b> Check the expiry of medicines and fire extinguishers</p> <p><b>P5.</b> Check the emergency alarms</p> <p><b>P6.</b> Ensure regular practice of gathering the workers in assembly area during the emergency.</p>
<b>CU6: Respond to emergencies</b>	<p><b>P1.</b> Follow emergency plan</p> <p><b>P2.</b> Communicate instructions to co workers</p> <p><b>P3.</b> Assess risk and determine course of action</p> <p><b>P4.</b> Operate emergency equipment and supplies</p> <p><b>P5.</b> Ensure that the ambulance and fire brigade is at stand by (for major emergency)</p>
<b>CU7: Adopt company policies and procedures</b>	<p><b>P1.</b> Ensure company's safety policy</p> <p><b>P2.</b> Adopt company safety procedure</p> <p><b>P3.</b> Advocate worker with company safety policy</p> <p><b>P4.</b> Implement Safety sign board as per standard</p>

### Knowledge & Understanding

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

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

## 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)

**Overview :**

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

Competency Units	Performance Criteria
<b>Demonstrate work ethic</b>	P1. Follow principles of work ethics in all situations P2. Adopt professional behavior
<b>Select factors affecting personal health</b>	P1. Follow factors affecting personal health P2. Aware about the situations/conditions that cause stress in professional and personal life
<b>Resolve problems or disagreements with others</b>	P1. Communicate effectively P2. Adopt peaceful approach P3. Regulate cause of problem or disagreement P4. Resolve issues
<b>Participate in professional development</b>	P1. Assess own knowledge and skills P2. Acquire information about training opportunities P3. Adopt to Learn through various methods, such as on job training, reading, courses and co-workers
<b>Work with others</b>	P1. Work as a team member to achieve common goals P2. Keep mind open. P3. Participate in work place meetings P4. Communicate accurately and clearly P5. Co-ordinate job related activities P6. Cooperate with others
<b>Work independently</b>	P1. Confirm and clarify assignment P2. Take initiative, anticipate and prepare for next steps in job P3. Identify and resolve potential and actual problems P4. Communicate with other site personnel P5. Complete assignment
<b>Speak and listen effectively</b>	P1. Listen carefully to what is said P2. Confirm understanding, such as repeat instructions P3. Communicate message clearly and accurately to others P4. Exchange information with others, such as supervisor, signaler, general public, inspectors, other operators and trade people
<b>Interpret documentation</b>	P1. Access and maintain documents P2. Provide complete, legible and accurate information in documents P3. Interpret equipment inspection documentation from previous shifts before conducting pre-operational inspection
<b>Communicate with signals</b>	P1. Identify and work with signals P2. Communicate with audible signals, such as back-up alarm, and site emergency horn P3. Communicate with hand signals
<b>Communicate with electronic equipment</b>	P1. Check communication devices to verify operating condition, such as complete radio checks P2. Deliver and receive messages using communication equipment P3. Follow communication protocol

## Knowledge & Understanding

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

### Critical Evidence(s) Required

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

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

## 14. Computer Fundamentals

### 0714E&A4 Identify Main Components of Computer

## Overview:

This competency standard covers the skills and knowledge required to identify the main components of the computer system (system software, application software, peripherals). It consists of competencies to identify computer hardware, operating system, application software and peripherals.

Competency Units	Performance Criteria
<b>Identify input peripheral</b>	<ul style="list-style-type: none"><li>P1. Identify key board</li><li>P2. Identify mouse</li><li>P3. Identify Camera</li><li>P4. Identify Scanner</li><li>P5. Identify microphone</li><li>P6. Identify Joysticks</li><li>P7. Identify Read only Memory (ROM) drive</li></ul>
<b>Identify output peripherals</b>	<ul style="list-style-type: none"><li>P1. Identify monitor</li><li>P2. Identify printer</li><li>P3. Identify headphone / earphone</li><li>P4. Identify speaker</li><li>P5. Identify multimedia project</li></ul>
<b>Identify processing unit</b>	<ul style="list-style-type: none"><li>P1. Identify processor</li><li>P2. Identify Random Access Memory (RAM)</li><li>P3. Identify Read only Memory (ROM)</li></ul>
<b>Identify secondary storage devices</b>	<ul style="list-style-type: none"><li>P1. Identify hard disk and types</li><li>P2. Identify pen drive/ Universal Serial Bus (USB) storage device</li><li>P3. Identify compact disk (CD)</li><li>P4. Identify Digital Versatile Disk (DVD)</li><li>P5. Identify External Portable USB storage device</li></ul>
<b>Identify computer for user requirements</b>	<ul style="list-style-type: none"><li>P1. Select the hardware components of Computer.</li><li>P2. Install the necessary plug-ins</li><li>P3. Install the required computer software's for operations of peripherals</li></ul>
<b>Make a set of requirements for a personal computer</b>	<ul style="list-style-type: none"><li>P1. Arrange processor, RAM, Hard drive, Graphic card according to the requirement.</li><li>P2. Identify requirements for a computer to run windows MS Office and Eclipse IDE</li></ul>
<b>Work on windows 10 Environment and Install the required operating System with Device drivers.</b>	<ul style="list-style-type: none"><li>P1. Install and execute test of required Application Software's.</li><li>P2. Make the Ghost of Hard Disk / Partitions.</li><li>P3. Apply the appropriate operation and execution of system as per standard</li><li>P4. Perform loading and shutdown of operating system.</li><li>P5. Create items (icons, shortcut, folders etc.) and modifying taskbar.</li><li>P6. Change the wallpaper, screensaver, and resolution.</li><li>P7. Check the control panel items (add/remove, time and date, mouse, and create user account.)</li></ul>

## **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:

- Computer components
- Define different components of computer system
- Devices
- Differentiate system software's and application software's
- Types of computers
- Computer operating systems
- Knowledge of Microsoft Windows, Linux operating system, Apple's operating system (Mac)
- Power ON and power OFF
- Multimedia systems
- Motherboards
- Multimedia storage devices:
- Video cards
- Sound cards
- Define Basic purpose of computer
- Describe relevant software according to your work.
- Describe Input and Output devices.
- Describe the difference between solid state drive (SSD) and SATA hard drive.
- 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
- Describe relevant software according to your work.
- Describe the difference between solid state drive (SSD) and SATA hard drive.
- Explain type of Installation, Testing and inspection of operating system and their applications.

## **Critical Evidence(s) Required**

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

- Draw computer system block diagram
- Identify the OS in machine



## Tools and Equipment required

The tools and equipment required for this competency standard are given below:

S. No	Items
1	Computer system
2	Printer
3	Scanner
4	Microphone
5	USB
6	DVD/ CD
7	Joystick

## 0714E&A5 Process Data using MS Office

### Overview:

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

### 1. Create Document in MS Word

#### Overview:

This competency intends to provide knowledge and skills on preparation of word documents. It also deals with basic interface, tools/menu management and word processing software handling techniques.

Competency Units	Performance Criteria
<b>1. Install MS Office suit</b>	P1. Ensure that necessary precautions have been taken before installing any software application P2. Register a software with the help of its key P3. Install MS Office application carefully as per instructional manual
<b>2. Type a Word Document</b>	P1. Open a new word file P2. Give a name and location to save the word file P3. Type in a MS word file P4. Ensure typed document is error free P5. Develop the typing speed as per standards
<b>3. Set-up page in a Word Document</b>	P1. Apply the page margins on the word document P2. Set a suitable orientation P3. Set the suitable size of the page P4. Divide word page in columns in the word file P5. Add new page
<b>4. Edit Word Document</b>	P1. Edit a typed word document P2. Insert a new word or delete a word in the MS word file P3. Insert a new paragraph or delete a paragraph in the MS word file P4. Add or delete a page or group of paragraph through

selection  
P5. Check the spellings in the word file through available dictionary  
P6. Edit a MS document as per the given specification / criteria / demand

## 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:

- Understand different software applications.
- Explain the procedure to install a software application as per given instructional manual.
- Explain how to open a new or saved file in MS Word.
- Explain how to save file in MS Word.
- Give details for use of Key Board for typing
- Explain how to apply the page margins in a word document.
- Define page set-up for word format.
- Explain editing, Add or delete a word, add or delete a paragraph, Add or delete a page and Apply spell checking

## Critical Evidence(s) Required

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

- Perform installation of a software application as per given instructional
- Set up page margins in a word document

## Tools and Equipment required

The tools and equipment required for this competency standard are given below:

S. No	Items
1.	Computer System
2.	MS Office suit
3	Drivers

## 2. Apply Basic Formulas in MS Excel

### Overview:

This competency intends to provide knowledge and skills on preparation of spreadsheets. It also deals with basic interface, tools/menu management and spreadsheets handling techniques.

Competency Units	Performance Criteria
<b>1. Design a Basic Excel sheet</b>	P1. Open a blank workbook P2. Give a name and location to save the workbook P3. Enter data in Excel Sheet P4. Ensure typed document is error free
<b>2. Set-up page in Excel Sheet</b>	P1. Apply the page margins on the Excel sheet P2. Set a suitable orientation P3. Set the suitable size of the page P4. Add new worksheet
<b>3. Design a marks sheet in MS Excel</b>	P1. Create a mark sheet of the class student having roll#, name ,Subject marks P2. Use sum formula for adding subject marks P3. Use average formula for calculating average of student

### 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 how to open a new or saved workbook in MS Excel.
- Explain how to save file in MS Excel.
- Explain how to apply the page margins in MS Excel.
- Define page set-up for MS Excel.
- Define Basic Formulas.
- Explain editing, Add or delete data in MS Excel.

### Critical Evidence(s) Required

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

- Create a workbook
- Add sheets in workbook
- Apply arithmetic operation on data (addition, subtraction, division, multiplication)

### Tools and Equipment required

The tools and equipment required for this competency standard are given below:

S. No	Items
1	Computer System
2	MS Excel

## **Create presentation in MS PowerPoint**

### **Overview:**

This competency intends to provide knowledge and skills on preparation of presentation. It also deals with basic interface, tools/menu management and presentation handling techniques.

<b>Competency Units</b>	<b>Performance Criteria</b>
<b>1. Design a Basic Power Point presentation</b>	P1. Open a new Power Point presentation P2. Give a name and location to save the PowerPoint presentation P3. Enter text / graph / picture in slide P4. Ensure typed presentation is error free
<b>2. Set-up presentation templates</b>	P1. Open the existing slide design P2. Apply the desired design P3. Set the suitable size of the slide P4. Add new / delete slide P5. Set the slide view as per requirement
<b>3. Run a PowerPoint slide show</b>	P1. Open a power point presentation P2. Click on slide show icon on task bar P3. Press arrow key to move to the next slide P4. Press escape to end a slide show

### **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 how to open a new or saved power point presentation,
- Explain how to save file in MS Power point,
- Explain how to apply slide design in MS power point,
- Explain editing, Add or delete text image graph in power point slides.

### **Critical Evidence(s) Required**

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

- Prepare a power point presentation containing images, graphs and text as per given requirements

### **Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

<b>S. No</b>	<b>Items</b>
1	Computer System
2	MS Power point

## 0714E&A6 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
1. Write a program to perform arithmetic operations	P1. Install eclipse or other IDE with C++ P2. Design a program that can take inputs from users and perform arithmetic operations like a calculator P3. Run the program and verify the results
2. Write a program in C++ to preparing logical operation	P1. Design a program that takes two numbers and decides which is bigger and which is smaller P2. Design a program that takes number of lights, fans in a house and calculate load
3. Design a program to sort a string of numbers	P1. Write a script to take 10 numbers as input and display P2. Design a program to sort numbers in increasing order P3. Run the program and verify the results

### Knowledge & understanding

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

### Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Turbo C++ Software
2	PC

### Critical Evidence(s) Required

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

- Design a program to sort a string of numbers
- Write program to perform add two numbers

**Overview:**

This competency standard covers the skills and knowledge required for Application for the mathematic in C++ language

Competency Units	Performance Criteria
<b>CU1. Generate Addition &amp; Subtraction Program</b>	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
<b>CU2. Generate Multiplication &amp; Division Program</b>	P1. Open turbo C++ software P2. Create new file P3. write a program for multiplication P4. Save and run the program P5. Identify the error in compiler P6. Remove the error if required
<b>CU3. Generate Program For Power Calculations</b>	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
<b>CU4. Generate Program For Roots Calculations</b>	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
<b>CU5. Generate Program For Exponential Calculations</b>	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
<b>CU6. Generate Trigonometric Function Program</b>	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
<b>CU7. Generate Inverse Trigonometric Function Program</b>	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
<b>CU8. Generate The Program and Calculate Impedance In Polar</b>	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
<b>CU9. Generate the Program And Calculate Impedance In Rectangular</b>	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
<b>CU10. Generate the Program And CU11. Calculate Impedance In Polar</b>	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
<b>CU12. Generate the Program And Calculate Impedance In Rectangular</b>	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
<b>CU13. Generate Rectangular To Polar Form Conversion program</b>	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
<b>CU14. Generate Polar Form To Rectangular Form program</b>	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 Types
- Describe operational procedure of C++.
- Describe complex number, its rectangular and polar form.
- Describe formula for conversion of rectangular to polar form.

### Tools and Equipment Required

Tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Power Cables
2	Keyboard,
3	CPU
4	Monitor
5	Printer
6	Multimedia
7	Multimedia Screen

8	Internet
9	Relevant Software Disks.
10	Presentation manuals
11	Handouts
12	Hardware equipment

### **Critical Evidence(s) Required**

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

- How an existing C++ program works
- discover errors in a C++ program and describe how to fix them
- critique a C++ program and describe ways to improve it write code of calculator



## 15. Electric wiring

### 0714E&A8 Carryout basic Electrical Installation

#### Overview:

This competency standard deal with the skills and knowledge required to lay cables, perform single & three phase connections, basic electric wiring and wiring test for carrying out basic electrical Air Condition (AC) installation.

Competency Units	Performance Criteria
<b>CU1.</b> Perform Basic Electrical wiring	P1. Measure cables as per requirement P2. Connect cables P3. Perform joints P4. Insulate Joints
<b>CU2.</b> 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
<b>CU3.</b> Lay cables	P1 Interpret electrical drawing/ document P2. Identify cables P3. Lay cables P4. Perform earthling
<b>CU4.</b> Perform single-phase Connection	P1. Select cable gauge P2. Select cables colors P3. Connect cables P4. Insulate Joints
<b>CU5.</b> Perform three phase Connection	P1. Select cable Gauge P2. Select cables colors P3. Connect cables P4. Insulate Joints

#### Knowledge & Understanding

- Define the Types of cables
- Describe Gauges of cables
- Define single phase

- Connection
- Describe the types of joints
- Define conductor and insulator
- Define three phase connection
- Explain color code of cables / phase sequence
- Explain Methods of Wiring ,Types of wiring
- Describe Types of connections
- Describe types of wiring tests
- Explain different wiring systems
- Explain the uses of each type of wiring.

**Critical Evidence(s) Required**

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

Evidence of the following is essential:

- Enlist the name of Electrical wiring test.
- Perform short circuit test on electrical wiring.
- Perform open circuit test on electrical wiring.
- Perform continuity test on electrical wiring.

**Tools and Equipment required**

Sr.No.	Name
	Cables. Wires. Wire stripper. Plier. Nose plier. Insulation remover. Solder. Solder wire. Soldering paste.

**0714E&A9      Make & Solder the Joints**

**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
<b>Make Cross/Twist joint</b>	P1. Select the cable. P2. Strip the wire according to 50mm. P3. Twist the conductors. P4. Solder the conductor P5. Insulate the joint
<b>Make Straight/Married joint</b>	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.
<b>Make T- Joint</b>	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.
<b>Make Rat tail joint</b>	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.
<b>Make Britannia joint</b>	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.

### Critical Evidence(s) Required

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

Evidence of the following is essential:

- Enlist the name of cables joints.
- Perform cross or twist joint.
- Make T joint for cable.
- Make Britannia joint for cable.

### **Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

<b>Sr.No.</b>	<b>Name</b>
1	Cables.
2	Wires.
3	Wire stripper.
4	Plier.
5	Nose plier.
6	Insulation remover.
7	Solder.
8	Wire Tester

**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 tunnel circuit and make impulse switch circuit.

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

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

### Knowledge & Understanding

- Describe sockets.
- What is lamp?
- Explain single pole switch circuit and its use.
- Define current, voltage, power and resistance
- Explain two way switch circuit and its use.
- Describe two way circuits.
- Explain series circuit and its use
- Define parallel circuit.

### Critical Evidence(s) Required

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

Evidence of the following is essential:

- Make connection of single pole switch to control a light bulb.
- Control a switch socket with the help of single pole switch.
- Implement two-way switch to control the stair case lamp.
- Make series test board.

### Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Electrician Tool kit.

2	Single pole switch.
3	Lamp holder
4	Lamp.
5	Wooden/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	Series board.
14	Electrician Tool kit.
15	Two way switch
16	Socket

**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
<p><b>1. Install Bell indicator circuit.</b></p>	<p>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</p>
<p><b>Prepare fluorescent tube circuit and install.</b></p>	<p>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</p>

**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 bell circuit.
- Explain fluorescent tube circuit

**Critical Evidence(s) Required**

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

Evidence of the following is essential:

- Make circuit connection for door bell.
- Enlist different applications of operational amplifier.
- Make connection to install fluorescent tube light.

**Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Electrician Tool kit.
2	Single pole switch.
3	Lamp holder
4	Lamp.
5	Wooden/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	Series board.
15	Test Indicator.
16	Fluorescent Tube.

**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.

Competency Units	Performance Criteria
<p><b>CU5. Make and Install 3 phase motor connection ON/OFF by CAM Switch</b></p>	<p>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</p>
<p><b>Make and Install 3 phase motor connection reversing by CAM Switch</b></p>	<p>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                      P10. Connect the main supply</p>
<p><b>Make and Install 3 phase motor connection ON/OFF by Magnetic Contactor</b></p>	<p>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</p>

### **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 control diagram
- Describe Magnetic contactor.
- 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.

### **Critical Evidence(s) Required**

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

Evidence of the following is essential:

- Control the on/off operation of three phase motor with the help of Cam switch
- Implement magnetic contactor to on/off a three-phase motor.

### **Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

<b>Sr.No.</b>	<b>Name</b>
1	Electrician Tool kit
2	On/Off CAM switch.
3	Three phase induction motor.
4	Fuse.
5	PVC Board.
6	PVC Wire.
7	PVC Connector Bar
8	PVC Pipe/Duct.
9	Reversing CAM switch.
10	Three phase induction motor.
11	Fuse.
12	Reversing CAM switch.
13	Push button.
14	Overload relay
15	Magnetic contactor.

## 0714E&A12 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
<b>Make and Install 3 phase motor connection Reverse/ forward by Magnetic contactor.</b>	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
<b>Make and Install 3 phase motor connection Reverse/ forward by Magnetic contactor with indicator.</b>	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
<b>Make and Install 3 phase motor connection Star/Delta (Manual) by Magnetic contactor.</b>	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

<b>Make and Install 3 phase motor connection Star/Delta (Manual) by Magnetic contactor with indicator.</b>	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
<b>Make and Install 3 phase motor connection Star/Delta (Auto) by Magnetic contactor.</b>	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
<b>Make and Install 3 phase motor connection Star/Delta (Auto) by Magnetic contactor with indicator</b>	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
<b>Make and Install 3 phase motor connection 2 speed by Magnetic contactor.</b>	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
<b>Make and Install 3 phase motor connection 2 speed by Magnetic contactor with indicator</b>	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

### **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.
- 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.
- Describe 2 speed motor connection and its uses.
- Describe the purpose of 2 speed motor circuit.

### **Critical Evidence(s) Required**

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

Evidence of the following is essential:

- Make DOL starter connection with three phase motor.
- Make connection of automatic star-delta starter with three phase motor.
- Make manual star delta starter connection with three phase motor.

### **Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

<b>Sr.No.</b>	<b>Name</b>
1	Electrician Tool kit
2	Magnetic Contactor.
3	Three phase induction motor.
4	Fuse.
5	PVC Board.
6	PVC Wire.
7	PVC Connector Bar
8	Screw.
9	Push button.
10	Over load relay.
11	Three phase induction motor
15	PVC Pipe/Duct.
17	Push button.

<b>20</b>	Indicator
<b>21</b>	PVC Board.

## 16. PCB Fabrication

### 0714E&A13 Use PCB Layout software for designing the circuits

After this competency standard the trainee will be able to use PCB layout software and generate various circuits.

<b>Run the PCB layout software</b>	P1. Recognize the occupational health and safety (OHS) rules and establish risk control measures P2. Search for the PCB layout software installed in your system P3. Run the software
<b>Prepare circuit designs</b>	P1. Discover the toolbar and libraries. P2. Draw various schematic diagrams of different circuits. P3. Perform Routing. P4. Convert the schematic diagrams into PCB layout diagrams using software.

#### Knowledge and understanding

- Describe the occupational health and safety (OHS) rules
- Define the toolbar and libraries
- Knowledge of the various software used.

#### Critical Evidence(s) Required

- The candidates need to produce following critical evidence(s) in order to be competent in this competency standard:

Prepare circuit designs

#### Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	PCB Board
2	Computer
3	Software



**0714E&A14 Design & Assemble a Printed Circuit Board****Overview:**

After this competency standard, the trainee will be able to gain knowledge and develop competence required to design and assemble a Printed Circuit Board (PCB).

Competency Units	Performance Criteria
<b>Prepare the design for PCB</b>	<p>P1. Recognize the occupational health and safety (OHS) rules and establish risk control measures</p> <p>P2. Choose the most appropriate method from Iron on Glossy paper method, Circuit by hand method and Laser cutting edge etching method.</p> <p>P3. Select tool and material required during various steps, involved in manufacturing</p> <p>P4. Prepare a time and cost estimation draft for the PCB.</p>
<b>Prepare a schematic diagram and PCB layout</b>	<p>P1. Select the PCB design software and its version</p> <p>P2. Discover the toolbar and libraries.</p> <p>P3. Draw a schematic diagram of the circuit.</p> <p>P4. Perform Routing.</p> <p>P5. Convert the schematic diagram into PCB layout diagram using software.</p>
<b>Print the PCB layout.</b>	<p>P1. Select the appropriate printer</p> <p>P2. Choose the suitable paper</p> <p>P3. Choose the proper ink for the print</p> <p>P4. Adjust the size of paper in printer</p> <p>P5. Send 'Print' command</p>
<b>Transfer Circuit to the PCB.</b>	<p>P1. Cut the copper board according to the size of the layout using a hacksaw or a cutter</p> <p>P2. Gently rub the copper side of PCB using sponge in order to remove the top oxide layer of copper as well as the photo resist layer by gentle rub</p> <p>P3. Adjust the printed paper on the board and use tape to align it properly</p> <p>P4. Apply moderate heat for few minutes using laundry iron to transfer ink from the paper to PCB board.</p> <p>P5. Soak it into the water until paper gets soggy and then gently remove the paper.</p>

<b>Perform Etching and cleaning</b>	<p>P1. Put on rubber or plastic gloves.</p> <p>P2. Place some newspaper on the bottom so the etching solution does not spoil your floor.</p> <p>P3. Take a plastic box and fill it up with some water.</p> <p>P4. Dissolve 2-3 teaspoons of ferric chloride powder in the water.</p> <p>P5. Dip the PCB into the etching solution (Ferric chloride solution, FeCl<sub>3</sub>) for approximately 30 minutes.</p> <p>P6. Use thinner (nail polish remover) on a pinch of cotton wool to remove tonner ink.</p> <p>P7. Dry the plate using clean cloth</p>
<b>Drill and Solder the components</b>	<p>P1. Select the mini drill.</p> <p>P2. Perform drilling on the copper side according to the layout</p> <p>P3. Properly rinse with water and dry the plate to remove unwanted particles</p> <p>P4. Select solder and perform soldering of the components</p> <p>P5. Perform Testing(If required)</p>

### Knowledge and understanding

- Describe the occupational health and safety (OHS) rules
- Differentiate between Glossy paper method, Circuit by hand on PCB and Laser cutting edge etching.
- Which method is an industrial method?
- Describe the various steps involved in manufacturing and the tools and materials required.
- How to prepare cost and time estimation draft for the PCB
- Enlist the PCB design software and their latest versions
- Explain the tools and their functions in a toolbar
- Describe the Electronic Components and Sub-Assemblies required in circuit design
- Define 'Routing'.
- How to prepare a schematic drawing and convert it into a PCB layout
- Explain the selection of printers
- Explain the usage of black ink
- Define the side of the paper, suitable for prints
- Explain the printing of your circuit

- Explain the steps involved in cutting a PCB board and removing oxide layer of copper
- What are the different temperature ranges for different papers?
- How to remove paper from the board?
- Describe the safety measures.
- Describe Etching?
- Why is there need for removing excessive copper?
- Which solution is used for Etching?
- What are the advantages of using FeCl<sub>3</sub>?
- What are advantages of using thinner?
- What safety measures should be followed?
- Explain the uses of mini drill
- Why is drilling done on the copper side?
- Explain the size selection for solder
- Describe the post assembly Tests.

### **Critical Evidence(s) Required**

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

- PCB of charging circuit

### **Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	PCB Board
2	Etching Solution (Ferric Chloride)
3	Fine Tipped Marker
4	Ruler (optional)
5	Magazine Paper
6	Glossy Paper
7	Plastic Straws
8	Small Piece of Cloth
9	Sanding Paper
10	Mini Drill (Dremel)
11	Flat Iron
12	Laser Printer / Photocopying Machine
13	Latex Gloves /Eye Protection
14	Altium Designer, OrCAD, Pads, KiCad, Eagle

## 17. Digital Skills

### 0714E&A15 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
<b>Identify operating system and hardware components</b>	<p>P1. Determine ICT organizational requirements and specifications</p> <p>P2. Identify and select operating system</p> <p>P3. Identify appropriate external hardware components</p> <p>P4. Identify internal hardware components</p>
<b>2. Install and configure operating system and application software with hardware components</b>	<p>P1. Install and configure operating system to meet organizational requirements</p> <p>P2. Identify the functions associated with the operating system and associated boot process</p> <p>P3. Configure power-management settings to minimize power consumption as an environmentally sustainable measure</p> <p>P4. Use both the graphical user interface and the command line interface to perform basic tasks</p> <p>P5. Install or upgrade application software onto the operating system and hardware configuration</p> <p>P6. Determine the relationship between an application program, the operating system and hardware</p> <p>P7. Identify general differences between the different computer platforms and their respective operating systems</p>
<b>3. Optimize operating system and hardware components</b>	<p>P1. Optimize operating system using included tools or third-party utilities</p> <p>P2. Customize the graphical user interface</p> <p>P3. Use techniques unique to the command line interface</p> <p>P4. Set up and configure external hardware components and check functionality</p> <p>P5. Install drivers as appropriate and check functionality</p>

#### 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.

## 0714E&A16 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
<b>Create documents</b>	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
<b>Customize basic settings to meet page layout conventions</b>	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
<b>Format documents</b>	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
<b>Create tables</b>	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
<b>Add images</b>	P1. Insert appropriate images into document and customize as necessary P2. Position and resize images to meet document formatting needs
<b>Print documents</b>	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.

**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
<b>Create presentations</b>	<ul style="list-style-type: none"> <li>P1. Open presentation package and create a simple design for a presentation according to organizational requirements</li> <li>P2. Open blank presentation and add text and graphics</li> <li>P3. Apply existing styles within a presentation</li> <li>P4. Use presentation template and slides to create a presentation</li> <li>P5. Use various tools to improve the look of the presentation</li> <li>P6. Save presentation to the appropriate storage device and folder</li> </ul>
<b>Customize basic settings</b>	<ul style="list-style-type: none"> <li>P1. Adjust display to meet user requirements</li> <li>P2. Open and view different toolbars to view options</li> <li>P3. Ensure font settings are appropriate for the presentation purpose</li> <li>P4. View multiple slides at once</li> </ul>
<b>Format presentations</b>	<ul style="list-style-type: none"> <li>P1. Use and incorporate organizational charts and bulleted lists, and modify as required</li> <li>P2. Add objects and manipulate to meet presentation purposes</li> <li>P3. Import objects and modify for presentation purposes</li> <li>P4. Modify slide layout, including text and colors, to meet presentation requirements</li> <li>P5. Use formatting tools as required within the presentation</li> <li>P6. Duplicate slides within and across a presentation</li> <li>P7. Reorder sequence of slides and delete slides for presentation purposes</li> <li>P8. Save presentation in another format</li> <li>P9. Save to storage device and close presentation</li> </ul>
<b>Add slide show effects</b>	<ul style="list-style-type: none"> <li>P1. Incorporate pre-set animation and multimedia effects into presentation as required to enhance the presentation</li> <li>P2. Add slide transition effects to presentation to ensure smooth progression through the presentation</li> <li>P3. Test presentation for overall effect</li> <li>P4. Use onscreen navigation tools to start and stop slide show or move between different slides as required</li> </ul>
<b>Print presentation and notes</b>	<ul style="list-style-type: none"> <li>P5. Select appropriate print format for presentation</li> <li>P6. Select preferred slide orientation</li> <li>P7. Add notes and slide numbers</li> <li>P8. Preview slides and run spell check before presentation</li> <li>P9. Print selected slides and submit presentation to appropriate person for feedback</li> </ul>

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.

**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
<b>Create spreadsheets</b>	<ul style="list-style-type: none"> <li>P1. Open the spreadsheet application, create spreadsheet files and enter numbers, text and symbols into cells according to information requirements</li> <li>P2. Enter simple formulas and functions using cell referencing when required</li> <li>P3. Correct formulas when error messages occur</li> <li>P4. Use a range of common tools during spreadsheet development</li> <li>P5. Edit columns and rows within the spreadsheet</li> <li>P6. Use the auto-fill function to increment data where required</li> <li>P7. Save the spreadsheet to a folder on a storage device</li> </ul>
<b>Customize basic settings</b>	<ul style="list-style-type: none"> <li>P1. Adjust page layout to meet user requirements or special needs</li> <li>P2. Open and view different toolbars</li> <li>P3. Change font settings so they are appropriate for the document purpose</li> <li>P4. Change alignment options and line spacing according to spreadsheet formatting features</li> <li>P5. Format cell to display different styles as required</li> <li>P6. Modify margin sizes to suit the purpose of the spreadsheets</li> <li>P7. View multiple spreadsheets concurrently</li> </ul>
<b>Format spreadsheet</b>	<ul style="list-style-type: none"> <li>P1. Use formatting features as required</li> <li>P2. Copy selected formatting features from another cell in the spreadsheet or from another active spreadsheet</li> <li>P3. Use formatting tools as required within the spreadsheet</li> <li>P4. Align information in a selected cell as required</li> <li>P5. Insert headers and footers using formatting features</li> <li>P6. Save spreadsheet as another file type</li> <li>P7. Save to storage device and close spreadsheet</li> </ul>
<b>Incorporate object and chart in spreadsheet</b>	<ul style="list-style-type: none"> <li>P1. Import an object into an active spreadsheet</li> <li>P2. Manipulate imported object by using formatting features</li> <li>P3. Create a chart using selected data in the spreadsheet</li> <li>P4. Display selected data in a different chart</li> <li>P5. Modify chart using formatting features</li> </ul>
<b>Print spreadsheet</b>	<ul style="list-style-type: none"> <li>P1. Preview spreadsheet in print preview mode</li> <li>P2. Select basic printer options</li> <li>P3. Print spreadsheet or selected part of spreadsheet</li> <li>P4. Submit the spreadsheet to appropriate person for approval or feedback</li> </ul>

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:

#### 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 spreadsheets
- customize basic settings
- format spreadsheets
- create basic formulas
- insert objects and charts in spreadsheets
- Save and print spreadsheets.

## 0714E&A19 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
<b>Apply clear and appropriate language and style to writing and editing tasks</b>	<p>P1. Use safe work practices including addressing ergonomic requirements when undertaking writing tasks</p> <p>P2. Use clear, concise and plain English in writing and editing tasks</p> <p>P3. Apply appropriate paragraph structure to written material to ensure clarity of meaning and ease of reading</p> <p>P4. Make clear and logical connections between sentences, paragraphs and sections</p> <p>P5. Determine and incorporate the language and style of the audience</p>
<b>Apply the appropriate voice, tone and tense</b>	<p>P1. Determine appropriate voice, tone and tense of the written materials according to audience requirements</p> <p>P2. Maintain consistent voice, tone and tense throughout written material</p>
<b>Apply appropriate grammar, spelling and punctuation</b>	<p>P1. Apply appropriate grammar conventions to a range of written contexts including use of numbers, quotations, and tables</p> <p>P2. Apply appropriate spelling and punctuation conventions in writing and editing tasks.</p>
<b>Perform editing and proofreading tasks to meet requirements</b>	<p>P1. Edit written material to ensure clear meaning through language and paragraphs, consistent voice, tone and tense</p> <p>P2. Copyedit written material by checking grammar, spelling and punctuation using standard editing conventions</p> <p>P3. Proofreading using style guides and by monitoring written material for errors</p>

### 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

Follow relevant health and safety practices for writing tasks

## 0714E&A20 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
<b>Plan and prepare for task to be undertaken</b>	<p>P1. Requirements of task are determined as per standard</p> <p>P2. operating procedures</p> <p>P3. Appropriate hardware and software is selected according to task assigned and required outcome</p> <p>P4. Task is planned to ensure</p>
<b>Input data into computer</b>	<p>P1. Data are entered into the computer using appropriate program/application in accordance with company procedures</p> <p>P2. Accuracy of information is checked and information is saved in accordance with standard operating procedures</p> <p>P3. Inputted data are stored in storage media according to requirements</p> <p>P4. Work is performed within ergonomic guidelines</p>
<b>Access information using computer</b>	<p>P1. Correct program/application is selected based on job requirements</p> <p>P2. Program/application containing the information required is accessed according to company procedures</p> <p>P3. Desktop icons are correctly selected, opened and</p> <p>P4. closed for navigation purposes</p> <p>P5. Keyboard techniques are carried out in line with OH &amp;S requirements for safe use of keyboards</p>
<b>Produce/output data using computer system</b>	<p>P1. Entered data are processed using appropriate software commands</p> <p>P2. Data are printed out as required using computer hardware/peripheral devices in accordance with standard operating procedures</p> <p>P3. Files and data are transferred between compatible</p> <p>P4. systems using computer software, hardware/ peripheral</p> <p>P5. devices in accordance with standard operating</p> <p>P6. procedures</p>
<b>Maintain computer equipment and systems</b>	<p>P1. Systems for cleaning, minor maintenance and replacement of consumables are implemented</p> <p>P2. Procedures for ensuring security of data, including regular back-ups and virus checks are implemented in accordance with standard operating procedures</p> <p>P3. Basic file maintenance procedures are implemented in line with the standard operating procedures</p>

### 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

## 0714E&A21 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
<b>Use appropriate OHS office work practices</b>	<ul style="list-style-type: none"> <li>P1. Use safe work practices to ensure ergonomic, work organization, energy and resource conservation requirements are addressed</li> <li>P2. Use wrist rests and document holders where appropriate</li> <li>P3. Use monitor anti-glare and radiation reduction screens where appropriate</li> </ul>
<b>Install and remove software</b>	<ul style="list-style-type: none"> <li>P1. Select software to be installed</li> <li>P2. Follow installation instructions</li> <li>P3. Delete unrequired software</li> </ul>
<b>Use appropriate word-processing software</b>	<ul style="list-style-type: none"> <li>P1. Select word-processing software appropriate to perform activity</li> <li>P2. Identify document purpose, audience and presentation requirements, and clarify with personnel as required</li> <li>P3. Identify organizational requirements for text-based business documents and design document structure and layout to ensure consistency of style and image</li> <li>P4. Match document requirements with software functions to provide efficient production of documents</li> <li>P5. Use technical functions, other data and formatting to finalize documents</li> <li>P6. Ensure the naming and storing of documents in appropriate directories or folders and the printing of documents to the required specifications</li> </ul>
<b>Use appropriate spreadsheet software</b>	<ul style="list-style-type: none"> <li>P1. Select spreadsheet software appropriate to perform activity</li> <li>P2. Identify document purpose, audience and presentation requirements, and clarify with personnel as required</li> <li>P3. Enter simple formulas and functions using cell referencing where required</li> <li>P4. Customize spreadsheet settings and format documents to meet requirements</li> <li>P5. Ensure the naming and storing of documents in appropriate directories or folders and the printing of documents to the required specifications</li> </ul>
<b>Use appropriate presentation software</b>	<ul style="list-style-type: none"> <li>P1. Select software application package appropriate to perform activity</li> <li>P2. Identify purpose, audience and presentation requirements, and clarify with personnel as required</li> <li>P3. Use technical functions, other data and formatting to finalize documents</li> <li>P4. Ensure documents are named and stored in appropriate directories or folders and printed to required specifications</li> <li>P5. Make a presentation</li> </ul>

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.

## 0714E&A22 Create User Documentation

### Overview :

This unit 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
<b>Determine documentation standards and requirements</b>	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
<b>Produce user documentation</b>	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
<b>Review and obtain sign-off</b>	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.

## 0714E&A23 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
<b>Identify and analyze documentation requirements and client needs</b>	<p>P1. Consult with client to identify documentation requirements</p> <p>P2. Interpret and evaluate documentation requirements and confirm details with client</p> <p>P3. Investigate industry and documentation standards for requirements</p> <p>P4. Define and document the scope of work to be produced</p> <p>P5. Consult with client to validate and confirm the scope of work</p>
<b>Design documentation</b>	<p>P1. Identify information requirements with reference to layout and document structure</p> <p>P2. Create document templates and style guides consistent with information requirements</p> <p>P3. Conduct a review of the system in order to understand its functionality</p> <p>P4. Extract content that meets information requirements according to copyright restrictions</p> <p>P5. Develop the structure of the technical documentation giving focus to the flow of information, style, tone and content format</p> <p>P6. Validate the technical documentation structure with the client</p>
<b>Develop documentation</b>	<p>P1. Write technical documentation based on the template and scope of work using the information gathered</p> <p>P2. Translate technical terminology into plain English where appropriate</p> <p>P3. Apply content format and style according to documentation standards and templates</p>
<b>Evaluate and edit documentation</b>	<p>P1. Submit technical documentation to appropriate person for review Gather and analyze feedback</p> <p>P2. Incorporate alterations into the technical documentation</p> <p>P3. Edit the technical documentation for technical and grammatical accuracy</p>
<b>Prepare documentation for publication</b>	<p>P1. Check that the completed technical documentation meets client requirements and scope of work</p> <p>P2. Submit the technical documentation to appropriate person for approval</p> <p>P3. Prepare the technical documentation for publication and distribution using appropriate channels</p>

### 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.

**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.

<b>Unit of Competency</b>	<b>Performance Criteria</b>
<b>Analyze the requirements for the database</b>	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
<b>Use data modeling to design the database to suit requirements</b>	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
<b>Create a database on a web or database server</b>	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
<b>Test the database and debug</b>	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.

**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
<b>Use appropriate OHS office work practices</b>	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
<b>Identify and select appropriate digital media package</b>	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
<b>Use digital media package</b>	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
<b>Review digital media design</b>	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.

**0714E&A26 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.

<b>Unit of Competency</b>	<b>Performance Criteria</b>
<b>Describe different types of social media tools and applications</b>	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
<b>Compare different types of social media tools and applications</b>	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
<b>Set up and use popular social media tools and applications</b>	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.

**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
<b>Social Media Marketing</b>	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
<b>SCM (Supply Chain Management)</b>	P1. Identity 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
<b>SEO (Search Engine Optimization)</b>	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

- Describe Knowledge of different social media sites that is Facebook, Twitter, LinkedIn, Google+ etc., Comparative Statement, Award of Contract, Maintenance)
- K2: Explain Brand pages 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
- K5: 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 pages 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:

#### 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:

**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
<b>Prepare to use the digital device</b>	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
<b>Set up and use the digital device</b>	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
<b>Access and use basic connectivity devices</b>	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
<b>Shut down digital device</b>	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
- Save the results of work.

## 18. Computer Applications

### 0714E&A29 Develop and Analyse Electrical Circuit with MULTISM

#### Overview:

This competency standard covers the skills and knowledge required to identify computer software components Install and operate MULTISM. Identify 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
<b>CU1. Identify computer software components</b>	P1. Classify the software components of Computer. P2. Install the necessary plug-ins P3. Install computer software's as for requirement.
<b>CU2. Install and operate MULTISM</b>	P1. Open the MULTISM Screen and its menu. P2. Select component of circuit diagrams. P3. Insert electric component. P4. Draw wiring schematic diagram. P5. Perform circuit simulation. P6. Transfer to PCB layout. P7. Perform routing of the board. P8. Analyze result by changing components.
<b>CU3. Identify toolbox and libraries</b>	P1. Open the MULTISM Screen and its menu. P2. Select the required toolbox P3. Select the component of circuit diagrams. P4. Draw PCB layout. P5. Analyze result by changing component
<b>CU4. Develop RC circuit</b>	P1. Open the MULTISM screen and its menu. P2. Select component of circuit diagrams. P3. Insert electric component (resistor and capacitor). P4. Simulate the schematic diagram. P5. Transfer to PCB layout. P6. Analyze results for AC and DC.
<b>CU5. Develop RLC circuit</b>	P1. Open the MULTISM screen and its menu. P2. Select component of circuit diagrams. P3. Insert electric component (resistor, inductor and capacitor). P4. Simulate the schematic diagram. P5. Transfer to PCB layout Analyze results for AC and DC.
<b>CU6. Construct active filter</b>	P1. Open the MULTISM screen and its menu. P2. Select component of circuit diagrams. P3. Insert electric component. P5. Transfer to PCB layout. P6. Analyze results for low pass and band pass filter.
<b>CU7. Construct passive filter</b>	P1. Open the MULTISM and its menu. P2. Select component of circuit diagram. P3. Insert electric component. P5. Transfer to PCB layout P6. Analyze results for low, high, band and all pass.
<b>CU8. Construct Amplifier frequency response</b>	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.
<b>CU9. Construct half wave rectifier</b>	P1. Open the MULTISM screen and its menu. P2. Select component of circuit diagrams. P3. Insert electric component. P4. Transfer to PCB layout P5. Analyze results
<b>CU10.Construct full wave rectifier</b>	P1. Open the MULTISM screen and its menu. P2. Select component of circuit diagrams. P3. Insert electric component. P5. Transfer to PCB layout. P6. Analyze results.

### Knowledge & Understanding

- Define Basic purpose of computer
- Describe basic software components of computer.
- 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 issues/problems related to RC circuit.
- Understand basic hardware configuration required for software.
- Understand and knowledge of basic issues/problems related to RLC circuit.
- Describe basic issues/problems related to active/passive filter circuit.

### 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 techniques

**0714E&A30 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 assembling procedures and use of computer software PSPICE for developing/analysing electrical networks.

<b>Competency Units</b>	<b>Performance Criteria</b>
<b>CU1.Install and operate PSPICE</b>	<ul style="list-style-type: none"> <li>P1. Install the PSPICE from setup</li> <li>P2. Open the PSPICE Screen and its menu.</li> <li>P3. Select component of circuit diagrams.</li> <li>P4. Insert electric component.</li> <li>P5. Perform wiring of schematic.</li> <li>P6. Save file and Analyze setup.</li> <li>P7. Sweep AC to change frequency.</li> <li>P8. Analyze result by changing components.</li> </ul>
<b>CU2.Develop filters</b>	<ul style="list-style-type: none"> <li>P1. Open the PSPICE Screen and its menu.</li> <li>P2. Select component of circuit diagrams.</li> <li>P3. Insert electric component.</li> <li>P4. Perform wiring of schematic.</li> <li>P5. Save file and Analyze setup.</li> <li>P6. AC sweep to change frequency.</li> <li>P7. Analyze result for low pass filter and high pass filter.</li> </ul>
<b>CU3.Develop rectifier</b>	<ul style="list-style-type: none"> <li>P1. Open the PSPICE Screen and its menu.</li> <li>P2. Select component of circuit diagrams.</li> <li>P3. Insert electric component.</li> <li>P4. Wiring schematic.</li> <li>P5. Save file and Analysis setup.</li> <li>P6. AC sweep to change frequency.</li> <li>P7. Analyze result for half and full rectifier.</li> </ul>
<b>CU4. Construct CE Amplifier</b>	<ul style="list-style-type: none"> <li>P1. Open the PSPICE Screen and its menu.</li> <li>P2. Select component of circuit diagrams.</li> <li>P3. Insert electric component.</li> <li>P4. Wiring schematic.</li> <li>P5. Save file and Analysis setup.</li> <li>P6. AC sweep to change frequency.</li> <li>P7. Analyze frequency response for CE Amplifier</li> </ul>
<b>CU5. Construct CB amplifier</b>	<ul style="list-style-type: none"> <li>P1. Open the PSPICE Screen and its menu.</li> <li>P2. Select component of circuit diagrams.</li> <li>P3. Insert electric component.</li> <li>P4. Wiring schematic.</li> <li>P5. Save file and Analysis setup.</li> <li>P6. AC sweep to change frequency.</li> <li>P7. Analyze frequency response for CB amplifier.</li> </ul>
<b>CU6.Construct CC Amplifier</b>	<ul style="list-style-type: none"> <li>P1. Open the PSPICE Screen and its menu.</li> <li>P2. Select component of circuit diagrams.</li> <li>P3. Insert electric component.</li> <li>P4. Wiring schematic.</li> </ul>

	P5. Save file and Analysis setup. P6. AC sweep to change frequency. P7. Analyze frequency response for CC amplifier.
<b>CU7. Design WEIN Bridge Oscillator</b>	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 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 knowledge of Wien 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
14	Hardware 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

**0714E&A31 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
<b>.Analyze customer requirement and specification</b>	<p>P1. Draw the general value chain of the end user.</p> <p>P2. Highlight the various stages and set of activities in the value chain drawing</p> <p>P3. Enlist the electrical appliances/materials required in electrical development process</p> <p>P4. Identify critical stages in the development</p> <p>P5. Identify the safety aspect required in the critical stages of the development</p> <p>P6. Enlist the possible energy efficient appliance/devices and global trends in electrical works</p> <p>P7. Analyze the client requirement at broad level.</p> <p>P8. Generate a report of various stages of electrical works.</p> <p>P9. Proposed appliance/materials as per global trends and clarify the technical specification.</p>
<b>Plan and estimate domestic electric work</b>	<p>P1. Plan the client requirement at broad level from the proposal.</p> <p>P2. Plan the electrical appliances/materials / used in different stages of the electrical development process</p> <p>P3. Plan and estimate electrical wiring</p> <p>P4. Estimate Installation and Material Cost</p> <p>P5. Estimate Power consumption for lighting and appliances</p> <p>P6. Plan a main and sub distribution board.</p> <p>P7. Ensure safety system.</p>
<b>Plan and estimate commercial electric work.</b>	<p>P1. Analyze the client requirement at broad level from the proposal.</p> <p>P2. Plan the electrical equipment /appliances/materials / used in different stages of the commercial electrical work</p> <p>P3. Plan and estimate electrical wiring</p> <p>P4. Estimate Installation and Material Cost</p> <p>P5. Estimate Power consumption for centralize lighting, heating, cooling system and other appliances.</p> <p>P6. Plan a main and sub distribution board.</p> <p>P7. Ensure safety measures in development process.</p> <p>P8. Enlist the material required.</p>
<b>Plan and estimate industrial electric work.</b>	<p>P1. Analyze the client requirement at broad level from the proposal.</p> <p>P2. Plan the electrical equipment /appliances/materials / used in different stages of the commercial electrical work</p> <p>P3. Plan and estimate electrical wiring</p> <p>P4. Estimate Installation and Material Cost</p> <p>P5. Estimate Power consumption for centralize lighting, heating, cooling system and other appliances.</p> <p>P6. Plan 3-phase line for heavy loads</p> <p>P7. Plan a separate control panel box for heavy machinery.</p>

- 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
- Describe 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.
- Describe 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.
- 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 domestic living room

**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.

<b>Competency Units</b>	<b>Performance Criteria</b>
<b>CU1. Install PLC software and Simulator</b>	<ul style="list-style-type: none"> <li>P1. Install the PLC Programming</li> <li>P2. Software as per PLC manufacturer such as RS logix 5000 and rest links classic etc.</li> <li>P3. Select the best and most frequently used Simulator for programming</li> <li>P4. Select the module</li> <li>P5. Input the generic value as per universal settings (check from internet/helped)</li> <li>P6. Start The Simulator.</li> <li>P7. Open PLC programming software</li> </ul>
<b>CU2. Create a program in simulator to switch ON/OFF a PLC timer.</b>	<ul style="list-style-type: none"> <li>P1. Open the programming software as per PLC manufacturer</li> <li>P2. Ensure that the Simulator is connected and is in switch ON condition</li> <li>P3. Create a basic ladder logic program for ON/OFF of a bulb using Examine ON and Examine OFF switch</li> <li>P4. Create a basic ladder logic program for Simple Start/Stop Ladder Logic Relay</li> <li>P5. Create a basic ladder logic program for Single Push Button On/Off Ladder Logic</li> <li>P6. Create a basic ladder logic program for with On Delay Timer</li> <li>P7. Create a basic ladder logic program for with Off Delay Timer</li> <li>P8. Create a basic ladder logic program for Traffic signal lights</li> <li>P9. Create a basic ladder logic program for Elevator Control.</li> </ul>
<b>CU3. Analyze user requirements and specifications</b>	<ul style="list-style-type: none"> <li>P1. Draw the general value chain of the end user industry</li> <li>P2. Highlight the set of activities that a firm operating in a specific industry performs in the value chain drawing</li> <li>P3. Enlist the equipment/gauges/sensors/actuators/transducers used in different stages of the process</li> <li>P4. Identify critical stages in the process</li> <li>P5. Identify the safety aspect required in the critical stages of the process</li> <li>P6. Analyze the possible automation in the existing processes and global trends in automation</li> <li>P7. Analyze the client requirement at broad level from the proposal</li> <li>P8. Generate a report of various industrial processes involved in industry</li> <li>P9. Collect the required specification of the equipment (if already prepared by the user) and clarify the technical specification.</li> </ul>

## 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:



- ✓ Install PLC Simulator on your PC/system
- ✓ Write a program to switch ON/OFF a motor by using Ladder Logic.

## Electrical Instruments & Measurements

### 0714E&A33 Convert galvanometer into ammeter, voltmeter, Ohm meter & calibrate them

#### Overview:

This competency standard covers the skills and knowledge required to Dismantle and identify the parts of PMMC, Convert milli ammeter into ampere meter with shunt, Convert ammeter meter into voltmeter with multiplier, Convert ammeter into ohm meter.

Competency Units	Performance Criteria
<b>Disassemble and identify the parts of PMMC.</b>	<p>P1. Select the PMMC and establish a method for disassembling activity as per SOP.</p> <p>P2. Use standard tools described in user manual</p> <p>P3. Apply disassembling techniques</p> <p>P4. Organize the tag-identification of the parts/components/wires of instruments.</p> <p>P5. Identify the parts (coil, needle, scale, moving iron, balance and control weight, scale, air damping chamber, permanent magnet etc )</p> <p>P6. Check for the proper operation/ functionality</p> <p>P7. Apply assembling techniques.</p>
<b>Convert milli ammeter into ampere meter with shunt.</b>	<p>P1. Identify the values of <math>I_m</math> &amp; <math>R_m</math> from Galvano meter.</p> <p>P2. Use the values of <math>I_m</math>, <math>R_m</math> &amp; <math>I_T</math> (total current) for which meter has to design, in shunt resistance (<math>R_{sh}</math>) formula to calculate value of shunt resistor.</p> <p>P3. Connect the calculated shunt resistor in parallel to the Galvano meter.</p> <p>P4. Apply desired current to modified Galvano meter.</p> <p>P5. Record full scale movement of needle on the Galvanometer scale</p>
<b>Convert ammeter meter into voltmeter with multiplier.</b>	<p>P1. Identify the values of <math>I_m</math> &amp; <math>R_m</math> form ammeter.</p> <p>P2. Calculate value of multiplier resistor by Using the values of <math>I_m</math>, <math>R_m</math> &amp; <math>V_T</math> (total voltage) for which meter must design, in multiplier resistance (<math>R_{se}</math>) formula</p> <p>P3. Connect the calculated multiplier resistor in series to the ammeter.</p> <p>P4. Apply desired voltage to the modified ammeter.</p> <p>P5. Record full scale movement of needle on the ammeter.</p>
<b>Convert ammeter into ohm meter.</b>	<p>P1. Get the full-scale deflection by using DC battery and series resistance</p> <p>P2. Connect the rheostat parallel to galvanometer for zero adjustment.</p> <p>P3. Short the connecting lead and verify the full-scale deflection.</p> <p>P4. Connect the leads across the known value resistor and record the needle deflection according to their values.</p>

<b>Calibrate voltmeter.</b>	<p>P1. Check the voltmeter physically for any abnormality.</p> <p>P2. If it is a digital voltmeter check its power On / Off system and necessary display. And if it is an Analog voltmeter carry out its physical checking of its electro dynamic or needle movement.</p> <p>P3. Select relevant appropriate reference voltage standard / source against which the voltmeter is to be calibrated.</p> <p>P4. Give proper warm up time / stabilization time to voltage meter before putting into the calibration setup.</p> <p>P5. Connect the voltage meter in the test / calibration set up / circuit according to the requirement of method selected or to the instructions given in its manual.</p> <p>P6. Select the desired ranges on the voltage meter and apply appropriate magnitude of voltage according to the range selected for calibration from the calibrator or the reference source.</p> <p>P7. Note the readings observed on the voltmeter.</p> <p>P8. Keep on increasing the applied magnitude of voltage from the source and note the corresponding readings given by the voltmeter.</p> <p>P9. Repeat every observation at least three times for each value of parameter selected.</p> <p>P10. Find standard deviation and uncertainty.</p> <p>P11. Prepare calibration report.</p>
<b>Calibrate ammeter</b>	<p>P1. Check the Instrument physically for any damage or abnormality.</p> <p>P2. Switch on the instrument and give proper time to stabilize the instrument.</p> <p>P3. Connect the two terminals of the voltage source to either side of the 1 k Ohm resistor.</p> <p>P4. Connect the two terminals of the ammeter in series to the resistor.</p> <p>P5. Switch on the voltage supply, and set it to 1 V.</p> <p>P6. Calculate the expected value of current using Ohm's law. Ohm's law states <math>V=IR</math>, where V is the voltage, I is the current and R is the resistance</p> <p>P7. Repeat every observation at least three times for each value of parameter selected.</p> <p>P8. Find standard deviation and uncertainty.</p> <p>P9. Prepare calibration report.</p>

### Knowledge & Understanding

- 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
- Define shunt.
- Define multiplier
- Describe the formula of shunt & multiplier.
- Define full scale current.
- Define  $I_m$ ,  $R_{sh}$ ,  $R_{se}$ .
- Knowledge of Calibration.

- Working of precision digital multimeter.
- Working of voltmeter.
- Working of ammeter.
- Mathematical knowledge of calculating standard deviation,
- Average Uncertainty A and Uncertainty B

**Critical Evidence(s) Required**

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

Evidence of the following is essential:

- Identify different parts of PMMC.
- Convert milli ammeter into voltmeter.
- Convert milli ammeter into ampere meter.
- Draw circuit diagram of series ohm meter using galvanometer.
- Draw circuit diagram of shunt ohm meter using galvanometer.
- Enlist methods of calibration for voltmeter & ampere meter

**Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

Sr. No	Items
	Ammeter
	Voltmeter
	Electrical test bench
	Power source (AC/DC)
	Multimeter
	Test probes
	Magnetic/ compass
	Static hand gloves
	Screw drivers
	Tweezer
	Wire cutter
	Nose plier
	Galvanometer
	DC power supply
	Connecting leads
	Resistance decade box
	Plier

## 0714E&A34 Use different instruments to measure the parameters of electrical signals & components

### 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, Use frequency counter to measure the frequency, Use VU meter to measure sound intensity, Use XY recorder to record the signal on paper.

Competency Units	Performance Criteria
Measure frequency with the help of frequency counter.	P1. Generate sine or square wave with signal generator. P2. Connect the output of signal generator to the input of frequency meter. P3. Note the reading form display
Measure sound intensity by Using VU meter	P1. Connect vu meter directly to 600 ohm line as per specification. P2. Give audio electrical signal to the input of 600 ohm line. P3. Take reading form vu meter.
Record the signal on paper Using XY recorder.	P1. Turn on the XY recorder and make proper adjustment to record the electrical signal. P2. Generate the signal form signal generator. P3. Apply the output of signal generator to its x and y input of recorder. P4. Take the pattern of given signal on the paper.
Measure unknown resistance using wheat stone bridge	P1. Select the unknown resistor Rx P2. Connect Rx in Wheatstone P3. bridge. P4. Balance the wheat stone bridge. P5. Calculate unknown resistance Rx using formula.
Measure unknown C & L. Using universal bridge	P1. Select the unknown Cx/Lx P2. Connect the Cx/Lx in the universal bridge. P3. Balance the universal bridge. P4. Calculate unknown Cx/Lx using formula.
Measure unknown R,L& C Using LCR meter	P1. Select R/L/C to measure its value. P2. Select the proper control and range of LCR meter for R/L/C measurement. P3. Connect the leads of LCR meter across the unknown R/L/C P4. Record the value of R/L/C from display.
Measure Q of coil Using Q meter	P1. Select the coil whose quality factor has to measure. P2. Turn on the supply of Q meter and Connect the coil with Q meter P3. Change the capacitance of Q meter form its control till voltmeter shows maximum reading. P4. Take reading of electronic voltmeter and thermal volt meter in Q meter & find out the Q value of coil by taking ration of both meter.
Measure AC current Using Clamp on AC .	P1. Select the proper load for the measurement of current P2. Select the proper control and scale of clamp on AC meter.

	<p>P3. Give supply to the load and insert one wire of load in the mouth of clamp on AC meter by use of pushing clip.</p> <p>P4. Record the value form display.</p>
<b>Measure High voltage with high voltage probe.</b>	<p>P1. Select voltage control of multimeter</p> <p>P2. Connect positive lead of multimeter with high voltage probe and negative to ground.</p> <p>P3. Turn on the supply of TV set and connect the high voltage probe to the anode of CRT.</p> <p>P4. Take the reading of voltmeter and multiply it by multiplying factor of high voltage probe and get the actual value of high voltage.</p>
<b>Measure power using watt meter</b>	<p>P1. Select a proper load to calculate the power</p> <p>P2. Connect watt meter with it.</p> <p>P3. Give supply and measure the reading of power.</p>

### Knowledge & Understanding

- Explain different controls of frequency meter.
- Describe working principle of frequency meter.
- Define is Schmitt trigger and describe its use.
- Define VU meter.
- Describe the unit of sound intensity
- Define XY recorder.
- Define working principle of XY recorder.
- Define recording type instrument.
- Describe and draw the wheat stone bridge circuit
- Working principle of Wheat stone Bridge circuit
- Describe and draw the universal bridge
- Working principle of universal Bridge.
- Describe the balance condition of bridge.
- Describe purpose of LCR meter.
- Define resistance, capacitance and inductance.
- Describe working principle of LCR meter
- Describe Q meter.
- Explain the Q of a coil
- Define thermal voltmeter
- Describe Clamp on AC meter.
- Describe working principle of clamp on AC meter.
- Describe different controls of clamp on AC meter.
- Describe the nominal range clamp on AC meter.
- Describe High voltage probe.
- Describe working principle of High voltage probe.
- What is multiplying factor of high voltage probe.
- Describe Watt meter
- Describe working principle of watt meter.

- Define current coil & voltage coil.

### **Critical Evidence(s) Required**

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

Evidence of the following is essential:

- Make connection diagram of VU meter to measure sound intensity.
- Draw wave shape of electrical signal using XY recorder.
- Measure value of unknown resistor using wheat stone bridge.
- Enlist the parameters which can be measured by universal bridge.
- Measure the Q value of a coil by using Q-meter.
- Measure AC current of a load using clamp on AC meter.
- Make connection of watt meter with load to measure its power.

### **Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

<b>Sr. No</b>	<b>Items</b>
1.	Power supply
2.	Signal generator
3.	Oscilloscope
4.	Connecting leads
5.	UV meter
6.	X ray recorder
8.	Universal bridge
9.	Wheat stone bridge circuit
10.	Resistors
11.	Inductors
12.	Capacitors
13.	LCR meter
14.	Q meter
15.	Coil
16.	Voltmeter
17.	Clamp on AC meter
18.	Load
19.	High Voltage probe
20.	Watt meter
21.	Proper AC load

**Overview:**

This competency standard covers the skills and knowledge required to Use logic pulser and logic probe to test the logic output of digital gates, Use clip to test the logic output of digital gates.

Competency Units	Performance Criteria
Test the logic output of digital gates using logic pulser and logic probe	P1. Place digital gate IC on bread board. P2. Connect IC with Vcc and Ground. P3. Give logic pulses at the input of digital gate with logic pulser. P4. Connect logic probe at the output terminal of gate and record the output.
Test the logic output of digital gates using clip.	P1. Place digital gate IC on bread board. P2. Connect IC with Vcc and Ground. P3. Connect logic Clip with pins of digital gate IC. P4. Give logic pulses at the input of digital gate with logic pulser. P5. Record the output form logic clip against each given input.

**Knowledge & Understanding**

- Describe logic pulser.
- Describe the function of logic probe.
- Define logic clip.

**Critical Evidence(s) Required**

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

Evidence of the following is essential:

- Generate 15 KHz, square wave signal, using signal generator.
- Measure voltage, frequency and time period of a signal using oscilloscope.
- Find out the rms& average value of AC signal using oscilloscope

**Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

Sr. No	Items
1.	Digital gate IC
2.	Bread board
3.	Logic Probe
4.	Logic pulser
5.	Logic clip
6.	Connecting leads



## 19. Electronic devices

### 0714E&A36 Identify Basic Electronics Components

#### Overview:

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
<b>1. Identify Various Diodes</b>	P1. Identify the Diodes P2. Identify its types & polarities P3. Draw Diode characteristics curves in forward and reverse Biased
<b>2. Identify Resistors in circuit</b>	P1. Identify Resistor & its types P2. Recognize Coding & Color coding of resistor P3. Design series & Parallel circuit of Resistor P4. Use formulas to calculate the resistance in Series & parallel circuit
<b>3. Identify Capacitor in circuit</b>	P1. Identify Capacitor & its types P2. Recognize Coding & rating of Capacitor P3. Design Parallel and series circuit of Capacitor P4. Use formulas to calculate the capacitance in Series & parallel circuit
<b>4. Identify Inductor in circuit</b>	P1. Identify an Inductor P2. Recognize Coding & Rating of Inductor P3. Use formulas to calculate the inductance in Series & parallel circuit,
<b>5. Identify IC's Packages.</b>	P1. Identify IC Packages & types. P2. Apply the appropriate ICs Packages in circuit

### **Critical Evidence(s) Required**

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

Evidence of the following is essential:

- Identify the anode and cathode of diode.
- Calculate the resistance of resistor having color (Red, Green, Blue & Gold).
- Enlist types of capacitor
- Identify the pin no. of an IC

### **Knowledge & Understanding**

- Describe the diodes, polarities & their applications in circuits
- Explain the uses of multi-meter & power Supply
- Explain the data sheets
- Explain Resistor & their applications in Parallel & Series circuits
- Describe Capacitor & their applications in circuits
- Describe the Inductor & their applications in circuits
- Understand the data sheets
- Describe the basics of IC Packages

### **Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

<b>Sr.No.</b>	<b>Name</b>
1	Multi-meter
2	Power supply
3	Trainer
4	Resistor
5	Capacitor
6	Inductor
7	ICs
8	Source of data sheets

## 0714E&A37 Design a Rectifier using Diode

### Overview:

This competency standard will help the candidate in construction of Diode rectifier and its uses in industry.

Competency Units	Performance Criteria
<b>1. Construct half wave Rectifier</b>	<p>P1. Identify the required components for half wave Rectifier circuits.</p> <p>P2. Construct circuit Diagram of half wave Rectifier</p> <p>P3. Connect the circuit with the AC supply</p> <p>P4. Observe the input and Output wave form on oscilloscope</p> <p>P5. Calculate the ripple Factor</p> <p>P6. Calculate output voltage using proper formulas</p>
<b>2. Construct Full Wave Rectifier (two diode rectifier)</b>	<p>P1. Identify the required components for Full Wave and half wave Rectifier circuits.</p> <p>P2. Construct circuit Diagram of half wave Rectifier</p> <p>P3. Construct circuit Diagram of Full Wave Rectifier</p> <p>P4. Connect the circuit with the AC supply</p> <p>P5. Observe the input and Output wave form on oscilloscope</p> <p>P6. Calculate the ripple Factor</p> <p>P7. Calculate output voltage using proper formulas</p>
<b>3. Construct Full Wave Rectifier using Diode Bridge</b>	<p>P1. Identify the required components for Full Wave Bridge Rectifier circuit.</p> <p>P2. Construct circuit Diagram of Full Wave Bridge Rectifier</p> <p>P3. Connect the circuit with the AC supply</p> <p>P4. Observe the input and Output wave form on oscilloscope</p> <p>P5. Calculate the ripple Factor</p> <p>P6. Calculate output voltage using proper formulas</p>

### Knowledge and understanding

- Explain the basics of diodes, AC & DC voltages For Rectifiers.
- Explain the uses of multi-meter
- Understand the data sheets
- Explain the uses oscilloscope
- Explain the uses of power Supply
- Explain the uses of oscilloscope and power Supply

### Critical Evidence(s) Required

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

Evidence of the following is essential:

- Enlist types of rectifiers circuits.

- Draw the circuit diagram of full wave bridge rectifier.
- Draw input & output wave form of half wave & full wave rectifier.

### **Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

<b>Sr.No.</b>	<b>Name</b>
1	Multi-meter
2	Power Supply
3	Trainer
4	Oscilloscope
5	Diodes and Resistors
6	Source of Data Sheets
7	Functions Generator
8	Center taped Transformer

## 0714E&A38 Design different types of Filters

### Overview:

After completion of this competency standard the student will be able to apply rectifier through a filter circuit to filter the ac components, design and implement various types of Filters in a circuit.

Competency Units	Performance Criteria
<b>1. Construct the Choke Input / L Section Filter.</b>	P1. Draw the Choke Input or L Section Filter P2. Select the proper component for L type filter P3. Place the components of L type filter on bread board. P4. Give the pulsating DC of rectifier to the input of L type filter and Check the output signal on oscilloscope P5. Record the difference between input and output.
<b>2. Design the Capacitor Input / <math>\pi</math> Filter.</b>	P1. Draw the capacitor Input or $\pi$ Section Filter P2. Select the proper component for $\pi$ type filter P3. Place the components of $\pi$ type filter on bread board. P4. Give the pulsating DC of rectifier to the input of $\pi$ type filter and Check the output signal on oscilloscope P5. Record the difference between input and output.
<b>3. Troubleshoot the Rectifier Circuits</b>	P1. Check the input and output voltage of the transformer. P2. Check required output voltage at each section of a rectifier. P3. Identify the faulty section and its faulty component/components. P4. Replace the faulty components P5. Check the output of repaired rectifier

### Knowledge and understanding

- Study the theory & components of filters
- Learn to use oscilloscope and power Supply
- Understand the data sheets
- Learn to use signal generators
- Describe the working knowledge of Rectifier, Filter & Troubleshooting.
- Explain the uses of hand tools
- Learn to place Clamp-on AC – DC ammeter Voltage detectors
- Learn workplace safety measures

### Critical Evidence(s) Required

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

Evidence of the following is essential:

- Enlist types of rectifier filters.
- Draw the circuit diagram of full wave bridge rectifier.
- Differentiate between L type and Pi type filter.

### Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Multi-meter & LCR Meter
2	Power supply
3	Trainer
4	Oscilloscope
5	Diodes, resistors inductor & Capacitor
6	Signal generator

### 0714E&A39 Design the Voltage Multipliers (Doublers, Tripler & Quadrupler)

#### Overview:

After completion of this competency standard the student will be able to design & implement various voltage multipliers in a circuit and will be able to demonstrate their uses in the industry.

Competency Units	Performance Criteria
<b>1. Design the Voltage Doubler</b>	P1. Draw the diagram of voltage doubler circuit P2. Select required components for voltage doubler circuit according to the circuit diagram P3. Place and inter connect the components of voltage doubler on bread board as per diagram. P4. Give proper AC voltage at the input of voltage doubler circuit form the output of stepdown transformer. P5. Observe input and output wave form of voltage doubler circuit and record the difference between them.
<b>2. Design the voltage Tripler</b>	P1. Draw the diagram of voltage Tripler circuit P2. Select required components for voltage Tripler circuit according to the circuit diagram P3. Place and inter connect the components of voltage Tripler on bread board as per diagram. P4. Give proper AC voltage at the input of voltage Tripler circuit form the output of stepdown transformer. P5. Observe input and output wave form of voltage Tripler circuit and record the difference between them.
<b>3. Design the Voltage Quadrupler</b>	P1. Draw the diagram of voltage Quadrupler circuit P2. Select required components for voltage Quadrupler circuit according to the circuit diagram P3. Place and inter connect the components of voltage Quadrupler on bread board as per diagram. P4. Give proper AC voltage at the input of voltage Quadrupler circuit form the output of stepdown transformer. P5. Observe input and output wave form of voltage Quadrupler circuit and record the difference between them.

#### Knowledge & Understanding

- Learn basic knowledge of multiplier.

- Learn to identify different components for Doubler circuit
- Understand the data sheets
- Learn to use signal generators
- Learn to identify different components for Tripler circuit
- Learn to oscilloscope and power Supply

### **Critical Evidence(s) Required**

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

Evidence of the following is essential:

- Enlist types of multiplier.
- Differentiate between voltage doubler&trippler.
- Draw the schematic diagram of voltage quadrupler.

### **Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

<b>Sr.No.</b>	<b>Name</b>
1	Multi-meter
2	Power supply
3	Trainer
4	Oscilloscope
5	Diodes, Capacitor & Transformer
6	Signal generator
7	Multi-meter

**0714E&A40 Carry out the implementation of Zener & Light Emitting Diode**

**Overview:**

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 despite of variations in the input voltage or changes in the load current.

Competency Units	Performance Criteria
<b>Make voltage regulator using Zener diode</b>	P1. Draw the circuit diagram of Zener voltage Regulator circuit. P2. Select required components for Zener voltage regulator circuit according to the circuit diagram P3. Place and interconnect the components on bread board. P4. Give DC voltage form the output of filter section of a rectifier. P5. Change the load or input voltage and measure the output voltage of regulator. P6. Record the difference between input and output
<b>Make Seven Segment Using Light Emitting Diode</b>	P1. Draw the Seven Segment Display Circuit P2. Select required components for seven segment display P3. Place and interconnect the components for Seven Segment Display Circuit P4. Apply the input to Seven Segment Display and Verify the required output. P5. Generate the output report.

**Knowledge & Understanding**

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

**Critical Evidence(s) Required**

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

Evidence of the following is essential:

- Implement Zener diode as voltage regulator.
- Draw characteristic curve of Zener diode.
- Differentiate between common anode and common cathode 7 segment display.
- Differentiate between Zener diode and light emitting diode.



## Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Oscilloscope
2	Zener diode
3	Resistor,
4	Variable DC power supply, Milli ammeter
5	Voltmeter
6	Soldering iron
7	Connecting wire
8	Light Emitting diode

## 0714E&A41 Implement Bipolar Junction Transistor (BJT) in Different Applications

### Overview:

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
<b>Perform the Biasing of Transistors</b>	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
<b>Implement Transistor as an amplifier using CB Configuration.</b>	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.
<b>Implement Transistor as an amplifier using CC Configuration.</b>	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
<b>Implement Transistor as an amplifier using CE Configuration.</b>	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.
<b>Implement BJT as a switch.</b>	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
- Learn basics of Coupling Capacitor.
- Learn the V-I Characteristics

### Critical Evidence(s) Required

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

Evidence of the following is essential:

- Draw connection for proper biasing of transistor.

- Identify the base, collector and emitter terminals of a transistor.
- Enlist types of transistor.
- Enlist the types of amplifiers according to configuration of transistor.
- Implement transistor as a switch.

#### **Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

<b>Sr.No.</b>	<b>Name</b>
1	Transistors
2	Trainer
3	Multi-meter
4	Capacitors
5	Resistors
6	Power Supplies
7	Oscilloscope

## 0714E&A42 Implement Field Effect Transistor (FET) in Different Applications

### Overview:

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
<b>1. Perform the Biasing of FET</b>	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 ( $V_{gs}$ ) & Threshold Voltage ( $V_{th}$ )
<b>2. Implement MOSFET as a switch.</b>	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.
<b>3. Draw the VI characteristics curves for FETs</b>	P1. Construct an amplifier circuit using FETs P2. Apply $V_{ds}$ & $V_{gs}$ P3 Measure the drain current P4. Draw VI characteristic curves

### 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 Switching theory
- Learn the behavior of current and voltage in FET's
- Learn biasing mechanism and basic formulae of FET's
- Learn the  $v_{gs}$ ,  $v_{ds}$ ,  $I_{dss}$  &  $R_{ds}$  as per datasheet.

### Critical Evidence(s) Required

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

Evidence of the following is essential:

- Draw connection for proper biasing of FET
- Identify the source, drain and gate terminals of a FET.
- Enlist types of FET
- Differentiate between JFET and MOSFET.

- Implement MOSFET as a switch.

### Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	FET Transistors
2	Multi-meter
3	Capacitors
4	Resistors
5	Power Supplies
6	Trainer
7	Oscilloscope
8	FET Transistors
9	Trainer
10	Oscilloscope
11	Simple FET
12	MOSFET
13	FET Trainer

**0714E&A43 Carry out thyristor Implementation (Uni Junction Transistor, Silicon Control Rectifier, Diac and Triac) in electronics circuits.**

### Overview:

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
<b>1. Construct relaxation oscillator using UJT</b>	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.
<b>2. Implement the SCR in electronic circuits as switch</b>	P1. Identify the SCR terminals P2. Draw the circuit of switch using SCR. P3. Select the components for SCR switching circuits. P4. Construct the SCR switching circuit. P5. Apply the trigger Pulse and Check out the desired outputs
<b>3. Construct the dimmer circuit using Diac &amp; Triac.</b>	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
- Understand the data sheets
- Learn adequate knowledge of hand tools
- Learn basics of SCR
- Learn the uses of oscilloscope, power Supply & Multi-meter
- Learn the basics of diac & triac

### Critical Evidence(s) Required

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

Evidence of the following is essential:

- Draw schematic diagram of relaxation oscillator using UJT.
- Identify the anode, cathode and gate terminals of a SCR.
- Differentiate between DIAC and TRIAC
- Draw schematic diagram of SCR as phase control rectifier.
- Draw characteristic curve of SCR.

### Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Oscilloscope
2	UJT,
3	Resistor,
4	Variable DC power supply,
5	Multi-meter
6	Soldering iron, wire
7	Breadboard or trainer
8	SCR, Diodes, Resistors, Inductors, Capacitors & connecting wire
9	Trainer / Breadboard
10	Diac, Triac and resistors
11	Diode, Capacitor

## 20. Electrical Circuits (Basic Electronics Concept)

### 0714E&A44 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 ohm's law.

Competency Units	Performance Criteria
<b>CU1. Make series circuit and measure voltage and verify KVL</b>	P1. Construct series circuit with different resistors on bread board and give supply voltage. P2. Measure the voltage across each resistor. P3. Note the value of voltage against each resistor. P4. Sum the voltage of each resistor and verify it equal to applied voltage.
<b>CU2. Make parallel circuit, measure current and verify KCL</b>	P1. Construct parallel circuit with different resistors on bread board. P2. Measure the current of each resistor as well as total current. P3. Note the value of current against each resistor. P4. Sum the reading of ampere meters & verify
<b>CU3. Verify resistance of a resistor</b>	P1. Select the 4 color band resistor. P2. Determine the value of resistor using color code. P3. Connect ohm meter across the resistor. P4. Note reading from ohm meter. P5. Compare both reading.
<b>CU4. Find unknown value of ohms law</b>	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 by ohm law

#### 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:

- Characteristics of series circuit
- Use of volt meter
- Characteristics of parallel circuit

- Use of ampere meter
- Color code and its use.
- Purpose of ohm meter
- Current, voltage and resistor interact with one another
- Purpose of ohm meter
- Kirchhoff's first law.
- Kirchhoff's second law.

### Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Ammeter
2	Ohmmeter
3	Multimeter
4	Resistors of different values
5	DC battery
6	Small pieces of copper wire

### Critical Evidence(s) Required

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

- Evidence of the following is essential:
- Implement series circuit and verify KVL.
- Implement parallel circuit and verify KCL.
- Find the value of resistance having colors Red, Green, Blue and Golden.

### 0714E&A45 Overhaul the Lead Acid Batteries & implement their series & Parallel circuits

#### Overview:

This competency standard covers the skills and knowledge required to overhaul the lead acid batteries, preparation of their electrolyte, servicing & implementation of lead acid batteries in series & parallel circuit.

Competency Units	Performance Criteria
<b>CU1. Construct series combination of batteries.</b>	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.



<b>CU2. Construct series combination of batteries</b>	<p>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.</p>
<b>CU3. Prepare Electrolyte for battery</b>	<p>P1. Select the proper container &amp; and use proper safety equipment to prepare electrolyte  P2. Pour H<sub>2</sub>SO<sub>4</sub> 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.</p>
<b>CU4. Check specific gravity of Electrolyte.</b>	<p>P1. Open the vent plug of battery  P2. Fill the hydrometer with electrolyte  P3. Keep the hydrometer vertical and take reading form hydrometer</p>
<b>CU5. Determine internal resistance of cell</b>	<p>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.</p>
<b>CU6. Charge the battery with appropriate voltage.</b>	<p>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.</p>

### 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:

- series combination of cell
- parallel combination of cell
- Electrolyte
- specific gravity
- hydrometer and its uses
- value of specific gravity of lead acid battery
- internal resistance of cell

- difference between “E” and “V” of cell
- parts of a charger
- function of charger
- minimum or zero reading OF Ammeter at full charging
- specific gravity of battery at full charge condition

### Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Cells
2	Connecting leads
3	Voltmeter
4	Change over switch
5	H <sub>2</sub> SO <sub>4</sub>
6	Water
7	Container
8	Hydrometer
9	Wooden/ Glass Rod

### Critical Evidence(s) Required

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

- Implement batteries battery connection to get more voltage.
- Implement batteries battery connection to get more current.
- Prepare electrolyte having specific gravity of 1.2 to 1.23.
- Check and note specific gravity of electrolyte of using hydrometer.
- Write the steps to determine the internal resistance of cell.
- Implement connection of charger to charge two batteries in series and set proper voltage to charge them.

**0714E&A46 Measure Electrical power, Energy & Power Factor**

Overview:

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

Competency Units	Performance Criteria
<b>CU1. Measure power using Volt-Ampere meter method</b>	<p>P1. Select a proper load to calculate the power and give supply to it.</p> <p>P2. Measure the voltage and current by using voltmeter and ampere meter.</p> <p>P3. Find power using power formula.</p>
<b>CU2. Measure power using watt meter</b>	<p>P1. Select a proper load to calculate the power and connect watt meter with it.</p> <p>P2. Give supply and measure the reading of power.</p>
<b>CU3. Measure consumed energy with Energy meter</b>	<p>P1. Connect phase line of AC supply to the left side terminal of energy meter.</p> <p>P2. Connect neutral line of AC supply to the next input terminal of energy meter.</p> <p>P3. Connect any AC load to the output terminals of energy meter.</p> <p>P4. Give supply and take reading of energy in terms of unit after few minutes from display.</p>
<b>CU4. Measure power factor with voltmeter, ampere meter and watt meter</b>	<p>P1. Connect voltmeter &amp; ampere meter with inductive load (Motor)</p> <p>P2. Connect watt meter with the load also.</p> <p>P3. Give AC supply and take the readings of volt, ampere and watt meter.</p> <p>P4. Utilize the above readings and calculate power factor using power formula <math>P=VI \cos \phi</math></p>
<b>CU5. Measure power factor with power factor meter</b>	<p>P1. Connect current coil of power factor meter in series to the load.</p> <p>P2. Connect voltage coil of power factor meter in parallel to the load.</p> <p>P3. Give supply and note the value of power factor from power factor meter.</p>
<b>CU6. Improve power factor &amp; measure it with power factor meter</b>	<p>P1. Connect ampere meter as well as current coil of power factor meter in series with load</p> <p>P2. Connect voltage coil of power factor meter in parallel to the load.</p> <p>P3. Connect a capacitor bank parallel to load.</p> <p>P4. Select the small value capacitor with the help of selector switch and give supply and note the value of power factor from power factor meter and current reading from ampere meter.</p> <p>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.</p>

## 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:

- Formula of D.C power
- measurement of power of any circuit with any meter
- difference between electrical and mechanical power
- C.C (current coil) & P.C (potential Coil) internal resistance of cell
- difference between power & Energy
- B.O.T
- Revolutions of energymeter
- loading Rheostat
- power factor
- the reasons for power factor lagging
- way to improve power factor of an A.C inductive circuit
- uses of wattmeter
- leading power factor
- way to improve power factor of an A.C inductive circuit with capacitor
- inductive load
- effect of improved power factor on load current

### Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Wattmeter
2	Ammeter
3	Voltmeter
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 lead
9	Rheostat load 2 Kw. 220/230 volts A.C
10	Power Supply with switch & fuse protection (0 -220 V.ac). Single phase Wattmeter. 0-500 watt.
11	Single phase inductive load. Any available load at your lab (up to 100 watt)
12	Capacitor bank
13	Single phase power factor meter
14	Connecting leads. As required.

### Critical Evidence(s) Required

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

Evidence of the following is essential:

- Measure power of load using voltmeter and ampere meter.

- Make connection of watt meter to measure the power of a load.
- Make connection of energy meter to measure energy consumption of load.
- Connect power factor meter with load to measure its power factor.
- Connect the capacitor with inductive load to improve its power factor.

**0714E&A47 Implement Electromagnet to observe various effects & verify Faraday's law**

**Overview:**

This competency standard covers the skills and knowledge required to implement the electromagnet, observe its various characteristics and verify the Faraday's law.

Competency Units	Performance Criteria
<b>CU1. Construct Electromagnet</b>	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 record the observation
<b>CU2. Implement circuit to determine the effect on current carrying conductor in magnetic field.</b>	P1. Take copper rod (5cm in length) and connect wires across it. P2. Give DC supply to copper rod through rheostat. P3. Place current carrying copper rod inside the horse shoe magnet.
<b>CU3. Determine the effect on conductor by varying the current with the help of rheostat.</b>	P1. Reduce the rheostat resistance P2. Record the effect on copper rod. P3. Increase the rheostat resistance P4. Record the effect on copper rod.
<b>CU4. Plot magnetic lines of forces of bar magnet</b>	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
<b>CU5. Verify Faradays law by moving magnet inside the coil.</b>	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 Galvano meter with coil. P3. Move permanent magnet inside the coil, vary its speed 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 Galvano meter.
<b>CU6. Verify Faradays law by moving coil near the magnet field.</b>	<p>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.</p> <p>P2. Connect Galvano meter with coil.</p> <p>P3. Fix permanent magnet and move the coil fast and slow on it and record the effect on reading of Galvano meter.</p> <p>P4. Hold the coil near the magnetic field do not move, now record the effect on reading of Galvano meter.</p>
<b>CU7. Verify emf through induction.</b>	<p>P1. Take step down transformer and connect its secondary with a Galvano meter and primary winding with a DC battery through a rheostat.</p> <p>P2. Continuously variate the rheostat and observe the reading on the Galvano meter</p>

### 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:

- Magnet, magnetism & electromagnet
- The functions of iron core
- Strong magnet
- The movement of current carrying conductor which is placed in magnetic field
- Fleming's left-hand rule
- Magnetic lines of force.
- Magnetic field.
- Travel of magnetic lines of force with respect to each other.
- The first & 2<sup>nd</sup> law of michael faraday
- The role of magnetic strength in faraday's law
- The role of conductor's length or turns in faraday's law
- Lenz's law
- Induction
- Faraday's first law of electro-magnetic induction
- Coupled coils
- The induction of emf in 2<sup>nd</sup> coil, when voltage is applied to 1<sup>st</sup> coil
- Mutual induction core

## Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Iron nail as core
2	Thin coated copper wire
3	Current carrying conductor
4	Horse shoe magnet
5	Power Supply
6	Compass needle
7	Bar Magnet
8	Paper
9	Lead pencil
10	Coil
11	Galvanometer
12	Magnet
13	Connecting leads
14	Transformer

## Critical Evidence(s) Required

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

Evidence of the following is essential:

- Construct an electromagnet and verify its operation.
- Plot magnetic field of around the magnet using compass.
- Verify faradays law using magnet and coil.
- Implement a circuit to verify emf through induction

## 0714E&A48 Measure different parameters of AC signal & Components

### 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
<b>CU1. Measure AC voltage with oscilloscope</b>	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.

<b>CU2. Measure current with oscilloscope</b>	<p>P1. Select the proper load to measure the current.</p> <p>P2. Connect the low value of resistance in series with the load.</p> <p>P3. Connect the oscilloscope across low value of resistor and measure the voltage.</p> <p>P4. Apply ohms law by using value of low value of resistor and voltage across it and find out current.</p>
<b>CU3. Measure time period of AC signal with oscilloscope</b>	<p>P1. Select a proper time/division and give AC voltage to oscilloscope.</p> <p>P2. Calculate number of divisions between the one AC cycle of the AC signal.</p> <p>P3. Apply the formula to calculate the time period of AC voltage.</p>
<b>CU4. Measure frequency of AC signal with oscilloscope</b>	<p>P1. Select a proper time/division and give AC voltage to oscilloscope.</p> <p>P2. Calculate number of divisions between the one AC cycle of the signal.</p> <p>P3. Apply the formula to calculate time period</p> <p>P4. Apply the formula to calculate the actual frequency of AC voltage</p>
<b>CU5. Measure rms value of AC signal with oscilloscope</b>	<p>P1. Select a proper volt/division and give AC voltage to oscilloscope.</p> <p>P2. Read number of divisions between the +ve and -ve peaks of the signal.</p> <p>P3. Apply the formula to calculate Vp-p of AC voltage.</p> <p>P4. Calculate peak value form Vp-p</p> <p>P5. Calculate rms value form peak voltage of AC</p>
<b>CU6. Use LCR meter to measure unknown Resistor.</b>	<p>P1. Select Resistor to measure its value.</p> <p>P2. Select the proper control and range of LCR meter for resistance measurement.</p> <p>P3. Connect the leads of LCR meter across the unknown Resistor.</p> <p>P4. Record the value of Resistance from display.</p>
<b>CU7. Use LCR meter to measure unknown Capacitance.</b>	<p>P1. Select capacitor to measure its value.</p> <p>P2. Select the proper control and range of LCR meter for capacitance measurement.</p> <p>P3. Connect the leads of LCR meter across the unknown capacitor.</p> <p>P4. Record the value of capacitance from display.</p>
<b>CU8. Use LCR meter to measure unknown Inductance</b>	<p>P1. Select Inductor to measure its value.</p> <p>P2. Select the proper control and range of LCR meter for inductance measurement.</p> <p>P3. Connect the leads of LCR meter across the unknown Inductor.</p> <p>P4. Record the value of Inductance from display.</p>



## 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:

- Different controls of an oscilloscope
- Volt/division control.
- time/division control
- trigger, channel, frequency, time period & RMS value
- average value of ac signal.
- purpose of LCR meter.
- resistance, capacitance and inductance
- working principle of LCR meter

## Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Cathode-ray oscilloscope
2	Multimeter
3	Oscillator
4	Signal generator
5	Power supply
6	LCR meter
7	Resistors
8	Inductors
9	Capacitors
10	Connecting leads

## Critical Evidence(s) Required

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

Evidence of the following is essential:

- Measure amplitude of AC voltage with the help of oscilloscope.
- Measure frequency of AC signal using oscilloscope.
- Measure time period of AC signal using oscilloscope.
- Use LCR meter to measure Inductance, capacitance and resistance.

## 21. Analog Electronics

### 0714E&A49 Identify Semiconductor devices and perform their Applications

#### Overview:

After completion of this competency standard the candidate will be able to understand diodes, BJTs and FETs with help of Data sheets and Implement it in different Applications.

Competency Units	Performance Criteria
<b>1. Identify The parameter of Diode and Draw the characteristic curve of it.</b>	<p>P1. Identify the Diodes and their terminal (Anode and Cathode ) whit the Help of Datasheet</p> <p>P2. Describe Different parameter (Current, Voltage, and power rating) of Diode Using Diode Data sheets.</p> <p>P3. Implement the Diode in forward and Reverse Configuration</p> <p>P4. Perform the forward and reverse biases operation</p> <p>P5. Monitor the Output waveform on oscilloscope</p> <p>P6. Draw the characteristic curves in forward and reverse Biased</p> <p>P7. Generate the Lab report</p>
<b>2. Identify The parameter of BJT and Draw the characteristic curve of it.</b>	<p>P1. Identify the Transistor (BJT) and there terminal (Emitter, base and collector ) whit the Help of Datasheet</p> <p>P2. Describe Different parameter (Current, Voltage, and power rating) of BJT Using Data sheets.</p> <p>P3. Implement the PNP OR NPN transistor in common base Configuration</p> <p>P4. Monitor the Output waveform on oscilloscope</p> <p>P5. Draw the characteristic curves of common base transistor (BJT)</p> <p>P6. Generate the Lab report</p>
<b>3. Design the circuit of Common Emitter(CE) Amplifier</b>	<p>P1. Identify the Transistor ( BJT) and there terminal (Emitter, base and collector ) whit the Help of Datasheet</p> <p>P2. Select the component for CE Amplifier</p> <p>P3. Implement the circuit of PNP OR NPN Amplifier in common Emitter Configuration</p> <p>P4. Analyze the different parameter of CE Amplifier</p> <p>P5. Monitor the Output waveform on oscilloscope</p> <p>P6. Draw the characteristic curves of common Emitter Amplifier (BJT)</p> <p>P7. Generate the Lab report</p>
<b>4. Design the circuit of Common Base(CB) Amplifier</b>	<p>P1. Identify the Transistor ( BJT) and there terminal (Emitter, base and collector ) whit the Help of Datasheet</p> <p>P2. Select the component for Common Base(CB) Amplifier</p> <p>P3. Implement the circuit of PNP OR NPN Amplifier in common Base(CB) Configuration</p> <p>P4. Analyze the different parameter of common Base(CB) Amplifier</p> <p>P5. Monitor the Output waveform on oscilloscope</p> <p>P6. Draw the characteristic curves of common Base(CB) Amplifier (BJT)</p>

	P7. Generate the Lab report
<b>Design the circuit of Common Collector (CC) Amplifier.</b>	<p>P1. Identify the Transistor ( BJT) and there terminal (Emitter, base and collector ) whit the Help of Datasheet</p> <p>P2. Select the components for Common Collector (CC) Amplifier</p> <p>P3. Implement the circuit of PNP OR NPN Amplifier in Common Collector (CC) Configuration</p> <p>P4. Analyze the different parameter of Common Collector (CC) Amplifier</p> <p>P5. Monitor the Output waveform on oscilloscope</p> <p>P6. Draw the characteristic curves of Common Collector (CC) Amplifier (BJT)</p> <p>P7. Generate the Lab report</p>
<b>6. Design the circuit of Class A Power Amplifier</b>	<p>P1. Identify the Class A power Amplifier</p> <p>P2. Select the component for Class A power Amplifier</p> <p>P3. Implement the circuit of PNP OR NPN transistor in Class A power Amplifier Configuration</p> <p>P4. Analyze the different parameter of Class A power Amplifier</p> <p>P5. Monitor the Output waveform on oscilloscope</p> <p>P6. Draw the characteristic curves of Class A power Amplifier</p> <p>P7. Calculate the Voltage gain and Power Gain of Class A power Amplifier</p> <p>P8. Generate the Lab report</p>
<b>7. Identify The parameter of FET and Draw the characteristic curve of it.</b>	<p>P1. Identify the FET and there terminal (gate, drain and Sources ) whit the Help of Datasheet</p> <p>P2. Describe Different parameter (Current, Voltage, and power rating) of FET Using Data sheets.</p> <p>P3. Implement the FET in common Sources Configuration</p> <p>P4. Monitor the Output waveform on oscilloscope</p> <p>P5. Draw the characteristic curves of common Sources Amplifier</p> <p>P6. Generate the Lab report</p>
<b>8.Design the circuit of Common Drain (CD) Amplifier</b>	<p>P1. Identify the FET and there terminal ( gate, drain and Sources ) whit the Help of Datasheet</p> <p>P2. Select the components for Common Drain (CD) Amplifier</p> <p>P3. Implement the circuit of Common Drain (CD) Amplifier</p> <p>P4. Analyze the different parameter of Common Drain (CD) Amplifier</p> <p>P5. Monitor the Output waveform on oscilloscope</p> <p>P6. Draw the characteristic curves of Common Drain (CD) Amplifier</p> <p>P7. Generate the Lab report</p>

<b>9. Design the circuit of Common Gate (CG) Amplifier</b>	P1. Identify the FET and there terminal ( gate, drain and Sources ) whit the Help of Datasheet P2. Select the components for Common Gate (CG) Amplifier P3. Implement the circuit of Common Gate (CG) Amplifier P4. Analyze the different parameter of Common Gate (CG) Amplifier P5. Monitor the Output waveform on oscilloscope P6. Draw the characteristic curves of Common Gate (CG) Amplifier P7. Generate the Lab report
<b>10. Design a switching Circuit Using MOSFET</b>	P1. Identify the MOSFET and there terminal ( gate, drain and Sources ) whit the Help of Datasheet P2. Select the components for Switching Circuit P3. Implement Switching Circuit using MOSFET P4. Perform the operation of switching P5. Monitor the Output P6. Generate the Lab report
<b>Design a Low voltage transistor based regulated power supply</b>	P1. Draw the Schematic of power supply P2. Select the components for power supply P3. Implement the circuit of power supply P4. Perform individual operations on different sections of a power supply P5. Measure Output Voltage P6. Generate the Lab report

### Knowledge and understanding

- Study the basic of diodes, & their applications in circuits
- Knowledge of basic electronics
- Understand Multi-meter, Oscilloscope& power Supply
- Study the basic of BJTs, their applications in circuits
- Study the basic of FETs, their applications in circuits
- Understand the data sheets

### Critical Evidence(s) Required

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

- Draw VI characteristic curve of diode.
- Draw connection for proper biasing of transistor.
- Enlist the types of amplifiers according to configuration of transistor.
- Implement transistor as a switch.
- Draw connection for proper biasing of FET
- Enlist types of FET amplifiers.
- Differentiate between JFET and MOSFET.
- Implement MOSFET as a switch.
- Draw schematic diagram of regulated power supply

### Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Multi-meter
2	Power supply
3	Trainer
4	Diodes
5	Digital
6	Oscilloscope
7	Datasheets

**0714E&A50 Design Radio Frequency (RF) and Audio Frequency (AF) Amplifiers**

**Overview:**

After the completion of this competency standard the candidate will be able to design and implement the Audio and RF amplifiers in a variety of industrial circuits.

Competency Units	Performance Criteria
<b>Design 25/50 Watt Audio power Amplifier</b>	P1. Draw the Schematic diagram of Audio power Amplifier using power amplifier IC P2. Select the components for Audio power Amplifier P3. Implement the circuit of Audio power Amplifier P4. Perform the operation of Audio power Amplifier P5. Measure the Power, Distortion, gain and efficiency of Audio power Amplifier P6. Generate the Lab report
<b>Measure the Frequency response of Direct coupled Audio Amplifier</b>	P1. Draw the Schematic diagram of direct coupled Audio Amplifier P2. Select the components for direct coupled Audio Amplifier P3. Implement the circuit of direct coupled Audio Amplifier P4. Perform the operation of direct coupled Audio Amplifier P5. Measure the bandwidth by observing the frequency response of direct coupled Audio Amplifier P6. Generate an output report for the operations of direct coupled Audio Amplifier
<b>Measure the Frequency response of R.C coupled Audio Amplifier</b>	P1. Draw the Schematic diagram of R.C coupled Audio Amplifier P2. Select the components for R.C coupled Audio Amplifier P3. Implement the circuit of R.C coupled Audio Amplifier P4. Perform the operation of R.C coupled Audio Amplifier P5. Measure the bandwidth by observing the frequency response of R.C coupled Audio Amplifier P6. Generate an output report for the operations of R.C coupled Audio Amplifier
<b>Measure the Frequency response of Transformer coupled Audio Amplifier</b>	P1. Draw the Schematic diagram of Transformer coupled Audio Amplifier P2. Select the components for Transformer coupled Audio Amplifier P3. Implement the circuit of Transformer coupled Audio Amplifier P4. Perform the operation of Transformer coupled Audio Amplifier P5. Measure the bandwidth by observing the frequency response of Transformer coupled Audio Amplifier P6. Generate an output report for the operations of Transformer coupled Audio Amplifier
<b>Design a Radio Frequency Amplifier</b>	P1. Draw the Schematic diagram of Radio Frequency Amplifier P2. Select the components for Radio Frequency Amplifier P3. Implement the circuit of Radio Frequency Amplifier P4. Perform the operation of class 'C' Radio Frequency Amplifier P5. Measure the Voltage gain, power output and efficiency of Radio Frequency Amplifier P6. Measure the frequency response of RF amplifier

	<p>using load tuning</p> <p>P7. Generate the Lab report</p>
<b>Measure the Frequency response of R.C coupled Radio Frequency Amplifier</b>	<p>P1. Draw the Schematic diagram of R.C coupled Radio Frequency Amplifier</p> <p>P2. Select the components for R.C coupled Radio Frequency Amplifier</p> <p>P3. Implement the circuit of R.C coupled Radio Frequency Amplifier</p> <p>P4. Perform the operation of R.C coupled Radio Frequency Amplifier</p> <p>P5. Measure the bandwidth by observing the frequency response of R.C coupled Radio Frequency Amplifier</p> <p>P6. Generate an output report for the operations of R.C coupled Radio Frequency Amplifier</p>
<b>Measure the Frequency response of Transformer coupled Radio Frequency Amplifier</b>	<p>P1. Draw the Schematic diagram of Transformer coupled Radio Frequency Amplifier</p> <p>P2. Select the components for Transformer coupled Radio Frequency Amplifier</p> <p>P3. Implement the circuit of Transformer coupled Radio Frequency Amplifier</p> <p>P4. Perform the operation of Transformer coupled Radio Frequency Amplifier</p> <p>P5. Measure the bandwidth by observing the frequency response of Transformer coupled Radio Frequency Amplifier</p> <p>P6. Generate an output report for the operations of Transformer coupled Radio Frequency Amplifier</p>
<b>Measure the Frequency response of Impedance coupled Radio Frequency Amplifier</b>	<p>P1. Draw the Schematic diagram of Impedance coupled Radio Frequency Amplifier</p> <p>P2. Select the components for Impedance coupled Radio Frequency Amplifier</p> <p>P3. Implement the circuit of Impedance coupled Radio Frequency Amplifier</p> <p>P4. Perform the operation of Impedance coupled Radio Frequency Amplifier</p> <p>P5. Measure the bandwidth by observing the frequency response of Impedance coupled Radio Frequency Amplifier</p> <p>P6. Generate an output report for the operations of Impedance coupled Radio Frequency Amplifier</p>

### Knowledge and Understanding

- Study the basic of BJTs, ICs & their applications in circuits
- Study the basics of Transistors, ICs, Capacitors, Resistors& their applications in circuits
- Study the basics of Transistors, ICs, Capacitors, Resistors, Transformers & their applications in circuits
- Explain the basics of electronics and amplifier and their applications
- Understand Multi-meter, Oscilloscope & power Supply& their applications
- Understand the data sheets

### Critical Evidence(s) Required

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

Evidence of the following is essential:

- Draw the Schematic diagram of direct coupled Audio Amplifier

- Draw the Schematic diagram of Impedance coupled Radio Frequency Amplifier
- Draw the Schematic diagram of Transformer coupled Radio Frequency Amplifier
- Differentiate between Impedance coupled, transformer coupled & RC coupled amplifier.

### **Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

<b>Sr.No.</b>	<b>Name</b>
1	Multi-meter
2	Power supply
3	Trainer
4	Transistors
5	Resistors
6	Capacitors
7	Digital Oscilloscope
8	Datasheets



**Overview:**

This competency standard identifies the competencies required to design a variety of oscillators for various industrial applications.

<b>Competency Units</b>	<b>Performance Criteria</b>
<b>Construct an R.C phase shift oscillator</b>	P1. Draw the schematic diagram of R.C phase shift Oscillator. P2. Select the required components for the oscillator circuit P3. Implement the circuit of RC phase shift oscillator. P4. Perform individual operations on different sections of RC phase shift oscillator. P5. Measure the output for RC phase shift oscillator P6. Generate an output report
<b>Construct a Hartley oscillator</b>	P1. Draw the schematic diagram of Hartley Oscillator. P2. Select the required components for Hartley oscillator circuit P3. Implement the circuit of Hartley oscillator. P4. Perform individual operations on different sections of Hartley oscillator. P5. Measure the output for Hartley oscillator P6. Generate an output report
<b>Construct a Colpite oscillator</b>	P1. Draw the schematic diagram of Colpite Oscillator. P2. Select the required components for Colpite oscillator circuit P3. Implement the circuit of Colpite oscillator. P4. Perform individual operations on different sections of Colpite oscillator. P5. Measure the output for Colpite oscillator P6. Generate an output report
<b>Construct a Crystal oscillator</b>	P1. Draw the schematic diagram of Crystal Oscillator. P2. Select the required components for Crystal oscillator circuit P3. Implement the circuit of Crystal oscillator. P4. Perform individual operations on different sections of Crystal oscillator. P5. Measure the output for Crystal e oscillator P6. Generate an output report
<b>Construct Pulse-tone Oscillator Using 555 timer IC</b>	P1. Draw the schematic diagram of Pulse-tone Oscillator Using 555 timer IC. P2. Select the required components for Pulse-tone Oscillator circuit P3. Implement the circuit of Pulse-tone Oscillator. P4. Perform individual operations on different sections of Pulse-tone Oscillator. P5. Measure the output of Pulse-tone Oscillator circuit P6. Generate an output report

**Knowledge and understanding**

- Study the basics of Transistors, ICs, Capacitors, Resistors, Transformers & their applications in circuits
- Explain the basics of electronics and oscillator, their applications
- Understand Multi-meter, Oscilloscope & power Supply & their applications
- Understand the data sheets

- Study the basics of Transistors, ICs( 555 timer IC ), Capacitors, Resistors, Transformers & their applications in circuits

### **Critical Evidence(s) Required**

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

Evidence of the following is essential:

- Enlist types of oscillators.
- Draw the circuit diagram of crystal oscillator
- Differentiate between Hartley and Colpitts oscillator.
- Implement pulse tone oscillator using 555 IC

### **Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

<b>Sr.No.</b>	<b>Name</b>
1	Multi-meter
2	Power supply
3	Trainer
4	Transistors
5	Resistors
6	Inductors
7	Capacitors
8	Digital Oscilloscope
9	Datasheets
10	Transformer
11	Functions

**Overview:**

This competency standard identifies the competencies required to Construct Operation Amplifier and understand its uses in a variety of industrial circuits.

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

	<p>P4. Perform the operations of Integrator circuit.  P5. Measure the output, frequency response &amp; gain  P6. Draw the characteristic curves of Integrator circuit.  P7. Generate the Output report</p>
<b>Construct a differentiator circuit using operational amplifier</b>	<p>P1. Draw the Schematic diagram of differentiator circuit using Op-Amp.  P2. Select the components for differentiator circuit.  P3. Implement differentiator circuit.  P4. Perform the operations of differentiator circuit.  P5. Measure the output, frequency response &amp; gain  P6. Draw the characteristic curves of differentiator circuit.  P7. Generate the Output report</p>
<b>Construct a Comparator circuit using operational amplifier</b>	<p>P1. Draw the Schematic diagram of Comparator circuit using Op-Amp.  P2. Select the components for Comparator circuit.  P3. Implement Comparator circuit.  P4. Perform the operations of Comparator circuit.  P5. Measure the output, frequency response &amp; gain  P6. Draw the characteristic curves of Comparator circuit.  P7. Generate the Output report</p>
<b>Construct a Unity Follower circuit using operational amplifier</b>	<p>P1. Draw the Schematic diagram of Unity Follower circuit using Op-Amp.  P2. Select the components for Unity Follower circuit.  P3. Implement Unity Follower circuit.  P4. Perform the operations of Unity Follower circuit.  P5. Measure the output, frequency response &amp; gain  P6. Draw the characteristic curves of Unity Follower circuit.  P7. Generate the Output report</p>

### 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 Multi-meter, Oscilloscope & power Supply & their applications
- Understand the data sheet

### Critical Evidence(s) Required

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

Evidence of the following is essential:

- Implement non inverting amplifier using operational amplifier.
- Enlist different applications of operational amplifier.
- Differentiate between integrator and differentiator.
- Implement summer circuit using operational amplifier.

### Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Multi-meter
2	Power supply
3	Trainer
4	Op-Amp
5	Resistors
6	Inductors
7	Capacitors
8	Digital Oscilloscope
9	Datasheets
10	Functions Generator

### 0714E&A53 Design a Multi-Vibrator

#### Overview:

After the completion of this competency standard the candidate will be able to construct the Multi-Vibrator circuit for various industrial applications.

Competency Units	Performance Criteria
<b>Construct an Emitter Coupled, A-stable Multi-Vibrator</b>	P1. Draw the Schematic diagram of Emitter Coupled, A-stable Multi-Vibrator. P2. Select the components for Emitter Coupled, A-stable Multi-Vibrator circuit. P3. Place the components in circuit for Emitter Coupled, A-stable Multi-Vibrator. P4. Perform the operations on Emitter Coupled, A-stable Multi-Vibrator circuit. P5. Monitor the output, frequency response. P6. Generate the Output report
<b>Construct an Emitter Coupled, Mono-stable Multi-Vibrator</b>	P1. Draw the Schematic diagram of Emitter Coupled, Mono-stable Multi-Vibrator. P2. Select the components for Emitter Coupled, Mono-stable Multi-Vibrator circuit. P3. Place the components in circuit for Emitter Coupled, Mono-stable Multi-Vibrator. P4. Perform the operations on Emitter Coupled, Mono-stable Multi-Vibrator. P5. Control pulse width of Mono-stable Multi-Vibrator. P6. Monitor the output, frequency response. P7. Generate the Output report

<b>Construct an Bi-stable Multi-Vibrator with collector Trigger</b>	P1. Draw the Schematic diagram of Bi-stable Multi-Vibrator. P2. Select the components for Bi-stable Multi-Vibrator. P3. Place the components in circuit for Bi-stable Multi-Vibrator. P4. Perform the operations on Bi-stable Multi-Vibrator. P5. Monitor the output, frequency response. P6. Generate the Output report
<b>Construct an A-stable Multi-Vibrator Using 555 timer</b>	P1. Draw the Schematic diagram of, A-stable Multi-Vibrator using the 555 Timer. P2. Select the components for, A-stable Multi-Vibrator circuit. P3. Place the components in circuit for 555 Timer, A-stable Multi-Vibrator. P4. Perform the operations on, A-stable Multi-Vibrator circuit. P5. Monitor the output waveform, frequency response Pulses P6. Generate the Output report
<b>5 Construct a RC Differentiator and Integrator circuit to the Verify the input Pulses(Step, square and pulse )</b>	P1. Draw the Schematic diagram RC Differentiator and Integrator circuit P2. Select the components for RC Differentiator and Integrator circuit. P3. Implement RC Differentiator and Integrator circuit P4. Apply different inputs and verify the Output response of RC Differentiator and Integrator P5. Generate the Output report

### Knowledge and understanding

- Study the basics of Transistors, ICs, Capacitors, Resistors, Multi-Vibrator & their applications in circuits
- Explain the basics of electronics.
- Understand Multi-meter, Oscilloscope & power Supply & their applications
- Understand the data sheets

### Critical Evidence(s) Required

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

Evidence of the following is essential:

- Differentiate between collector coupled and emitter coupled MV.
- Enlist types of Multi-vibrator
- Differentiate between mono stable, bi-stable and a-stable Multi-vibrator.
- Implement a-stable Multi-vibrator with the help of transistor.
- Implement RC differentiator and draw its output against square input.

### Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Multi-meter
2	Power supply
3	Trainer
4	Resistors
5	Transistor
6	Inductors
7	Capacitors
8	Digital Oscilloscope
9	Datasheets
10	Functions Generator
11	Multi-meter

### 0714E&A54 Construct Ramp Generator

#### Overview:

After the completion of this competency standard the candidate will be able to construct the Ramp generator circuit for various industrial applications.

Competency Units	Performance Criteria
<b>Construct a RC Ramp generator</b>	P1. Draw the Schematic diagram RC Ramp generator P2. Select the components for RC Ramp generator circuit. P3. Implement RC Ramp generator circuit P4. Apply different inputs and verify the Output response of RC Ramp generator P5. Generate the Output report
<b>Construct a Bootstrap Ramp generator</b>	P1. Draw the Schematic of Bootstrap Ramp generator circuit P2. Select the components for Bootstrap Ramp generator circuit. P3. Implement Bootstrap Ramp generator circuit P4. Apply different inputs and verify the Output response of Bootstrap Ramp generator P5. Monitor the feedback response in Bootstrap Ramp generator P6. Generate the Output report
<b>Construct a Current sweep generator</b>	P1. Draw the Schematic diagram Current sweep generator P2. Select the components for Current sweep generator circuit. P3. Implement Current sweep generator circuit P4. Monitor the Frequency Response of filters using Current sweep generator P5. Generate the Output report
<b>Construct a Miller integrator ramp generator</b>	P1. Draw the Schematic diagram Miller integrator ramp generator P2. Select the components for Miller integrator ramp generator circuit. P3. Implement Miller integrator ramp generator circuit P4. Monitor the output Response with respect to the input of Miller integrator ramp generator P5. Generate the Output report

<b>Construct UJT relaxation Oscillator</b>	P1. Draw the Schematic diagram UJT relaxation Oscillator P2. Select the components for UJT relaxation Oscillator generator circuit. P3. Implement UJT relaxation Oscillator circuit P4. Monitor the output Response of UJT relaxation Oscillator P5. Calculate the standoff ratio of UJT relaxation Oscillator P6. Generate the Output report
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### Knowledge and understanding

- Study the basics of Transistors, ICs, Capacitors, Resistors, & their applications in circuits
- Explain the basics of electronics, ramp Generator and their applications
- Understand Multi-meter, Oscilloscope & power Supply & their applications
- Understand the data sheets
- Explain the basics of electronics UJT, filters, oscillator and their applications

### Critical Evidence(s) Required

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

Evidence of the following is essential:

- Enlist types of ramp generator.
- Differentiate between constant current and RC ramp generator.
- Differentiate between bootstrap and miller sweep ramp generator.
- Implement relaxation oscillator using UJT.
- Draw the schematic diagram of bootstrap ramp generator.

### Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Multi-meter
2	Power supply
3	Trainer
4	Resistors
5	Capacitors
6	Transistor
7	OP-Amp
8	Digital Oscilloscope
9	Datasheets
10	Functions Generator



**Overview:**

After the completion of this competency standard the candidate will be able to construct the Function Generator and comparator for various industrial applications.

Competency Units	Performance Criteria
<b>Construct a Function Generator using operational amplifier</b>	P1. Draw the Schematic diagram of Function Generator circuit using Op-Amp. P2. Select the components for Function Generator circuit. P3. Implement Function Generator circuit. P4. Perform the operations of Function Generator circuit. P5. Measure the output, frequency of different shape P6. Generate the Output report
<b>Construct a Function Generator using IC</b>	P1. Draw the Schematic diagram of Function Generator circuit using IC. P2. Select the components for Function Generator circuit. P3. Implement Function Generator circuit. P4. Perform the operations of Function Generator circuit. P5. Measure the output, frequency of different shape P6. Calculate the output voltage amplitude P7. Generate the Output report
<b>Construct a Comparator circuit using Diode</b>	P1. Draw the Schematic diagram of Comparator circuit using Diode P2. Select the components for Diode Comparator circuit. P3. Implement Comparator circuit. P4. Perform the operations of Comparator circuit. P5. Measure the output P6. Draw the characteristic curves of Diode Comparator circuit. P7. Generate the Output report
<b>Construct a Comparator circuit using Transistor</b>	P1. Draw the Schematic diagram of Comparator circuit using transistor P2. Select the components for Transistor Comparator circuit. P3. Implement Comparator circuit. P4. Perform the operations of Comparator circuit. P5. Measure the output P6. Draw the characteristic curves of Transistor Comparator circuit. P7. Generate the Output report
<b>Construct a Schmitt trigger using OP-amp</b>	P1. Draw the Schematic diagram of Schmitt trigger circuit using Op-Amp. P2. Select the components for Schmitt trigger circuit. P3. Implement Schmitt trigger circuit. P4. Perform the operations of Schmitt trigger circuit. P5. Measure the output, of Schmitt trigger for

different threshold  
 P6. Calculate the ON and OFF voltage of Schmitt trigger  
 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, Function Generator and their applications
- Understand Multi-meter, Oscilloscope
- & power Supply & their applications
- Understand the data sheets

### Critical Evidence(s) Required

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

Evidence of the following is essential:

- Draw schematic diagram of function generator.
- Implement comparator circuit using transistor.
- Implement Schmitt trigger by using operational amplifier.

### Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Multi-meter
2	Power supply
3	Trainer
4	Op-Amp
5	Resistors
6	Inductors
7	Capacitors
8	Digital Oscilloscope
9	Datasheets
10	Functions Generator

## 22. Engineering Drawing & Computer Aided Design

### 0714E&A56 Install CAD Software

**Overview:** This competency standard covers the specific skills and knowledge related to install software and create new file and create basic drawing.

Competency Unit	Performance Criteria
<b>CU1. Install software and Create New File</b>	P1. Install latest software version P2. Create New Template P3. Save the File P4. Create Drawing P5. Select units as per requirements P6. Select drawing Limits
<b>CU2. Create Basic Drawings</b>	P1. Select Coordinate System as per requirements P2. Draw a rectangle using line command P3. Draw an ARC P4. Draw a circle with given requirements P5. Draw a circle with 3-Point touching outer corner of Equilateral Triangle P6. Use the Erase Command

### Knowledge & Understanding

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

- Define Basic Drawing Settings
- Define Unit setting
- Define Limits setting
- Define User coordinate system Workspace setting
- Define Object Snap Settings
- Describe Basic Commands and Concepts Angles and lines in CAD.
- Describe differentiate between absolute, relative and polar system
- Define DIMSTYLE and MTEXT commands
- Define HATCHING concepts in CAD
- Describe differentiate between CHAMFER and FILLET command
- Define Types of Array
- Define OFFSET, CIRCLE and ROTATE short commands
- Define Zooming options
- Define Tools palettes window
- Define Design center
- Describe Scale and paper sizes
- Define Modify dimension style and text size according to paper size
- Describe Backup file

### Tools and Equipment

The tools and equipment required for this competency standard are given below:

S. No.	Items
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	Computer with all accessories
	CAD software disk
	Models

### **Critical Evidence(s) Required**

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

Evidence of the following is essential:

- Perform CAD software Installation and Create New File
- Perform to draw a circle with three point method on CAD software.

**0714E&A57 Design & Simulate the Electronic circuit by using Computer Aided Design Software**

**Overview**

After this Competency Standard, the trainee will be able to Design and Simulate Electrical and Electronic Circuits in CAD software.

<b>Competency Units</b>	<b>Performance Criteria</b>
<b>Select and analyze the equipment for drawing</b>	<ul style="list-style-type: none"> <li>P1. Analyze the purpose and scope of the drawing.</li> <li>P2. Organize available information related to project, study and propose further changes (if required).</li> <li>P3. Select computing equipment and software used for preparing the drawing.</li> <li>P4. Manage work flow and procedures for work supervision.</li> <li>P5. Adopt requirements for presentation of drawings</li> </ul>
<b>Perform the key features of CAD software.</b>	<ul style="list-style-type: none"> <li>P1. Generate 2-D drawings and 3-D models after finding the differences in CAD process.</li> <li>P2. Generate single and multiple view drawings.</li> <li>P3. Select CAD software and analyze its compatibility with other software programs.</li> <li>P4. Make list of the engineering components.</li> <li>P5. Select appropriate drawing method for drafting.</li> </ul>
<b>Adopt the CAD software for drawing work.</b>	<ul style="list-style-type: none"> <li>P1. Run software and navigate to the library.</li> <li>P2. Select software templates and determine its uses.</li> <li>P3. Adopt organizational symbols, codes and standards to be applied in drafting work.</li> <li>P4. Apply workplace procedures to retrieve and manipulate required information.</li> <li>P5. Apply navigate computing technology.</li> <li>P6. Make arrangement for working environment.</li> </ul>
<b>Design and Draw Electrical machine views using CAD software.</b>	<ul style="list-style-type: none"> <li>P1. Draw the cross sectional view of various AC machines using CAD software.</li> <li>P2. Draw the cross sectional view of various DC machines using CAD software.</li> <li>P3. Draw the winding diagrams of AC and DC machines.</li> <li>P4. Draw the aerial view from three different angle of AC and DC machines.</li> </ul>
<b>Design Electrical Circuits using CAD software.</b>	<ul style="list-style-type: none"> <li>P1. Draw general graphical symbols and notations used in Electrical engineering using CAD software.</li> <li>P2. Draw R-L (series &amp; parallel) electrical circuits using CAD software.</li> <li>P3. Draw R-C (series &amp; parallel) electrical circuits using CAD software.</li> <li>P4. Draw R-L-C (series &amp; parallel) electrical circuits using CAD software.</li> <li>P5. Draw the circuit diagram for hotel call bell system.</li> <li>P6. Draw lighting and power wiring diagram for</li> </ul>

	any given installation.
<b>Simulate Electrical Circuits.</b>	<p>P1. Perform the steps for opening Simulation software in Electrical Engineering.</p> <p>P2. Simulate and test the circuits prepared in previous competency unit CU5.</p> <p>P3. Generate graph and plot waveform for analysis.</p> <p>P4. Organize and analyze the output.</p>
<b>Design and Draw Electronics Circuits using CAD.</b>	<p>P1. Draw general graphical symbols and notations for Resistor, Inductor, Transformer, Diodes, Zener diode, Transistors PNP/ NPN, photo diode, FET, MOSFET and IGBT using CAD software.</p> <p>P2. Draw Half-wave, full-wave and bridge rectifier circuits using CAD software.</p> <p>P3. Draw the common emitter, common collector, and common base amplifier circuits using CAD software.</p> <p>P4. Draw the audio frequency, radio frequency and push/pull power amplifier circuits using CAD software.</p> <p>P5. Draw the circuit diagram for Intercom.</p> <p>P6. Draw the circuit diagram for thyristor working as a rectifier.</p>
<b>Simulate Electronics Circuits.</b>	<p>P1. Perform the steps for using Simulation software in Electronics Engineering.</p> <p>P2. Simulate and test the circuits prepared in previous competency unit CU7.</p> <p>P3. Generate graph and plot waveform for analysis.</p> <p>P4. Analyze the output.</p>
<b>Design a PCB using CAD.</b>	<p>P5. Select the software for PCB design.</p> <p>P6. Prepare a layout of rectifier circuit.</p> <p>P7. Prepare a layout of amplifier circuit.</p> <p>P8. Prepare a layout of oscillator circuit.</p>
<b>Finish CAD operations.</b>	<p>P1. Save the project in software.</p> <p>P2. Print drawing elements and evaluate presentation.</p> <p>P3. Evaluate work and identify areas for improvement.</p> <p>P4. Close applications, perform CAD housekeeping and maintain record.</p>

### **Knowledge & Understanding**

- Describe the basic requirements of an engineering drawing.
- Explain the information required to analyze a project.
- Describe types of CAD software used for detail drafting, their key features and suitability for producing specific drawing outcomes.
- Describe your selection for the drawing software
- Differentiate between 2D and 3D drawings
- Describe the process followed to generate single and multiple view drawings.
- Explain various engineering components.

- Describe different drawing methods for drafting.
- Explain the steps for running the software
- Explain the different libraries and extensions of the software
- Describe the process to analyze symbols, codes and standards to be applied in drafting work
- Describe how to setup working environment
- Explain the difference between AC and DC machines and compare their parts.
- Define aerial view and cross sectional view
- Describe the general graphical symbols and notations used in Electrical engineering.
- Define the types of R-L-C circuits and draw their circuit diagrams.
- Describe different components used in lighting and power wiring diagram
- What procedure should be adopted to maintain a record

### **Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

<b>Sr.No.</b>	<b>Name</b>
1	CAD software.
2	Personal Computer
3	Printer/plotter with all accessories.

### **Critical Evidence(s) Required**

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

- Simulate Electronics Circuits
- Design a PCB layout in CAD software

## 23. Electrical Machines

### 0714E&A58 Identify the Types of DC Generator & Draw Load Characteristics of DC Shunt Generator

#### Overview:

This competency standard identifies the competencies required to identify the types of generators & draw load characteristics of a DC Shunt Generator

Competency Units	Performance Criteria
<b>Identify DC shunt Generator</b>	<p>P1. Measure the terminal resistance of generator with ohm meter.</p> <p>P2. Identify DC shunt generator from measured value of resistance.</p> <p>P3. Disconnect both windings.</p> <p>P4. Identify the shunt field winding of shunt generator.</p> <p>P5. Identify armature of shunt generator.</p> <p>P6. Measure the resistance of both winding separately.</p> <p>P7. Record the resistance of armature winding and field winding.</p> <p>P8. Compare the resistance of armature winding and field winding to identify the difference between them.</p>
<b>Identify DC series Generator</b>	<p>P1. Measure the terminal resistance of generator with ohm meter.</p> <p>P2. Identify DC series generator from measured value of resistance.</p> <p>P3. Disconnect both windings.</p> <p>P4. Identify the series field winding of series generator.</p> <p>P5. Identify armature of series generator.</p> <p>P6. Measure the resistance of both winding separately.</p> <p>P7. Record the resistance of armature winding and field winding.</p> <p>P8. Compare the resistance of armature winding and field winding to identify the difference between them.</p>
<b>Identify DC compound Generator</b>	<p>P1. Measure the terminal resistance of generator with ohm meter.</p> <p>P2. Identify DC Compound generator from measured value of resistance.</p> <p>P3. Disconnect both windings.</p> <p>P4. Identify the series field winding of generator.</p> <p>P5. Identify the shunt field winding of generator.</p> <p>P6. Identify armature of shunt generator.</p> <p>P7. Measure and record the resistance of both winding separately.</p> <p>P8. Measure and Record the resistance of armature winding.</p> <p>P9. Compare the resistance of armature winding, series field winding and shunt field winding to identify the difference between them.</p>



<b>Plot the Open circuit characteristics of a D.C shunt Generator</b>	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.
<b>Plot the load characteristics of D.C shunt Generators</b>	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.

### Knowledge & Understanding

- Describe armature winding.
- Tell the types of generators.
- Describe DC series generator.
- Describe terminal voltage.
- Define faraday's law
- Explain the difference between Motors and generators
- Explain the rules of generators
- Define the Type of DC machines.
- Explain the principle of simple loop generator.
- Define Basic DC Systems.
- Describe types of DC Generators.

### Critical Evidence(s) Required

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

Evidence of the following is essential:

- Enlist types of DC generator.
- Differentiate between self-excited and separately excited DC generator.
- Differentiate between differential and cumulative compound DC generator.
- Plot OCC for shunt and series DC generator.

## Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Galvanometer
2	Resistive load
3	Connecting leads
4	Multi-meters
5	Rheostat.
6	Breakers
7	DC source
8	Techometer

**0714E&A59 Identify the Types of DC Motors & Draw Load characteristics of DC Series Motor**

**Overview:**

This competency standard identifies the competencies required to identify the DC Motors & draw their characteristics.

Competency Units	Performance Criteria
<b>Identify DC shunt motor</b>	<ul style="list-style-type: none"> <li>P1. Measure the terminal resistance of motors with ohm meter.</li> <li>P2. Identify DC shunt motor from measured value of resistance.</li> <li>P3. Disconnect both windings.</li> <li>P4. Identify field winding of shunt motor.</li> <li>P5. Identify armature of shunt motor.</li> <li>P6. Measure the resistance of both winding separately.</li> <li>P7. Record the resistance of armature winding and field winding.</li> <li>P8. Compare the resistance of armature winding and field winding to identify the difference between them.</li> </ul>
<b>Identify DC series motor</b>	<ul style="list-style-type: none"> <li>P1. Measure the terminal resistance of DC motors with ohm meter.</li> <li>P2. Identify DC series motor from measured value of resistance.</li> <li>P3. Disconnect both windings.</li> <li>P4. Identify the series field winding of series motor.</li> <li>P5. Identify armature of series motor.</li> <li>P6. Measure the resistance of both winding separately.</li> <li>P7. Record the resistance of armature winding and field winding.</li> <li>P8. Compare the resistance of armature winding and field winding to identify the difference between them.</li> </ul>
<b>Identify DC compound motor</b>	<ul style="list-style-type: none"> <li>P1. Measure the terminal resistance of DC motor with ohm meter.</li> <li>P2. Identify DC Compound motor from measured value of resistance.</li> <li>P3. Disconnect both windings.</li> <li>P4. Identify the series field winding of motor.</li> <li>P5. Identify the shunt field winding of motor.</li> <li>P6. Identify armature of compound motor.</li> <li>P7. Measure and record the resistance of both winding separately.</li> <li>P8. Record the resistance of armature winding.</li> <li>P9. Compare the resistance of armature winding, series field winding and shunt field winding to identify the difference between them.</li> </ul>
<b>Plot the load characteristics of D.C series motor.</b>	<ul style="list-style-type: none"> <li>P1. Select DC series motor and achieve connection as per diagram.</li> <li>P2. Turn on DC power supply and increase the load 0 to full value.</li> <li>P3. Record the value of speed and current on each load.</li> </ul>

	P4. Draw the graph between load current and speed
<b>Control speed of DC series motor.</b>	<p>P1. Make the connection as per circuit diagram.</p> <p>P2. Insert external resistances in series to armature and field coil.</p> <p>P3. Switch on the supply and increase the voltage gradually to its rated voltage.</p> <p>P4. Record speed at different supply voltages.</p> <p>P5. Make graph between speed and applied voltage.</p>
<b>Measure the Control speed of DC shunt motor.</b>	<p>P1. Make the connection as per circuit diagram.</p> <p>P2. Switch on the supply and increase the voltage gradually to its rated voltage.</p> <p>P3. Record speed at different supply voltages.</p> <p>P4. Make graph between speed and applied voltage.</p>
<b>Start DC shunt motor with 3 point starter.</b>	<p>P1. Make the connection as per circuit diagram.</p> <p>P2. Switch on the supply and move starter handle from off position to position 1.</p> <p>P3. Move the starter arm from position 1 to position 2 and continue this process till starter arm reach at its extreme position.</p>
<b>Identify the effect of back EMF in DC motor.</b>	<p>P1. Select DC series motor and make connection as per diagram.</p> <p>P2. Turn on DC power supply and increase the load 0 to full value.</p> <p>P3. Record the value of speed and current on each load.</p> <p>P4. Calculate back EMF by using the recoded values and appropriate formula.</p> <p>P5. Make graph between speed and back EMF and interpret the result.</p>

### **Knowledge & Understanding**

- Describe armature winding of motor.
- Tell the types of DC motors.
- Describe DC series and DC shunt motor.
- Describe terminal voltage.
- Define faraday's law
- Explain the difference between Motors and generators
- Explain the rules of motors.
- Explain the Type of DC machines.
- Define Basic DC Systems.
- Describe Load curves.
- Define 3 point starter.

### **Critical Evidence(s) Required**

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

Evidence of the following is essential:

- Enlist types of DC motor

- Differentiate between series, shunt and compound DC generator.
- Draw the circuit diagram of speed control of DC motor.
- Make connection of 4-point starter with DC shunt motor.

### **Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

<b>Sr.No.</b>	<b>Name</b>
1	Galvanometer
2	Connecting leads
3	Multi meters
4	All DC motors
5	Mechanical load
6	Rheostat.
7	Starters
8	Breakers
9	DC source
10	Tachometer

## 0714E&A60 Identify the Three Phase motors & their Starting Methods

### Overview:

This competency standard identifies the competencies required to identify the three phase motors and their starting methods

Competency Units	Performance Criteria
<b>Identify and operate 3 phase Squirrel cage motor.</b>	P1. Identify and select 3 phase squirrel cage motor. P2. Make connection as per diagram. P3. Connect the supply and interpret the result.
<b>Start a three phase Induction motor with direct on line starter</b>	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.
<b>Start 3 phase Induction motor with Star Delta starter.</b>	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.
<b>Make connection to reverse the direction of induction motor.</b>	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 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.
<b>Identify the effect of field current on three phase synchronous motor.</b>	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 & Understanding

- Describe 3 phase motors.
- Differentiate single phase and three phase motors.
- Explain line diagram.
- Describe direct on line starter.

- Tells the types of starter for three phase motors.
- Define 3 pole 3-way switch.
- Explain star delta connection.
- Tell the effect of reversing motor.
- Describe synchronous motor.
- Describe the effect of field current on synchronous motor.

**Critical Evidence(s) Required**

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

Evidence of the following is essential:

- Make connection of DOL starter with 3 phase induction motor.
- Make connection of star delta starter with 3 phase induction motor.
- Make connection diagram with induction motor for forward and reverse operation.

**Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Galvanometer
2	Connecting leads
3	Multi meters
4	3 phase induction motors
5	Mechanical load
6	Rheostat.
7	Starters
8	3Pole 2-way switch.
9	Breakers
10	DC source
11	Synchronous motor.
12	Techomete

**0714E&A61 Operate an Alternator**

**Overview:**

This competency standard identifies the competencies required to operate an alternator

Competency Units	Performance Criteria
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.

<b>Perform no load test.</b>	<p>P1. Make connection according to diagram.</p> <p>P2. Run the alternator with prime mover to its rated speed.</p> <p>P3. Supply the field current to make the terminal voltage to its rated value.</p> <p>P4. Measure Iron losses from watt meter.</p>
<b>Perform short circuit test.</b>	<p>P1. Make connection according to diagram.</p> <p>P2. Run the alternator with prime mover to its rated speed.</p> <p>P3. Supply the field current to make the terminal voltage 10 to 15% to its rated value.</p> <p>P4. Measure the copper loss from the watt meter.</p>
<b>Measure the efficiency of an alternator.</b>	<p>P1. Perform no load test to measure Iron losses.</p> <p>P2. Perform short circuit test to measure copper losses.</p> <p>P3. Apply formula to find efficiency.</p>
<b>Measure the effect of field current on terminal voltage.</b>	<p>P1. Run the alternator with prime mover to its rated speed.</p> <p>P2. Supply the field current to make the terminal voltage to its rated value.</p> <p>P3. Draw no load curve between field current and terminal voltage.</p>
<b>Measure the effect of speed changes on alternator frequency and active power.</b>	<p>P1. Run the alternator with prime mover to its rated speed.</p> <p>P2. Supply the field current to make the terminal voltage to its rated value.</p> <p>P3. Apply electrical load on alternator.</p> <p>P4. Measure the effects of load on alternator speed and frequency.</p> <p>P5. Adjust the prime mover speed to its rated value.</p> <p>P6. Measure the effect of this change on alternator speed and frequency.</p>
<b>Perform parallel operation of Alternators.</b>	<p>P1. Run the incoming alternator to its rated speed.</p> <p>P2. Supply the field current to make the terminal voltage to its rated value.</p> <p>P3. Use synchronous scope to synchronize alternator's frequency and phase angle.</p> <p>P4. Check the phase sequence with dark lamp method.</p> <p>P5. Check the voltage of bus bar and incoming machine with volt meter.</p> <p>P6. Switch on the breaker after completing parallel operation.</p>

### **Knowledge & Understanding**

- Define an alternator.
- What does it mean by no load test
- Which resistance is high stator winding or rotor winding.
- Describe iron losses.
- Describe copper losses.
- Define rated voltage and terminal voltage.
- How efficiency of alternator can be increased.
- What is the effect of change in field current on terminal voltage



- Describe the effect of speed on frequency.
- Describe the effect of speed on active power.
- Why parallel operation of two generators is required.
- What factor is most important for parallel operation of generator

### Critical Evidence(s) Required

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

Evidence of the following is essential:

- Measure frequency and voltage at the terminal of alternator.
  - Change the speed of alternator and write down the effect on output voltage of alternator.
- Enlist the requirements, necessary for the parallel operation of alternators.

### Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	AC Generators
2	Galvanometer
3	Connecting leads
4	Multi meters
5	Rheostat.
6	Switches.
7	Breakers
8	DC source
9	Watt meter.
10	Techometer

## 0714E&A62 Operate the Single Phase, Special Purpose Motors

### Overview:

This competency standard identifies the competencies required to operate the special purpose single phase motors

Competency Units	Performance Criteria
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.

<b>Operate capacitor start and Capacitor run single phase AC motor.</b>	<p>P1. Make connections according to circuit diagram.</p> <p>P2. Apply rated voltage to the stator.</p> <p>P3. Measure the RPM.</p> <p>P4. Remove the starting capacitor with centrifugal switch.</p> <p>P5. Measure the RPM again.</p> <p>P6. Check the effect of starting capacitor on motor torque.</p>
<b>Study the operation of shaded pole single phase motor.</b>	<p>P1. Make connections according to circuit diagram.</p> <p>P2. Apply rated voltage to the stator.</p> <p>P3. Change the applied voltage to measure the effect on motor speed.</p>
<b>Operate and speed control of AC series motor.</b>	<p>P1. Connect the armature and field winding in series.</p> <p>P2. Apply rated voltage to the motor.</p> <p>P3. Measure the effect on motor speed by change in applied voltage.</p>
<b>Operate miniature (reluctance and hysteresis) single phase AC motors.</b>	<p>P1. Connect the stator of motor with single phase supply.</p> <p>P2. Measure the effect of load change on motor speed.</p> <p>P3. Draw torque speed curves.</p>
<b>Construct and operate stepper motor.</b>	<p>P1. Connect the stator of the motor with control circuit.</p> <p>P2. Adjust the control voltage of control unit.</p> <p>P3. Measure the RPM.</p> <p>P4. Readjust the control voltage of control unit.</p> <p>P5. Measure the RPM again.</p> <p>P6. Make comparison between Control voltage and RPM.</p>
<b>Construct, Operate and develop control circuit with the help of servo motor.</b>	<p>P1. Pair the servo motor with some encoder to provide position and speed feedback.</p> <p>P2. Compare the measured position to external input to the controller.</p> <p>P3. Check the feedback on motor position.</p>

### Knowledge & Understanding

- Explain the difference between single phase and three phase motors.
- Tell the types of single phase motors.
- Where auxiliary winding exists in single phase motor.
- How RPM of motors measured.
- Explain the effect of capacitor in capacitor start capacitor run motor.
- How speed of single phase motor is affected by load.
- Name the special purpose motors.
- Explain the operation of stepper motor.
- Explain the principle/ working of servo motor.
- Elaborate the operation of servo motor depends upon feedback.
- Explain control circuit in servo motor.

### Critical Evidence(s) Required

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

Evidence of the following is essential:

- Enlist types of single-phase AC motors.
- Enlist types of commutator motor.
- Operate stepper motor and write the procedure to reverse its direction.
- Enlist types of servo motor.

### **Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

<b>Sr.No.</b>	<b>Name</b>
1	All type of single phase motors.
2	Servo motor.
3	Connecting leads
4	Multi meters
5	Breakers
6	DC source
7	Capacitors
8	Techometer
9	Centrifugal Switch

## 24. Communication systems

### 0714E&A63 Identify the parts of Analog & digital telephone set & verify their functions

#### Overview:

This competency standard covers the skills and knowledge required to identify the parts of analogue & digital telephone sets and their functions

Competency Units	Performance Criteria
<b>Dismantle and identify the parts of automatic telephone set</b>	<p>Select the automatic telephone set and establish a method for disassembling activity as per SOP.</p> <p>Use standard tools described in user manual</p> <p>Apply disassembling techniques</p> <p>Organize the tag-identification of the parts/components/wires of telephone set.</p> <p>Identify the parts (magneto bell, dial, antiside tone circuit, transmitter, receiver, cradle switch etc.)</p> <p>Check for the proper operation/ functionality</p> <p>Apply assembling techniques.</p>
<b>Dismantle and identify the parts of digital telephone set</b>	<p>Select the digital telephone set and establish a method for disassembling activity as per SOP.</p> <p>Use standard tools described in user manual</p> <p>Apply disassembling techniques</p> <p>Organize the tag-identification of the parts/components/wires of telephone set.</p> <p>Identify the parts (telephone buzzer, dial, Dial IC, speech IC transmitter, receiver, bridge rectifier, cradle switch etc.)</p> <p>Check for the proper operation/ functionality</p> <p>Apply assembling techniques.</p>
<b>Demonstrate the operation of Telephone buzzer</b>	<p>Connect the telephone set to telephone line.</p> <p>Dial the telephone No. which is connected to line, form any mobile/telephone.</p> <p>Hear the ringing tone in mobile/telephone and note what happen in telephone set connected to line.</p>
<b>Perform the operation of Transmitter &amp; receiver</b>	<p>Connect the telephone set to telephone line.</p> <p>Dial the telephone No. which is connected to line, form any mobile/telephone.</p> <p>On hearing ringing bell, pic up hand set and speak on the lower portion of hand set (transmitter).</p> <p>On replying form other side note the effect from upper portion of hand set (receiver).</p>
<b>Identify the parts of rotary dial &amp; verify its function.</b>	<p>Select automatic telephone set.</p> <p>Identify the dial plate of dialer.</p> <p>Identify the dial hole on dial plate.</p> <p>Identify the finger stop.</p> <p>Dial any number from rotary dial</p> <p>Note the sound of pulsed on receiver and count them and compare them to dial number.</p>
<b>Identify the parts of digital dial &amp; verify its function.</b>	<p>Select digital telephone set.</p> <p>Identify Key pad dialer on the telephone set.</p> <p>Press different numbers from key pad dialer.</p> <p>Note and compare the difference of sound effect in receiver against each dial number.</p>

### 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.
- Explain the function of cradle switch

### Critical Evidence(s) Required

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

Evidence of the following is essential:

- Enlist the parts of telephone set.
- Enlist the parts of rotary dial.
- Differentiate between rotary and digital dial.

### Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr. No	Items
	Electrical test bench
	Multimeter
	Test probes
	Power source (AC/DC)
	Screw drivers
	Twizer
	Wire cutter
	Nose plier
	Screw drivers
	Twizer
	Wire cutter
	Nose plier

**0714E&A64 Construct the AM / FM Transmitter & Receiver & verify their functionality**

**Overview:**

This competency standard covers the skills and knowledge required to construct the FM/AM transmitters and receivers to be used for industrial purposes.

Competency Units	Performance Criteria
<b>Construct AM Transmitter</b>	<p>Place the components on a Vero-board as per circuit diagram.                      Solder the components together.                      Solder/connect a wire to function as an antenna.                      Power on the circuit.                      Use a spectrum analyzer to detect the transmission frequency.                      Adjust the transmission frequency by varying the capacitance of the variable capacitor connected to the tank circuit alongside the antenna if the transmission frequency detected by the analyzer is not in range of 540 KHz to 1600 KHz.                      Play a sound into the Mic of the transmitter.                      Play AM Radio and Tune it to the transmission frequency of your circuit.                      Hear the transmitted voice playing on the AM Radio.</p>
<b>Construct AM Receiver</b>	<p>Place the components on a Vero-board as per circuit diagram.                      Solder the components together.                      Solder/connect a wire to function as an antenna.                      Power on the circuit.                      Transmit a voice using your FM Transmitter circuit that you made previously.                      Tune your AM Receiver circuit to the frequency of the transmitter.                      Hear the transmitted voice playing on your AM Receiver.</p>
<b>Construct FM Transmitter</b>	<p>Place the components on a Vero-board as per circuit diagram.                      Solder the components together.                      Solder/connect a wire to function as an antenna.                      Power on the circuit.                      Use a spectrum analyzer to detect the transmission frequency.                      Adjust the transmission frequency by varying the capacitance of the variable capacitor connected to the tank circuit alongside the antenna if the transmission frequency detected by the analyzer is not in range of 88 MHz to 108MHz.                      Play a sound into the Mic of the transmitter.                      Open FM Radio on your phone and Tune it to the transmission frequency of your circuit.                      Hear the transmitted voice playing on the FM Radio of your phone.</p>
<b>Construct FM Receiver</b>	<p>Place the components on a Vero-board as per circuit diagram.                      Solder the components together.                      Solder/connect a wire to function as an antenna.                      Power on the circuit.                      Transmit a voice using your FM Transmitter circuit that you made previously.                      Tune your FM Receiver circuit to the frequency of the transmitter.                      Hear the transmitted voice playing on your FM Receiver.</p>

### **Knowledge & Understanding**

- Identification of basic electronic components like resistors, capacitors, inductors and transistors.
- Circuit construction
- Wire wound inductors
- Transmitting signals using basic FM Transmitter circuit.
- Transmitting signals using basic FM Transmitter circuit.

### **Critical Evidence(s) Required**

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

Evidence of the following is essential:

- Draw the block diagram of AM transmitter.
- Draw the block diagram of AM Receiver
- Draw the block diagram of FM transmitter.
- Draw the block diagram of FM Receiver

### **Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

<b>Sr. No</b>	<b>Items</b>
1.	Circuit diagram
2.	Components as per circuit diagram
3.	Vero board
4.	Soldering station
5.	Power supply
6.	Spectrum analyzer
7.	FM transmitter

**0714E&A65 Demonstrate modulation, demodulation, multiplexing & de-multiplexing**

**Overview:**

This competency standard covers the skills and knowledge required to perform the modulation, demodulation, multiplexing and de-multiplexing operations on certain signals.

Competency Units	Performance Criteria
<b>Perform Amplitude Modulation of Information Signal</b>	<p>Calibrate CRO.            Generate Low Frequency Message signal and observe on channel 1 of CRO.            Apply the Message and Carrier signals to the AM Modulator Section of the AM Trainer.            Connect the output of the modulator to channel 2 of CRO and observe the signal.</p>
<b>Perform Demodulation of Modulated AM Signal</b>	<p>Calibrate CRO.            Generate AM Modulated signal and observe on channel 1 of CRO.            Apply the Modulated and Carrier signals to the AM De-Modulator Section of the AM De-Modulation Trainer.            Connect the output of the de-modulator to channel 2 of CRO and observe the signal.            Compare the Message signal to the Demodulated signal.</p>
<b>Calculate band width and modulation index</b>	<p>Calibrate CRO.            Measure the frequency and voltage of Low frequency and carrier frequency signal with oscilloscope.            Calculate modulation by formula            Calculate bandwidth by formula</p>
<b>Demonstrate the function of pre-emphasis circuit.</b>	<p>Give the audio signal to spectrum analyzer and note the relative amplitude of audio frequency signals.            Apply audio frequency signal to pre-emphasis circuit.            Give the output of pre-emphasis to spectrum analyzer and note the relative amplitude of audio frequency signals.            Form above readings compare the normal audio signal and pre-emphasized signal and write down the difference</p>
<b>Demonstrate the function of de-emphasis circuit.</b>	<p>Take the audio signal form FM detector of FM radio receiver and give it to spectrum analyzer and note the relative amplitude of audio frequency signals.            Take the audio signal form de-emphasis circuit of FM radio receiver and apply it to spectrum analyzer and note the relative amplitude of audio frequency signals.            Form above readings compare the detected audio signal and de-emphasized signal and write down the difference</p>
<b>Perform Frequency Modulation of Information Signal</b>	<p>Calibrate CRO.            Generate Low Frequency Message signal and observe on channel 1 of CRO.            Apply the Message and Carrier signals to the FM Modulator Section of the FM Trainer.            Connect the output of the modulator to channel 2 of CRO and observe the signal.</p>
<b>Perform Demodulation of Modulated FM Signal</b>	<p>Calibrate CRO.            Generate FM Modulated signal and observe on channel 1 of CRO.            Apply the Modulated and Carrier signals to the FM De-Modulator Section of the FM De-Modulation Trainer.            Connect the output of the de-modulator to channel 2 of CRO and observe the signal.</p>



	Compare the Message signal to the Demodulated signal.
<b>Perform Pulse Code Modulation (PCM) of an analog signal</b>	Generate Sine wave signal and observe on channel 1 of CRO. Apply the generated signal and Clock signal to the PCM Modulator using jumpers. Observe the output on channel 2 of CRO and also note the pattern of blinking of output LEDs.
<b>Perform Time Division Multiplexing (TDM) and De-multiplexing</b>	Generate multiple low frequency signals. Apply the signals to TDM Multiplexer. Observe the multiplexed output on channel 1 of CRO. Apply to multiplexed output to the De-multiplexer. 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. Repeat the step 5 for all the de-multiplexed signals one by one.
<b>Perform Frequency Division Multiplexing and De-multiplexing</b>	Generate multiple message signals. Generate multiple carrier signals of different frequencies. Apply each of the message and carrier signal pairs to their respective Balanced Modulators. Combine the modulated signals using Adder and observe this FDM Multiplexed output on Channel 1 of CRO. Apply the multiplexed signal to respective Band-Pass filters for each De-multiplexer section (or user). Apply the output of each Filter to their respective Demodulators. 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”
- Define pre-emphasis
- Define de-emphasis
- Define the use of spectrum analyzer
- Working Principle of FM Modulator
- Working Principle of FM Demodulator
- Sine wave and its different parameters.
- Working principle of PCM.
- Working principle of TDM.
- Define the Calibrating and Using CRO.
- Explain Working principle of CRO.
- Explain the AM DSB and SSB
- Define AM demodulation

- Describe the Filtering

### Critical Evidence(s) Required

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

Evidence of the following is essential:

- Draw the wave shape of Amplitude modulated signal.
- Draw the circuit diagram AM demodulator.
- Calculate %modulation, modulation index form amplitude modulated signal.
- Draw the wave shape of Frequency modulated signal.
- Draw pre-emphasis circuit diagram.
- Draw De-emphasis circuit diagram.
- Enlist types multiplexing.

### Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr. No	Items
1.	Oscilloscope with probes
2.	AM trainer jumpers
3.	AM demodulation trainer
4.	Signal generator
5.	FM radio receiver
6.	Connecting leads
7.	Spectrum analyzer
8.	FM demodulation trainer
9.	Jumpers
10.	PCM trainer
11.	TDM trainer
12.	Multiplexing trainer

## 0714E&A66 Install Chord less telephone, PABX, Fax machine & satellite dish system

### Overview:

This competency standard covers the skills and knowledge required to install chord less telephones, fax machines, PABX and satellite dish systems.

Competency Units	Performance Criteria
<b>Install cord less telephone system.</b>	Chose proper location to install the base station Connect the phone line to the base the base station of cord less telephone. Connect the supply to the base station. Pic-up the Mobile unit from cordless telephone and make a call to ensure the working functionality.

<b>Install and Configure of Private Automatic Branch Exchange(PABX)</b>	<p>Lay 2-Pair Telephone drop wire around the premises. Plug the telephone cord into your PBX console in an input that says, "Telephone Line."</p> <p>Connect the other end into a wall jack. This allows your PBX system to send and receive phone calls.</p> <p>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.</p> <p>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.</p> <p>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</p>
<b>Install Home satellite dish system.</b>	<p>Perform dish assembly as per SOP</p> <p>Perform dish installation on roof top as per SOP.</p> <p>Route coaxial cable and connect dish receiver to dish antenna.</p> <p>Connect dish receiver output to TV receiver input.</p> <p>Turn on the supply of both receivers, enter the frequency of required channel.</p> <p>Adjust the antenna with the help of satellite locator chart till required channel is observed on TV screen.</p>
<b>Install and configure FAX Machine</b>	<p>Remove all of the components of the fax machine from the box.</p> <p>Shake gently the ink toner cartridge to evenly distribute the toner.</p> <p>Insert the toner cartridge into the Fax machine.</p> <p>Install RJ-11 connector on both ends of 2-Pair telephone drop wire.</p> <p>Connect one end of the wire to Fax machine and the other to the Rosset Box connected to the telephone line.</p> <p>Load paper into the machine.</p> <p>Power on the Fax machine</p> <p>Run a test sheet through the machine.</p>

### Knowledge & Understanding

- Function and operating procedure of cordless telephone
- Installing RJ-11 Connectors on cable.
- Function and operating procedure of PABX
- Explain the Function & operating procedure of satellite dish system
- Installing Rosset box on Telephone line

### Critical Evidence(s) Required

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

Evidence of the following is essential:

- Enlist the steps to install the cord less telephone.
- Draw the block diagram of PABX
- Install and configure Fax machine.

- Make connections and configure satellite dish system.

## 0714E&A67 Apply different concepts of propagation of waves

### Overview:

After studying the subject the students will be able to: Understand a vector-calculus based description of static electric fields in cases of fixed charges, conductors, and dielectrics. Student will be able to describe the moving charges (for the case of steady electric currents) and resulting static magnetic fields are also presented and student will be able capable of understanding the Maxwell equations and the classical description of electromagnetic fields. Problem solving makes frequent use of symmetry and invariance.

Competency Units	Performance Criteria
<b>Identify Transmission Lines</b>	Categorize Transmission frequencies Differentiate various transition lines according to their band width and material
<b>Classify Waveguides</b>	Identify different types of waveguides according to their shape . Identify different modes of waveguides.
<b>Categorized Antennas</b>	Identify various types of Dipole Antenna. Categorize the Characteristics of Antennas

### Knowledge & Understanding

???

### Critical Evidence(s) Required

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

- Identify Transmission Lines
- Classify Waveguides
- Classify Waveguides

### Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Multi-meter
2	Power supply
3	Trainer
4	Resistor
5	Capacitor
6	Inductor
7	ICs

## 25. Digital Electronics

### 0714E&A68 Manipulate the Number System

#### Overview:

This competency standard identifies the competencies required to Manipulate Number Systems, apply the fundamental concepts of arithmetic logic function like number systems, their conversion and Boolean algebra.

Competency Units	Performance Criteria
<b>1. Convert Decimal Number to Octal, Binary , Hexadecimal Numbers</b>	Convert Decimal numbers into Binary numbers. Convert Decimal numbers into Octal numbers Convert Decimal numbers into Hexadecimal numbers.
<b>Convert Octal Number to Decimal, Binary, Hexadecimal Numbers</b>	Convert Octal numbers into Binary numbers. Convert Octal numbers into Decimal numbers Convert Octal numbers into Hexadecimal numbers.
<b>Convert Binary Number to Decimal, Octal , Hexadecimal Numbers</b>	Convert Binary numbers into Octal numbers Convert Binary numbers into Decimal numbers. Convert Binary numbers into Hexadecimal numbers.
<b>Apply arithmetic operations on number systems</b>	Performed Addition on Binary, Decimal, Octal, and Hexadecimal numbers. Performed Subtraction on Binary, Decimal, Octal, and Hexadecimal numbers. Performed Multiplication on Binary, decimal, Octal , Hexadecimal numbers Compute One's and two's compliment of Binary numbers

#### Knowledge and Understanding

- Describe essential elements of the binary, octal and hexadecimal numbering system
- Describe Binary, Octal and Hexadecimal Counting
- Define compliment of a number
- Explain Binary Addition, Subtraction & Multiplication
- Learn Number-Base Conversions
- Explain Signed Binary Numbers

**Critical Evidence(s) Required**

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

Evidence of the following is essential:

- Compute One's & two's compliment of Binary numbers
- Convert different type of codes and number systems which are used in digital communication and computer systems

**Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Stationary

## 0714E&A69    Verify Truth tables of Digital Logic 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 X-OR gate and Verify the truth table of X-NOR gate Verify the truth table of AND gate, OR gate, NOT gate, NAND gate, NOR gate, X-OR gate and X-NOR gate

Competency Units	Performance Criteria
CU1. Verify the truth table of AND gate	<p><b>P1.</b> Identify the symbol of logic gate, IC &amp; logic function.</p> <p><b>P2.</b> Place (AND gate IC) on bread board.</p> <p><b>P3.</b> Identify the input, output, Vcc and ground pin.</p> <p><b>P4.</b> Connect LED to the output pin of IC and apply different logics ant input pins.</p> <p><b>P5.</b> Record &amp; verify the output result against each given input.</p>
CU2. Verify the truth table of OR gate	<p><b>P1.</b> Identify the symbol of logic gate, IC &amp; logic function.</p> <p><b>P2.</b> Place (OR gate IC) on bread board.</p> <p><b>P3.</b> Identify the input, output, Vcc and ground pin.</p> <p><b>P4.</b> Connect LED to the output pin of IC and apply different logics ant input pins.</p> <p><b>P5.</b> Record &amp; verify the output result against each given input.</p>
CU3. Verify the truth table of NOT gate	<p><b>P1.</b> Identify the symbol of logic gate, IC &amp; logic function.</p> <p><b>P2.</b> Place (NOT gate IC) on bread board.</p> <p><b>P3.</b> Identify the input, output, Vcc and ground pin.</p> <p><b>P4.</b> Connect LED to the output pin of IC and apply different logics ant input pins.</p> <p><b>P5.</b> Record &amp; verify the output result against each given input.</p>
CU4. Verify the truth table of NAND gate	<p><b>P1.</b> Identify the symbol of logic gate, IC &amp; logic function.</p> <p><b>P2.</b> Place (NAND gate IC) on bread board.</p> <p><b>P3.</b> Identify the input, output, Vcc and ground pin.</p> <p><b>P4.</b> Connect LED to the output pin of IC and apply different logics ant input pins.</p> <p><b>P5.</b> Record &amp; verify the output result against each given input.</p>
CU5. Verify the	<p><b>P1.</b> Identify the symbol of logic gate, IC &amp; logic function.</p>



truth table of NOR gate	<p><b>P2.</b> Place (NOR gate IC) on bread board.</p> <p><b>P3.</b> Identify the input, output, Vcc and ground pin.</p> <p><b>P4.</b> Connect LED to the output pin of IC and apply different logics ant input pins.</p> <p><b>P5.</b> Record &amp; verify the output result against each given input.</p>
CU6. Verify the truth table of X-OR gate	<p><b>P1.</b> Identify the symbol of logic gate, IC &amp; logic function.</p> <p><b>P2.</b> Place (X-OR gate IC) on bread board.</p> <p><b>P3.</b> Identify the input, output, Vcc and ground pin.</p> <p><b>P4.</b> Connect LED to the output pin of IC and apply different logics ant input pins.</p> <p><b>P5.</b> Record &amp; verify the output result against each given input.</p>
CU7. Verify the truth table of X-NOR gate	<p><b>P1.</b> Identify the symbol of logic gate, IC &amp; logic function.</p> <p><b>P2.</b> Place (X-NOR gate IC) on bread board.</p> <p><b>P3.</b> Identify the input, output, Vcc and ground pin.</p> <p><b>P4.</b> Connect LED to the output pin of IC and apply different logics ant input pins.</p> <p><b>P5.</b> Record &amp; verify the output result against each given input.</p>

### Knowledge & Understanding

- Study logic gates Logic gates. AND, OR, NAND, NOR, NOT, X-OR and X-NOR.
- Study the Boolean expression of AND, OR, NAND, NOR, NOT, X-OR and X-NOR, 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

**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 X-NOR gate

**0714E&A70 Construct & Verify the Combinational Logic Circuit**

**Overview:**

This competency standard covers the skills and knowledge required to Construct & verify the truth table of Half adder, full adder and Half Subtractor.

Competency Units	Performance Criteria
<b>Apply Karnaugh mapping &amp; Boolean algebra to simplify logic expressions</b>	Identify the SOP & POS Apply Boolean algebra & Karnaugh mapping to simplify SOP & POS. Construct logic circuits with simplified SOP & POS.
<b>Construct &amp; verify the truth table of Half adder</b>	Place (AND gate IC) & (X-OR gate IC) on bread board. Identify the input, output, Vcc and ground pin. Connect LED to the output pin of IC and apply different logics at input pins. Record & verify the output result against each given input Design, Construct, and test a half-adder circuit using one X-OR gate and two NAND gates.
<b>Construct &amp; verify the truth table of Full adder</b>	Place (AND gate IC) & (X-OR gate IC) on bread board. Identify the input, output, Vcc and ground pin. Connect LED to the output pin of IC and apply different logics at input pins. Record & verify the output result against each given input Design, Construct, and test a full-adder circuit using two ICs & 7486 and & 7400.
<b>Construct &amp; verify the truth table of Full Subtractor</b>	Place (AND, NOT & X-OR gate IC) on bread board. Identify the input, output, Vcc and ground pin. Connect LED to the output pin of IC and apply different logics at input pins. Record & verify the output result against each given input.
<b>Verify the Decoder</b>	Place (Decoder IC) on bread board. Identify the input, output, Vcc and ground pin. Connect LED to the output pin of IC and apply different logics at input pins. Record & verify the output result against each given input.
<b>Operate seven segment displays with seven segment decoder.</b>	Insert (7 segment decoder IC) and 7 segment display on bread board. Identify the input, output, Vcc and ground pin. Connect segment display with seven segment decoder input output pins. Record & verify the output result against each given input.
<b>Verify the Encoder</b>	Place (Encoder IC) on bread board. Identify the input, output, Vcc and ground pin. Connect LED to the output pin of IC and apply different logics at input pins. Record & verify the output result against each given input.
<b>Verify multiplexer and DE- multiplexer</b>	Implement following function with multiplexer $F(ABC) = \sum(0,2,3,4,5,6)$ :

Implement 4-to-1 mux and one 2-to-1 mux.  
Implement 1-to-4 dmux using 1-to-2 dmux.

### Knowledge and understanding

- Describe the laws and rules of Boolean algebra.
- Understanding of commutative and distributive expression. That is,  $A \cdot (B + C) = (A \cdot B) + (A \cdot C)$  and  $A + (B \cdot C) = (A + B) \cdot (A + C)$ .
- Study the combinational logic circuit.( Half adder, Full adder, Half subtractor, Full subtractor, Binary Multiplier , Magnitude Comparator )
- Study the Product-of-Sums & Sum-of-product simplification
- Knowledge of Don't-Care Conditions
- Understanding of Karnaugh Map of four variables.
- Understanding of Decoders & Encoders
- Knowledge of Pin configuration of ICs
- Explain pin 7 segment display and common cathode 7 segment display.
- Define limiting resistor.
- Understand implementation functions using multiplexers.
- Explain the Multiplexer & De-Multiplexer

### Critical Evidence(s) Required

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

- Verify multiplexer and DE- multiplexer

### Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	X-OR gate (7486 2-input Quad)
2	AND gate (7408 2-input Quad)
3	OR gate (7432 2-input Quad)
4	NOT gate (7404 Hex not gate)
5	Bread board
6	LED
7	DC supply (5 V)
8	Connecting leads
9	74LS139 IC
10	Seven segment display
11	Resistances (1K ohm)
12	Connecting leads
13	Mux KL-33006 block e
14	Mux KL-33006 block f

## 0714E&A71 Use 555 Timer IC as Multi-Vibrator

### Overview:

This competency standard covers the skills and knowledge required to construct 555 Timer IC as A-stable, Mono-stable & Bi-stable Multi-vibrator and observe their outputs.

Competency Units	Performance Criteria
<b>Construct 555 Timer IC as A-stable Multi-vibrator</b>	Place 555 Timer IC on bread board. Make connection as per diagram. Apply voltage to circuit and observe the output with the help of oscilloscope.
<b>Construct 555 Timer IC as Mono-stable Multi-vibrator</b>	Place 555 Timer IC on bread board. Make connection as per diagram. Apply voltage to circuit and observe the output with the help of oscilloscope.
<b>Construct 555 Timer IC as Bi-stable Multi-vibrator and verify its set and reset conduction</b>	Place 555 Timer IC on bread board. Make connection as per diagram. Change the position of switch and verify set and reset conditions from output pin with the help of oscilloscope.

### Knowledge and understanding

- Describe basic elements of 555 timer IC.
- Explain pin configuration of 555 Timer IC and its specification.
- Explain function of voltage control input.
- Describe the A-stable Multi-vibrator.
- What is mono-stable Multi-vibrator
- What is bi-stable Multi-vibrator

### Critical Evidence(s) Required

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

- Construct 555 Timer IC as Bi-stable Multi-vibrator and verify its set and reset conduction

### Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	555 Timer IC
2	Dual trace Oscilloscope 0-20MHZ
3	Resistors 10 KΩ
4	Capacitor 0.01μF
5	Bread board
6	DC supply (5 V)

## 0714E&A72 Construct Shift Registers and Counters Using Flip Flops

### Overview:

After the completion of this competency standard the candidate will be able to construct a variety of registers to be used for industrial purposes.

Competency Units	Performance Criteria
<b>Construct a 4 bit shift register by using Flip Flops</b>	Make connection of D-Flip Flop as per diagram to construct 4 bit shift register. Apply data at the input of register and give clock pulse Observed and recode the output according to the input.
<b>Construct a 4 bit binary counter using Flip Flops</b>	Make connection of JK-Flip Flop as per diagram to construct 4 bit binary counter. Connect LEDs to the outputs pins. Apply the clock pulse and record the output.
<b>Repair &amp; Troubleshoot combinational logic circuits</b>	Identify principles and operations of types of logic gates Locate drawing and diagrams. Check the grounding system in electronic equipment. Locate external and internal digital IC faults

### Knowledge and understanding

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

### Critical Evidence(s) Required

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

- Construct a 4 bit binary counter using Flip Flops

### Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Software Simulator and IDE's.
2	DLD trainer

<b>3</b>	IC's and Components
<b>4</b>	Multi-meter
<b>5</b>	Logic tester
<b>6</b>	DC Supply
<b>7</b>	Connecting wires

## 26. Soft Skills

### 0714E&A73 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
<b>Develop workplace sustainability policy</b>	Define scope of sustainability policy Gather information from a range of sources to plan and develop policy Identify and consult stakeholders as a key component of the policy development process 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 Make recommendations for policy options based on likely effectiveness, timeframes and cost Develop policy that reflects the organization's commitment to sustainability as an integral part of business planning and as a business opportunity Agree to appropriate methods of implementation, outcomes and performance indicators
<b>Communicate workplace sustainability policy</b>	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
<b>Implement workplace sustainability policy</b>	P1 Develop and communicate procedures to help 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
<b>Review workplace sustainability policy implementation</b>	P1 Review workplace sustainability policy implementation P2 Investigate successes or otherwise of policy P3 Monitor records to identify trends that may require remedial action and use to promote continuous improvement of performance P4 Modify policy and or procedures as required to ensure improvements are made

#### Knowledge and Understanding

The Student 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 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 Student needs to produce following critical evidence(s) 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:
  1. minimizing resource use
  2. resource efficiency
  3. reducing toxic material and hazardous chemical use
  4. employing life cycle management approaches
  5. continuous improvement
    - plan and implement sustainability policy and procedures including:
      1. agreed outcomes
      2. performance indicators
      3. activities to be undertaken
      4. assigned responsibilities
      5. 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.

## 0714E&A74 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
<b>1. Respect work timeframes</b>	<p>P1 Demonstrate punctuality in meeting, set working hours and times.</p> <p>P2 Utilize working hours only for working and follow company regulations.</p> <p>P3 Complete work tasks within deadlines according to order of priority</p> <p>P4 Supervisors are informed of any potential delays in work times or projects.</p>
<b>2. Maintain personal appearance and hygiene</b>	<p>P1 Clean hair, body and nails regularly.</p> <p>P2 Wear suitable cloths for the workplace, and respect local and cultural contexts</p> <p>P3 Meet specific company dress code requirements</p>
<b>3. Maintain adequate distance with colleagues and clients</b>	<p>P1 Respect personal space of colleagues and clients with reference to local customs and cultural contexts.</p> <p>P2 Keep sufficient distance from others</p> <p>P3 Avoid cross transmission of infections (especially through respiration).</p>
<b>4. Work in an ethical manner</b>	<p>P1 Follow company values/ethics codes of ethics and/or conduct, policies and guidelines.</p> <p>P2 Use company resources in accordance with company ethical standards.</p> <p>P3 Conduct personal behavior and relationships in accord with ethical standards and company policies.</p> <p>P4 Undertake work practices in compliance with company ethical standards, organizational policy and guidelines.</p> <p>P5 Instruct co-workers on ethical, lawful and reasonable directives.</p> <p>P6 Share company values/practices with co-workers using appropriate behavior and language.</p> <p>P7 Report work incidents/situations and/or resolved in accordance with company protocol/guidelines.</p>

### Knowledge and understanding

The Student 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 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 Student needs to produce following critical evidence(s) 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.

## **0714E&A75     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
<b>1. Establish personal work goals</b>	Serve as a positive role model in the workplace through personal work planning Ensure personal work goals, plans and activities reflect the organization s plans, and own responsibilities and accountabilities Measure and maintain personal performance in varying work conditions, work contexts and when contingencies

	occur
<b>2. Set and meet own work priorities</b>	<p>Take initiative to prioritize and facilitate competing demands to achieve personal, team and organizational goals and objectives</p> <p>Use technology efficiently and effectively to manage work priorities and commitments</p> <p>Maintain appropriate work-life balance, and ensure stress is effectively managed and health is attended to</p>
<b>3. Develop and maintain professional competence</b>	<p>Assess personal knowledge and skills against competency standards to determine development needs, priorities and plans</p> <p>Seek feedback from employees, clients and colleagues and use this feedback to identify and develop ways to improve competence</p> <p>Identify, evaluate, select and use development opportunities suitable to personal learning style/s to develop competence</p> <p>Participate in networks to enhance personal knowledge, skills and work relationships</p> <p>Identify and develop new skills to achieve and maintain a competitive edge</p>

### **Knowledge and understanding**

The Student 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 principles and techniques involved in the management and organization of:
  1. performance measurement
  2. personal behavior, self-awareness and personality traits identification
  3. a personal development plan
  4. personal goal setting
  5. 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 Student needs to produce following critical evidence(s) 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 organise 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.

## 0714E&A76 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
<b>1. Research workforce requirements</b>	Review current data on staff turnover and demographics Assess factors that may affect workforce supply Establish the organization’s requirements for a skilled and diverse workforce
<b>2. Develop workforce objectives and strategies</b>	Review organizational strategy and establish aligned objectives for modification or retention of the workforce Consider strategies to address unacceptable staff turnover, if required Define objectives to retain required skilled labor Define objectives for workforce diversity and cross-cultural management Define strategies to source skilled labor

	<p>Communicate objectives and rationale to relevant stakeholders</p> <p>Obtain agreement and endorsement for objectives and establish targets</p> <p>Develop contingency plans to cope with extreme situations</p>
<b>3. Implement initiatives to support workforce planning objectives</b>	<p>Implement action to support agreed objectives for recruitment, training, redeployment and redundancy</p> <p>Develop and implement strategies to assist workforce to deal with organizational change</p> <p>Develop and implement strategies to assist in meeting the organization's workforce diversity goals</p> <p>Implement succession planning system to ensure desirable workers are developed and retained</p> <p>Implement programs to ensure workplace is an employer of choice</p>
<b>4. Monitor and evaluate workforce trends</b>	<p>Review workforce plan against patterns in exiting employee and workforce changes</p> <p>Monitor labor supply trends for areas of over- or under-supply in the external environment</p> <p>Monitor effects of labor trends on demand for labor</p> <p>Survey organizational climate to gauge worker satisfaction</p> <p>Refine objectives and strategies in response to internal and external changes and make recommendations in response to global trends and incidents</p> <p>Regularly review government policy on labor demand and supply</p> <p>Evaluate effectiveness of change processes against agreed objectives</p>

### **Knowledge and understanding**

The Student 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 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 Student needs to produce following critical evidence(s) 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.

## 0714E&A77 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
<b>1. Define project</b>	<ul style="list-style-type: none"> <li>Access project scope and other relevant documentation</li> <li>Define project stakeholders</li> <li>Seek clarification from delegating authority of issues related to project and project parameters</li> <li>Identify limits of own responsibility and reporting requirements</li> <li>Clarify relationship of project to other projects and to the organization's objectives</li> <li>Determine and access available resources to undertake project</li> </ul>
<b>2. Develop project plan</b>	<ul style="list-style-type: none"> <li>Develop project plan in line with the project parameters</li> <li>Identify and access appropriate project management tools</li> <li>Formulate risk management plan for project, including Work Health and Safety (WHS)</li> <li>Develop and approve project budget</li> <li>Consult team members and take their views into account in planning the project</li> <li>Finalize project plan and gain necessary approvals to commence project according to documented plan</li> </ul>
<b>3. Administer and monitor project</b>	<ul style="list-style-type: none"> <li>Take action to ensure project team members are clear about their responsibilities and the project requirements</li> <li>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</li> <li>Establish and maintain required recordkeeping systems throughout the project</li> <li>Implement and monitor plans for managing project finances, resources and quality</li> <li>Complete and forward project reports as required to stakeholders</li> <li>Undertake risk management as required to ensure project outcomes are met</li> <li>Achieve project deliverables</li> </ul>
<b>4. Finalize project</b>	<ul style="list-style-type: none"> <li>Complete financial recordkeeping associated with project and check for accuracy</li> <li>Ensure transition of staff involved in project to new roles or reassignment to previous roles</li> <li>Complete project documentation and obtain necessary sign-offs for concluding project</li> </ul>

### Knowledge and Understanding



The Student 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:

- 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 Student needs to produce following critical evidence(s) 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.



**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
<b>Prepare for the negotiation</b>	<ul style="list-style-type: none"> <li>P1. Identify objectives and preferred outcome of the negotiation and determine minimum acceptable outcome</li> <li>P2. Understand in relation to what can be offered and what is needed from the other party</li> <li>P3. Gather information regarding the other party – objectives,needs, preferences, resources, what they want to achieve – in order to determine best negotiating points</li> <li>P4. List and rank the issues to consider concessions that may be made.</li> <li>P5. Find examples and refine negotiation argument.</li> <li>P6. Check information to ensure it is correct and up-to-date.</li> <li>P7. 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.</li> <li>P8. Prepare an agenda in advance, which includes discussion topics, participants, location and schedule</li> </ul>
<b>Participate in negotiations</b>	<ul style="list-style-type: none"> <li>P1. Analyze all aspects of the incident for degree of hazard, priorities, optional outcomes and appropriate strategies</li> <li>P2. Analyze and determine strategies and priorities on the incident sought from a range of sources</li> <li>P3. Assess long term objectives against resources and priorities</li> <li>P4. Apply a range of communication techniques to make and maintain contact with the key people</li> <li>P5. Provide clear and factual information to enable an honest and realistic assessment of the interests of the key people and their positions</li> <li>P6. Resolve the conflict and express their likely consequences clearly and do an analysis of the benefits</li> <li>P7. Reassess points of disagreements for common positive positions</li> </ul>
<b>Coordinate support Services</b>	<ul style="list-style-type: none"> <li>P1. Assess the need for support services in terms of the determined strategies and priorities</li> <li>P2. Negotiate the resources of support services according to established procedures and availability</li> <li>P3. Provide information on strategies to support services and maintain the communication</li> <li>P4. Delegate roles and responsibilities according to expertise and resources</li> </ul>
<b>Restore order</b>	<ul style="list-style-type: none"> <li>P1. Assess the incidents for degree of risk and take appropriate action to reduce and remove the impact of the incident and restore order</li> <li>P2. Take action designed to minimize risk and the preserve the safety and security of all involved</li> </ul>

	<p>P3. Take action to prevent the escalation of the incident appropriate to the circumstances and agreed procedures.</p> <p>P4. Carry out the use of force for the restoration of control and the maintenance of security in the least restrictive manner.</p> <p>P5. Complete reports accurately and clearly provided to the appropriate authority promptly</p> <p>P6. Review, evaluate and analyze the incident and the organizational response to it and report it promptly and accurately.</p>
<p><b>Provide leadership, direction and guidance to the work group</b></p>	<p>P1. Link between the function of the group and the goals of the organization</p> <p>P2. Participate in decision making routinely to develop, implement and review work of the group and to allocate responsibilities where appropriate</p> <p>P3. Give opportunities and encouragement to others to develop new and innovative work practices and strategies</p> <p>P4. Identify conflict and resolve with minimum disruption to work group function</p> <p>P5. Provide staff with the support and supervision necessary to perform work safely and without risk to health</p> <p>P6. Allocate tasks within the competence of staff and support with appropriate authority, autonomy and training</p> <p>P7. Supervise appropriately the changing priorities and situations and takes into account the different needs of individuals and the requirements of the task</p>

### **Knowledge and Understanding**

The Student 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 Student needs to produce following critical evidence(s) 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

## 0714E&A79 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
<b>1. Prepare for meetings</b>	Develop agenda in line with stated meeting purpose Ensure style and structure of meeting are appropriate to its purpose Identify meeting participants and notify them in accordance with organizational procedures Confirm meeting arrangements in accordance with requirements of meeting Dispatch meeting papers to participants within designated timelines
<b>2. Conduct meetings</b>	Chair meetings in accordance with organizational requirements, agreed conventions for type of meeting and legal and ethical requirements Conduct meetings to ensure they are focused, time efficient and achieve the required outcomes Ensure meeting facilitation enables participation, discussion, problem-solving and resolution of issues Brief minute-taker on method for recording meeting notes in accordance with organizational requirements and conventions for type of meeting
<b>3. Follow up meetings</b>	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 Distribute and store minutes and other follow-up documentation within designated timelines, and according to organizational requirements Report outcomes of meetings as required, within designated timelines

### Knowledge and Understanding

The Student 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 Student needs to produce following critical evidence(s) 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.

**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
<b>1. Establish schedule requirements</b>	Identify organizational requirements and protocols for diaries and staff planning tools Identify organizational procedures for different types of appointments Determine personal requirements for diary and schedule items for individual personnel Establish appointment priorities and clarify in discussion with individual personnel
<b>2. Manage schedules</b>	Identify recurring appointments and deadlines, and schedule these in accordance with individual and organizational requirements Establish availability of attendees, and schedule new appointments in accordance with required timelines and diary commitments Negotiate alternative arrangements and confirm when established appointments are changed Record appointments and manage schedules in accordance with organizational policy and procedures

**Knowledge and Understanding**

The Student 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 Student needs to produce following critical evidence(s) 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.

**0714E&A81 Identify and Communicate Trends in Career Development**

**Overview:**

This 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
<p><b>Research and confirm career trends</b></p>	<p><b>P1.</b> Apply knowledge of changing organizational structures, lifespan of careers and methods of conducting work search, recruitment and selection processes</p> <p><b>P2.</b> Analyze changing worker and employer issues, rights and responsibilities in context of changing work practices</p> <p><b>P3.</b> Examine importance of quality careers development services</p> <p><b>P4.</b> Maintain all research, documentation, sources and references (electronic or physical) to a high degree of currency and relevance</p> <p><b>P5.</b> Analyze implications of relevant policy, legislation, professional codes of practice and national standards relating to worker and employer issues</p> <p><b>P6.</b> Investigate the changes and trends in theory of career development counseling and practice</p> <p><b>P7.</b> Confirm clusters, levels and combinations of transferable employability skills and preferences that may open employment options spanning more than one occupation or career pathway</p>
<p><b>Assess and confirm ongoing career development needs of target group</b></p>	<p><b>P1.</b> Analyze history and records in assessing needs of target group</p> <p><b>P2.</b> Assess success of previous career development services and techniques used for individual or target group</p> <p><b>P3.</b> Deploy other means to investigate appropriate care and counseling approaches as required</p> <p><b>P4.</b> Maintain privacy and security of all data, research and personal records according to relevant policy, legislation, professional codes of practice and national standards</p> <p><b>P5.</b> Establish existing work-life balance requirements, issues and needs</p>
<p><b>Maintain quality of career</b></p>	<p><b>P1.</b> Analyze and review relevance of career theories,</p>

**development services and professional practice**

- P2.** models, frameworks and research for target group  
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 Student 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 Student needs to produce following critical evidence(s) 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.

**0714E&A82 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
<b>1.Communicate effectively</b>	<p><b>P1.</b> Identify communication barriers and use strategies to overcome these barriers in the client-counselor relationship</p> <p><b>P2.</b> Facilitate the client-counselor relationship through selection and use of micro skills</p> <p><b>P3.</b> Integrate the principles of effective communication into work practices</p> <p><b>P4.</b> Observe and respond to non-verbal communication cues</p> <p><b>P5.</b> Consider and respond to the impacts of different communication techniques on the client-counselor relationship in the context of individual clients</p> <p><b>P6.</b> Integrate case note taking with minimum distraction</p>
<b>Use specialized counseling interviewing skills</b>	<p><b>P1.</b> Select and use communication skills according to the sequence of a counseling interview</p> <p><b>P2.</b> Identify points at which specialized counseling interviewing skills are appropriate for inclusion</p> <p><b>P3.</b> Use specialized counseling communication techniques based on their impacts and potential to enhance client development and growth</p> <p><b>P4.</b> Identify and respond appropriately to strong client emotional reactions</p>
<b>Evaluate own communication</b>	<p><b>P1.</b> Reflect on and evaluate own communication with clients</p> <p><b>P2.</b> Recognize the effect of own values and beliefs on communication with clients</p> <p><b>P3.</b> Identify and respond to the need for development of own skills and knowledge</p>

**Knowledge and understanding:**

The Student 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 Student needs to produce following critical evidence(s) 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.



## Microcontroller Programming and Applications

### 0714E&A83 Classify Microcontroller Types and Architectures

#### Overview:

After completion of this competency standard the student will be able to classify different types of microcontrollers and its function, will be able to bring his knowledge on paper in the form of block diagrams.

Competency Units	Performance Criteria
<b>Classify different types of Microcontroller</b>	Identify name and Family of Microcontroller Differentiate between microcontroller and microprocessor Generate block diagram of microcontroller Identify microcontroller pins and its function Connect microcontrollers in basic circuits Generate Lab reports
<b>Perform Microcontroller basic programming environment</b>	Install Application tool (keil u Vision, Mickro C &Arduino) of Microcontroller in PC Create a program for Flash LED ON and Off Generate Hex file Load the program in microcontroller Generate the lab reports
<b>Operate Microcontroller ports for various activity</b>	Identify I/O ports and its function of microcontroller Identify pins of ports and its function Program microcontroller ports for inputs Program microcontroller ports for outputs Connect LED with microcontroller in sink or source configurations Generate Lab reports
<b>Perform Basic Operation of Microcontroller Registers</b>	Identify register of Microcontroller Draw schematic diagram of Microcontroller interfacing to locate registers Select the components for microcontroller interfacing operation Implement the microcontroller circuit to use register Program the microcontroller for locating different register Perform the microcontroller operation to read/ write the register Generate the lab report

<b>Perform Basic Operation of Microcontroller timers</b>	Identify timer of Microcontroller Draw schematic diagram of Microcontroller interfacing to operate timer Select the components for microcontroller operation Implement the basic microcontroller circuit Program the microcontroller for timer operation Perform the operation of microcontroller with different electronics device
<b>Perform Basic Operation of Microcontroller Interrupts</b>	Identify basic operation of interrupts Draw schematic diagram of Microcontroller interfacing to perform interrupt operation Select the components for microcontroller interrupt operation Implement the basic microcontroller circuit for interrupt operation Program the microcontroller for interrupt operation Perform the interrupt operation of microcontroller with LED
<b>Implements logical gates using Special Function Register of microcontroller</b>	Identify basic operation of Microcontroller SFR Draw schematic diagram of Microcontroller interfacing to perform SFR function Select the components for microcontroller to perform SFR function Implement the basic microcontroller circuit for SFR operation Program the microcontroller for logical AND function using SFR. Verify the outputs and generate the lab reports Program the microcontroller for logical OR function using SFR Verify the outputs and generate the lab reports Program the microcontroller for Logical EOR function using SFR Verify out and generate the lab reports

### Knowledge and understanding

- Learn the basic knowledge about IC number reading/understanding

- Describe The features of currently available commercial microcontrollers
- Define the embedded system
- Explain the uses of microcontroller
- Learn the use of flow chart in programming
- Explain Microcontroller programming Tools
- Describe the set of instruction for CPU of Microcontroller to access and operate all Registers memory.
- Explain the pull up, pull down, sink and source configuration
- Describe the Instruction set
- Describe various instructions for moving data operation, port programming, arithmetic operations, logical operations, jump and loop operations
- Describe the Memory location and Addressing
- Knowledge about IC number reading/understanding
- Describe The features of currently available commercial microcontrollers
- Need of microcontroller in industry
- Explain the Block diagram, Registers; General purpose registers, Stack Pointer, Program counter, Special Function Registers (SFR), Program Status word, Data Pointer (DPTR), Timer Registers, Ports, Control Registers
- Pin description, connections, Parallel I/O ports, RAM organization
- Explain the RAM organization of Microcontroller
- Explain clock circuit and ports of Microcontroller

### **Critical Evidence(s) Required**

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

Evidence of the following is essential:

- Identify the microcontroller pins configuration and there functions.
- Identify microcontroller SFR and there function

### **Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

<b>Sr. No</b>	<b>Items</b>
	Micro controllers with different specifications
	Crystal
	Power supply
	LED
	Microcontroller programmer
	Microcontroller trainer
	Microcontrollers with different specifications
	Application tool for Microcontroller
	Capacitor
	Data sheet

**0714E&A84 Carryout Microcontroller Applications.**

**Overview:**

After completion of this competency standard the student will be able to perform a variety of tasks on a microcontroller and will be able to integrate the programming knowledge into the microcontroller.

Competency Units	Performance Criteria
<p><b>Perform BCD addition and subtraction using Microcontroller</b></p>	<p>Draw the schematic diagram of microcontroller for BCD addition and subtraction operation                      Select the components of microcontroller for BCD addition and subtraction operation                      Implement the circuit of microcontroller for BCD addition and subtraction operation                      Program the microcontroller for BCD addition Functions                      Apply the Inputs and verify the output,                      Program the microcontroller for subtraction Functions                      Apply the Inputs and verify the output.                      Generate Lab report</p>
<p><b>Perform multiplication and division using Microcontroller</b></p>	<p>Draw the schematic diagram of microcontroller for multiplication and division operation                      Select the components of microcontroller for multiplication and division operation                      Implement the circuit of microcontroller for multiplication and division operation                      Program the microcontroller for multiplication Functions                      Apply the Inputs and verify the output,                      Program the microcontroller division                      Apply the Inputs and verify the output,.                      Generate Lab report</p>
<p><b>Perform the operation to convert Centigrade in to Fahrenheit using Microcontroller</b></p>	<p>Draw the schematic diagram of microcontroller for the conversion of Centigrade in to Fahrenheit                      Select the components of microcontroller for the conversion of Centigrade in to Fahrenheit                      Implement the circuit of microcontroller for the conversion                      Program the microcontroller for the conversion of Centigrade in to Fahrenheit                      Apply the Inputs and verify the output                      Generate Lab report</p>
<p><b>Interface LCD with microcontroller</b></p>	<p>Identify the pins of LCD and its function                      Draw the schematic diagram of LCD interfacing with microcontroller                      Select the components of LCD interfacing with microcontroller                      Implement the circuit of LCD interfacing with microcontroller                      Write a code(Program) of LCD interfacing with microcontroller                      Generate the hex file and load in microcontroller                      Monitor the output                      Generate Lab report</p>

## Knowledge and understanding

- Basic knowledge of addition subtraction and BCD conversion BCD
- Explain the Block diagram, Registers; General purpose registers, Stack Pointer, Program counter, Special Function Registers (SFR), Program Status word, Data Pointer (DPTR), Timer Registers, Ports, Control Registers
- Explain the RAM organization of Microcontroller
- Explain clock circuit and ports of Microcontroller
- Explain pin description, connections, Parallel I/O ports, RAM organization
- Basic knowledge of the conversion of Centigrade in to Fahrenheit
- Basic knowledge of LCD

## Critical Evidence(s) Required

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

Evidence of the following is essential:

- Control a AC motor load using microcontroller

## Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr. No	Items
	Micro controllers with different specifications
	Crystal
	Power supply
	LED
	Microcontroller programmer
	Microcontroller trainer
	Microcontrollers with different specifications
	Application tool for Microcontroller
	Capacitor
	Data sheet
	DIP switches
	Terminal block
	PC

**Overview:**

After completion of this competency standard the student will be able to construct a control system using microcontrollers and will be able to demonstrate programming skills for the controls system.

Competency Units	Performance Criteria
<b>Control Industrial systems using microcontroller</b>	Select the AC load (light, motor) Draw a schematic diagram to control AC loads using microcontroller Implement the control circuit of AC load using microcontroller Create a code (PWM Technique) to control an AC Load through Relay Switching using microcontroller Monitor the output pin (duty cycle ) using scope. Generate a lab report
<b>Control AC load using Arduino</b>	Operate motor in forward and reverse direction using Arduino Design a traffic light controller system using Arduino Design a temperature controller system using Arduino
<b>Control AC load using ATMEL</b>	Operate motor in forward and reverse direction using ATMEL Design a traffic light controller system using ATMEL Design a temperature controller system using ATMEL

**Knowledge and understanding**

- Explain the Block diagram, Registers; General purpose registers, Stack Pointer, Program counter, Special Function Registers (SFR), Program Status word, Data Pointer (DPTR), Timer Registers, Ports, Control Registers
- pin description, connections, Parallel I/O ports, RAM organization
- Explain the RAM organization of Microcontroller
- Explain clock circuit and ports of Microcontroller
- Basic knowledge Of PWM techniques
- Basic Knowledge of Arduino
- Understand the devices , interfacing with Arduino
- Knowledge of programming of controllers
- Basic Knowledge of Arduino
- Understand the devices , interfacing with Arduino
- Knowledge of programming of controllers
- Basic Knowledge of ATMEL
- Understand the devices, interfacing with ATMEL
- Learn basic Knowledge of programming of controllers

**Critical Evidence(s) Required**

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

Evidence of the following is essential:

- Identify various gates and their data sheet
- Design a circuit by using Multiplexer and De-multiplexer

### **Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

<b>Sr. No</b>	<b>Items</b>
1.	Micro controllers with different specifications
2.	Crystal
3.	Power supply
4.	LED
5.	Microcontroller programmer
6.	Microcontroller trainer
7.	Microcontrollers with different specifications
8.	Application tool for Microcontroller
9.	Capacitor
10.	Data sheet
11.	DIP switches
12.	Terminal block
13.	AC load (fan, bulb etc)
14.	Arduino with different specifications
15.	DC load
16.	ATMEL with different specifications
17.	PC

## 27. Power Electronics

### 0714E&A86 Design Electronic Control circuits using Power Diodes

#### Overview:

After completion of this competency standard the candidate will be able to design and install various electronic circuits using power diodes

Competency Units	Performance Criteria
<b>Control the load by using Power Diode</b>	Identify the Power Diodes Draw the V-I Characteristic of Power Diodes Operate Power Diodes in Series circuit. Operate Power Diodes in Parallel Circuits. Use Resistive, loads with Half wave rectifier and measure the outputs Use Capacitive loads with Half wave rectifier and measure the outputs Use Inductive loads with Half wave rectifier and measure the outputs Generate the lab report
<b>Design Single Phase diode bridge rectifier</b>	Draw the Circuit of Single Phase diode bridge rectifier. Select the components for Single Phase diode bridge rectifier Place the components for Single Phase diode bridge rectifier. Perform the operation of diode bridge rectifier with Resistive load. Perform the operation of diode bridge rectifier with capacitive load. Perform the operation of diode bridge rectifier with inductive load. Verify the output voltage of single phase diode bridge rectifier. Generate the lab report
<b>Design three phase diode bridge rectifier</b>	Draw the Circuit of three Phase diode bridge rectifier. Select the components for three Phase diode bridge rectifier Place the components for three Phase diode bridge rectifier. Perform the operation of diode bridge rectifier with Resistive load. Perform the operation of diode bridge rectifier with capacitive load. Perform the operation of diode bridge rectifier with inductive load. Verify the output voltage of three phase diode bridge rectifier. Generate the lab report

#### Knowledge & Understanding

- Explain simple diode, power diode & their uses
- Explain structure properties and working principles of power diode
- Explain Series and Parallel Circuits
- Interpret the Operation of Power diodes in series and Parallel circuits
- Describe Half and Full wave Rectifiers
- Explain Resistive, Capacitive and Inductive Load



- Explain behavior of half wave rectifier with Resistive, capacitive and inductive load configuration.
- Learn basic knowledge of diode and diode bridge, there working principle for single phase and three phase
- Explain working principles of rectifier circuit
- Explain working principles of three phase diode bridge circuit
- Describe three phase diode bridge, resistive, capacitive and inductive loads
- Explain the calculation of output voltage using mathematical expressions

### **Critical Evidence(s) Required**

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

Evidence of the following is essential:

- Implement parallel operation of power diodes.
- Implement Series operation of power diodes.
- Draw the half wave rectifier using power diode.
- Implement power in diodes in bridge circuit for rectification.
- Draw the circuit diagram to show the free-wheeling action of power diode.

### **Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

<b>Sr.No.</b>	<b>Name</b>
1	Power diodes
2	Multi-meters
3	Transistors
4	Oscilloscope
5	Resistor
6	Capacitor
7	Inductor
8	Power supply
9	Soldering station
10	Function generator
11	Nose pliers and wire cutter
12	Screw driver set
13	Vero board
14	Breadboard
15	Push buttons
16	SCR
17	MOSFETS
18	IGBTs
19	Clamp meter

**Overview:**

After completion of this competency standard the candidate will be able to implement single phase & three phase converters in multiple situations

<b>Competency Units</b>	<b>Performance Criteria</b>
<b>Design the Power Control circuit using SCR in Series</b>	Draw the schematic for Power SCR in Series Circuits. Select the components for Power SCR. Place the components for Power SCR Draw the V-I characteristic of power SCR in Series Control different load by Using SCR in Series. Generate the lab report.
<b>Design the Power Control circuit using SCR in Parallel</b>	Draw the schematic for Power SCR in Parallel Circuits. Select the components for Power SCR. Place the components for Power SCR in Parallel circuit Draw the V-I characteristic of power SCR in Parallel Circuits. Control different load (AC Motor) by Using SCR in Parallel Circuits. Generate the lab report.
<b>Design a single phase Converter</b>	Draw the schematic for a single phase Semi and full Converter Select the components for single phase Semi and full Converter Place the components for single phase Semi and full Converter Use RL load with Semi & Full converter Inspect the Output wave form of Semi converter with load Inspect the Output wave form of Semi Full converter with load Generate the output report
<b>Design a three phase Full Converter</b>	Draw the schematic for a three phase Semi and full Converter Select the components for three phase Semi and full Converter Place the components for three phase Semi and full Converter Use RL load with Semi & Full converter Inspect the Output wave form of Semi converter with load Inspect the Output wave form of Full converter with load Generate the output report
<b>Design the DC-DC Buck converter</b>	P1. Draw the schematic for a Buck converter Select the components for Buck converter Place the components for Buck converter Measure the input and output voltage Generate the output lab report
<b>Design the DC-DC Boost converter</b>	Draw the schematic for a Boost converter Select the components for Boost converter Place the components for Boost converter Measure the input and output voltage Generate the output report
<b>Design the DC-DC Buck-Boost converter</b>	Draw the schematic for a Buck-Boost converter Select the components for Buck-Boost converter Place the components for Buck-Boost converter Measure the input and output voltage

	Generate the output report
<b>Implement DC-DC Flyback Converter</b>	Draw the schematic for a DC-DC (flyback) converter Select the components for DC-DC (flyback) converter Place the components for DC-DC (flyback) converter Operate the flyback converter in CCM and DCM mode Measure the input and output voltage Design Switch Mode Power Supply using converter Generate the output report
<b>Implement DC-DC Forward Converter</b>	Draw the schematic for a DC-DC (Forward) converter Select the components for DC-DC (Forward) converter Place the components for DC-DC (Forward) converter Operate the Forward converter in CCM and DCM mode Measure the input and output voltage Design Switch Mode Power Supply using converter Generate the output report

### Knowledge & Understanding

- Basic knowledge of SCR and working principle of SCR
- Study data sheet of SCR
- Recognize the power ratings of SCR
- Comprehend the V-I characteristic curve
- Calculate the gate recovery time using formulae
- Explain various types of single & Three phase converters & their operations in different configurations.
- Explain triggering angle and displacement factor
- Explain Symmetrical and asymmetrical single phase semi converters
- Explain working principle of buck, boost and buck-boost converter in CCM and DCM mode and its operation
- Describe uses of buck, boost and buck-boost converter
- Describe the working principle of flyback, DC-DC converter operation
- Explain uses of flyback and DC-DC converter & forward DC-DC converter
- Explain working principle of full bridge DC-DC converter
- Describe applications of flyback & Full bridge converter
- Describe the working principle of forward, DC-DC converter operation
- Explain uses of forward DC-DC converter
- Describe applications of forward converter

### Critical Evidence(s) Required

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

Evidence of the following is essential:

- Implement SCR in phase control rectifier circuit.
- Draw the VI curve of SCR.
- Implement 3 phase full converter.

- Differentiate between buck and boost converter.
- Differentiate between buck-boost and flyback converter.

### **Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

<b>Sr.No.</b>	<b>Name</b>
1	Power diodes
2	Multi-meters
3	Transistors
4	Oscilloscope
5	Resistor
6	Capacitor
7	Inductor
8	Power supply
9	Soldering station
10	Function generators
11	Nose pliers and wire cutter
12	Screw driver set
13	Vero board
14	Breadboard
15	Push buttons
16	SCR
17	MOSFETS
18	IGBTs
19	Clamp meter

**Overview:**

After the completion of this competency standard the student will be able to design a variety of inverters.

<b>Competency Units</b>	<b>Performance Criteria</b>
<b>Design the Single phase inverter using push pull configuration (Iron core transformer)</b>	Draw the schematic for a inverter using push pull configuration (Iron core transformer) Select the components for inverter using push pull configuration (Iron core transformer) Place the components for inverter using push pull configuration (Iron core transformer) Measure the input and output voltage Generate the output report
<b>Design the Single phase inverter using Ferrite Core Transformer (H-Bridge)</b>	Draw the schematic for a inverter using Ferrite Core Transformer (H-Bridge) Select the components for inverter using Ferrite Core Transformer (H-Bridge) Place the components for inverter using Ferrite Core Transformer (H-Bridge) Measure the input and output voltage Generate the output report
<b>Design the Three Phase inverter</b>	Identify the voltage source and current source inverter Draw the schematic for a inverter using Iron Core Transformer (H-Bridge) Select the components for inverter using Iron Core Transformer (H-Bridge) Place the components for inverter using Iron Core Transformer (H-Bridge) Measure the input and output voltage Generate the output report

**Knowledge & Understanding**

- Describe square wave, sine wave and step square wave inverters
- Explain iron core and ferrite core transformer, H-Bridge, MOSFETS and IGBTs
- Describe square wave, sine wave and step square wave inverters
- Explain iron core and ferrite core transformer, H-Bridge, MOSFETS and IGBTs
- Explain VSI (voltage source inverter)and CSI (current source inverter)

**Critical Evidence(s) Required**

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

Evidence of the following is essential:

- Implement single phase inverter using push pull configuration.

- Draw the circuit diagram of three phase inverter.

### Tools and Equipment required

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Power diodes
2	Multi-meters
3	Transistors
4	Oscilloscope
5	Resistor
6	Capacitor
7	Inductor
8	Power supply
9	Soldering station
10	Function generator
11	Nose plier and wire cutter
12	Screw driver set
13	Vero board
14	Breadboard
15	Push buttons
16	SCR
17	MOSFETS
18	IGBTs
19	Clamp meter

## 28. Industrial Electronics

### 0714E&A89 Carry Out System Automation Using Sensors and Transducers

#### Overview:

After the completion of this competency standard the candidate will be able to design an application for industrial, domestic and commercial automation using sensors and transducers.

Competency Unit	Performance Criteria
<b>Construct electronics switch to operate load (Relay) using Transistor</b>	<ul style="list-style-type: none"><li>P1. Draw the circuit of transistor as switch</li><li>P2. Select the components for transistor as switch.</li><li>P3. Place the components for transistor as switch.</li><li>P4. Perform the operation of transistor as switch</li><li>P5. Measure the output voltage</li><li>P6. Generate the lab report</li></ul>
<b>Install photo transistor (Position Sensors) to detect the position</b>	<ul style="list-style-type: none"><li>P1. Draw the circuit of photo transistor for position detecting</li><li>P2. Select the components of photo transistor for position detecting</li><li>P3. Place the components of photo transistor for position detecting</li><li>P4. Calculate the Common mode rejection ratio of Photo transistor for position detecting</li><li>P5. Measure the output voltage.</li><li>P6. Generate the lab report</li></ul>
<b>Install photo diode (smoke detector) to detect the smoke</b>	<ul style="list-style-type: none"><li>P1. Draw the circuit of photo diode for smoke detection</li><li>P2. Select the components of photo diode circuit for smoke detection</li><li>P3. Place the components of photo diode circuit for smoke detection.</li><li>P4. Measure the output voltage.</li><li>P5. Generate the lab report</li></ul>
<b>Construct isolation circuit (High and Low voltage) using opto-couplers</b>	<ul style="list-style-type: none"><li>P1. Draw the circuit of isolation circuit using opto-couplers</li><li>P2. Select the components of isolation circuit using opto-couplers</li><li>P3. Place the components of isolation circuit using opto-couplers</li><li>P4. Measure the output voltage</li><li>P5. Generate the lab report</li></ul>

<b>Design a circuit of street light using LDR</b>	P1. Draw the circuit of street light using LDR P2. Select the components of street light using LDR P3. Place the components of street light using LDR P4. Measure the output voltage P5. Calculate the common mode rejection ratio P6. Generate the lab report
<b>Design the potentiometer transducer</b>	P1. Identify the types of transducer P2. Draw the circuit of potentiometer transducer P3. Select the components of potentiometer transducer P4. Place the components of potentiometer transducer P5. Measure the output voltage P6. Generate the lab report
<b>Measure the displacement using LVDT( Linear Variable Differential Transformer)</b>	P1. Identify the working principle of LVDT P2. Draw the circuit of LVDT ( Linear Variable Differential Transformer) P3. Select the components of LVDT P4. Place the components of LVDT P5. Calculate the null position, sensitivity in LVDT P6. Measure the LVDT displacement (mm to cm) P7. Measure the output voltage on the voltmeter P8. Generate the lab report
<b>Measure the temperature in form of voltage using thermocouple</b>	P1. Analyze the working principle of thermocouple P2. Draw the circuit for temperature measurement (in form of voltage) using thermocouple, P3. Select the components for temperature measurement using thermocouple. P4. Place the components for temperature measurement using thermocouple P5. Measure the voltage variation on volt meter by applying temperature variation. P6. Generate the lab report
<b>Perform working operation of piezo-electric transducer in electronic circuit.</b>	P1. Analyze the working principle of piezo-electric transducer. P2. Draw the circuit of piezo-electric transducer. P3. Select the components for piezo-electric transducer. P4. Place the components for piezo-electric transducer. P5. Measure the voltage variation on volt meter by applying Pressure. P6. Generate the lab report



<b>Perform working operation of optical transducer in electronic circuit.</b>	<p>P1. Analyze the working principle of optical transducer.  P2. Draw the circuit of optical transducer.  P3. Select the components optical transducer.  P4. Place the components optical transducer.</p> <p>P5. Measure the voltage variation on volt meter by applying light on optical sensor.  P6. Generate the lab report</p>
<b>Assemble a speed controller for Servo System</b>	<p>P1. Identify different types of servo motors  P2. Assemble different section for control servo mechanism  P3. Tune the control for specific speeds.  P4. Record &amp; Observe the results in report</p>
<b>Construct a closed loop servo control system of a voltage stabilizer</b>	<p>P1. Analyze the working principle of digital servo controlled voltage stabilizer  P2. Draw the circuit of digital servo controlled voltage stabilizer.  P3. Select the components of digital servo controlled voltage stabilizer.  P4. Place the components of digital servo controlled voltage stabilizer  P5. Measure the output voltage on the voltmeter  P6. Generate the lab report</p>

### Knowledge & Understanding

- Explain the Darlington pair configuration
- Describe power rating of transistor
- Explain inductive load
- Describe freewheeling diode(Protective diode)
- Explain the use of transistor as switch
- Explain forward blocking mode and Reverse blocking mode
- Explain the Rms voltage , current and peak voltage
- Compute the power dissipation of the transistor
- Describe LED& LASCR wavelength
- Explain seven segment display
- Explain types of photo devices
- Explain characteristic of photo transistor
- Describe intrusion detection system

- Explain characteristic of photodarlington opto-coupler
- Differentiate between sensor and transducer
- Explain the applications of transducer
- Explain the LVDT and its applications.
- Understand the principle of Weight , force pressure measurement using LVDT
- Describe null position and sensitivity
- Describe RTD and thermocouple
- Explain the types and range of resistance thermometer and its working principle.
- Describe piezo electric transducer and its purpose.
- Explain parameters of piezo electric transducer, Seven segment display and counters
- Explain optical transducer and its applications
- Explain Armature and field controller
- Describe Characteristics of Servo System.
- Explain Automatic voltage stabilizer (servo type)
- Understand the working principle of servo control system
- Explain the difference between closed loop and open loop control system.
- Describe main components of feedback control system.

### **Critical Evidence(s) Required**

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

Evidence of the following is essential:

- Perform on/off operation of relay with the help of transistor.
- Implement smoke detector circuit with photo diode.
- Implement isolation circuit using optocoupler.
- Implement transistor as a switch.
- Use LVDT for displacement measurement.
- Draw block diagram of servo-based voltage stabilizer.

### **Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Transistors
2	Power Supply
3	Diodes
4	Resistors
5	Capacitor
6	Inductor
7	Multi-meter
8	Bread Board
9	Vero Board
10	Micro-Controllers

11	UJT's
12	SCR
13	MOSFETS
14	Temperature Sensors
15	Thyristors
16	LED
17	LASCR
18	Battery
19	1N5400 (3Amp)
20	Transformer
21	Seven segment display
22	Photo transistor
23	Photo diode
24	Opto-coupler

### 0714E&A90 Carry out Industrial Automation Using PLC

#### Overview:

After this competency the candidate will be able to design, develop, install and maintain the automation and control system.

Competency Unit	Performance Criteria
<b>Analyze user requirements and specifications</b>	<ul style="list-style-type: none"> <li>P1. Draw the general value chain of the end user industry</li> <li>P2. Highlight the set of activities that a firm operating in a specific industry performs in the value chain drawing</li> <li>P3. Enlist the equipment/gauges/sensors/actuators/transducers used in different stages of the process</li> <li>P4. Identify critical stages in the process</li> <li>P5. Identify the safety aspect required in the critical stages of the process</li> <li>P6. Analyze the possible automation in the existing processes and global trends in automation</li> <li>P7. Analyze the client requirement at broad level from the proposal</li> <li>P8. Generate a report of various industrial processes involved in industry</li> <li>P9. Collect the required specification of the equipment (if already prepared by the user) and clarify the technical specification.</li> </ul>
<b>Prepare work plan</b>	<ul style="list-style-type: none"> <li>P1. Suggest globally practiced and accepted automation systems if the user is not aware of the technical specifications</li> <li>P2. List down the sub systems that are involved in the process</li> <li>P3. List down sensors and actuators requirement.</li> <li>P4. Collect information on process logic</li> <li>P5. Collect information for operator station screens</li> <li>P6. Decide on whether the system can be developed as per the user requirement</li> <li>P7. Support the project manager in calculating the time required for each stage to ensure completion of project</li> <li>P8. Assist in preparing the work plan with deliverables and timelines</li> <li>P9. Explain the expected output to the user</li> <li>P10. Calculate the number of days needed for commissioning of the panel at site</li> <li>P11. Summarize the user requirement.</li> </ul>

<b>Design and program PLC</b>	<ul style="list-style-type: none"> <li>P1. Develop PLC application as per user requirement by following the standard procedure (SOP) of the organization</li> <li>P2. Apply approved engineering concepts, processes and principles in design application</li> <li>P3. Install organization approved software (system and application software) on the system</li> <li>P4. Identify the requirement of indications, switchgears and accessories</li> <li>P5. Develop the control circuit drawing</li> <li>P6. Prepare wiring plans</li> <li>P7. Integrate the main process system with the sub-systems as per the user requirements (e.g., using communication protocol)</li> <li>P8. Ensure that safety aspect of the process is captured in the design plan</li> <li>P9. Program PLC as per FDF</li> <li>P10. Program SCADA Application</li> <li>P11. PLC-SCADA Communication</li> <li>P12. Create backup copies of all designs developed for control panel and store them in a secure location</li> <li>P13. Prepare a product manual and store them for future references</li> </ul>	
<b>Test the PLC</b>	<ul style="list-style-type: none"> <li>P1. Locate field devices and their interface to PLC</li> <li>P2. Test the system in off line mode using simulator</li> <li>P3. Test the gauges independently</li> <li>P4. for integration of main system with the sub-systems (if applicable)</li> <li>P5. Verify that the system conforms with all the user specifications during testing</li> <li>P6. Rework if there are any issues found and fix them</li> <li>P7. Send the test report for review to the customer</li> <li>P8. Perform Factory Acceptance Test (FAT)</li> <li>P9. Perform site acceptance test plan</li> </ul>	
<b>Ensure quality and productivity standards</b>	<ul style="list-style-type: none"> <li>P1. Ensure timely delivery of the control panel design as per agreed timeline</li> <li>P2. Ensure that total cost and man hours spent is as per the budget planned</li> <li>P3. Ensure compliance with relevant regulations, standards and codes of practices</li> <li>P4. Ensure compliance of the application with manufacturing requirements and process capabilities analysis of the organization</li> <li>P5. Ensure that the design conforms with normal safety standards</li> <li>P6. Develop reliable panels so that the system does not fail during the usage</li> </ul>	
<b>Install and Commission the PLC</b>	<ul style="list-style-type: none"> <li>P1. Check availability of panel and tools required for installation</li> <li>P2. Check the internal panel wiring and ensure that it is in accordance with the design drawing</li> <li>P3. Carry out insulation check of internal panel wiring and devices within the panel</li> <li>P4. Check if batteries and chargers have been assembled in accordance with the manufacturers recommended procedures</li> <li>P5. Identify the conductors size and capacity for installation</li> <li>P6. Ensure that the panel is positioned as prescribed, following safety norms</li> <li>P7. Make connections to socket outlets, switches and protective conductors</li> <li>P8. Perform settings as per customer requirements on the equipment in each of the panels</li> <li>P9. Test all control system interlocks</li> </ul>	

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

### 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.
- Define Piping and instrumentation diagram/drawing (P&ID)
- How to prepare wiring diagram
- Define IEC standards
- Define formula for Electrical load calculations
- Describe the operations of relays, contactors, circuit breaker, solenoid, actuators, controllers, sensors, transducers etc. their types and applications
- Understand Working Principle of PLC and construction of PLC
- Understand different type of PLC
- Describe the advantages of the PLC
- Describe the applications of PLC.
- Describe the types of input and output signals.
- List down the PLC, DCS programming software.
- List down the SCADA, HMI development software.
- 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
- What are safety precautions while working in an electronic assembly unit

### **Critical Evidence(s) Required**

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

Evidence of the following is essential:

- Implement electrical circuit using PLC software.
- Program PLC to run a specific control operation.
- Install and commission the PLC for a specific task

### **Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

<b>Sr.No.</b>	<b>Name</b>
1	Reference Material
2	Clipboard
3	Calculation Sheet
4	Calculator
5	Psychometric Charts and Tables
6	Protective gear such as helmets, goggles, gloves, rubber shoes, etc
7	Site Visit
9	Clipboard
10	PLC Module
11	PLC Software
12	Connecting Cables
13	Simulating software(Emulator)
14	Power Supply
15	Sensors/Transducers
16	Anemometer
17	Tachometer
18	Data loggers
19	Multi-meter
20	Electronic Hygrometer
21	Electronic Pressure Gauge
22	Connecting Cables
23	Tool box
24	Protective gear
25	International Safety Standards
26	Budget Sheet

**0714E&A91 Carry out System Automation using Linear Control system**

**Overview:**

After completion of this competency standard the candidate will be able to implement various types of linear controllers in industry

Competency Unit	Performance Criteria
Analyze working principle of PI Controller in closed loop control system	P1. Identify PI control temperature control device. P2. Analyze the working operation of PI controller P3. Draw the block diagram of PI controller
Analyze working principle of PD Controller in closed loop control system	P1. Identify PD control in temperature control device. P2. Analyze the working operation of PD controller P3. Draw the block diagram of PD controller
Analyze working principle of PID Controller in closed loop control system	P1. Identify an on/off control in a system P2. Identify PID control in temperature control device. P3. Analyze the working operation of PD controller P4. Draw the block diagram of PD controller

**Knowledge & Understanding**

- Describe linear control system
- Describe Controller Fundamentals and applications of PI, PD and PID Controllers.
- Control loop components
- Open and closed loop control
- Control loop block diagram
- Direct acting and reverse acting controllers
- Study data sheet of controller(P,PI,PD,PID)

**Critical Evidence(s) Required**

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

Evidence of the following is essential:

- Enlist different types of controllers.
- Differentiate between PI, PD and PID controller.
- Draw the schematic diagram of PI controller using operational amplifier.
- Draw the schematic diagram of PD controller using operational amplifier.
- Draw the schematic diagram of PID controller using operational amplifier.

**Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

Sr.No.	Name
1	Different Automated systems for demonstration

## 29. Equipment Maintenance and Servicing

### 0714E&A92 Repair/service different Home Appliance

#### Overview:

This Competency Standard identifies the competencies required to carry out repair and maintenance of home appliances 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
<b>Repair the electric iron</b>	<ul style="list-style-type: none"><li>P1. Apply Occupational, Health and Safety regulations, codes and practices in the workplace</li><li>P2. Dismantle the electric Iron for internal tests/servicing/repairs according to manufacturer's instructions</li><li>P3. Check the continuity of wire/switch/protective device by using specified test</li><li>P4. Inspect visual mechanical defect such as, loose connection, short circuit, insulation and temperatures.</li><li>P5. Check the thermostats by using specified test instruments to detect defects..</li><li>P6. Diagnose the faulty area</li><li>P7. Clean the parts of the iron with specified cleaning material</li><li>P8. Repair/replace the faulty parts of iron as per diagnosed fault.</li><li>P9. Re assembled the iron and check iron in test bench as per standard.</li></ul>
<b>Repair &amp; Service the Pedestal &amp; Ceiling Fan.</b>	<ul style="list-style-type: none"><li>P1. Apply Occupational, Health and Safety regulations, codes and practices in the workplace</li><li>P2. Dismantle the fan for internal tests/servicing/repairs according to manufacturer's instructions</li><li>P3. Check the continuity of wire/switch/protective device by using specified test</li><li>P4. Inspect visual mechanical defect such as, loose connection, short circuit, insulation and temperatures.</li><li>P5. Check the speed and capacitor</li><li>P6. Check the winding by using specified test instruments to detect defects.</li><li>P7. Diagnose the faulty parts</li><li>P8. Clean the parts of the fan with specified cleaning material</li><li>P9. Repair/replace the faulty parts of fan as per diagnosed fault.</li><li>P10. Rewind the winding</li><li>P11. Assembled and test fan as per standard.</li></ul>
<b>Repair the juicer machine, kitchen instruments</b>	<ul style="list-style-type: none"><li>P1. Apply Occupational, Health and Safety regulations, codes and practices in the workplace</li><li>P2. Dismantle the juicer/grinder for internal tests/servicing/repairs according to manufacturer's instructions</li><li>P3. Check the continuity of wire/switch/protective device by using specified test</li><li>P4. Inspect visual mechanical defect such as, loose connection, short circuit, insulation and temperatures.</li><li>P5. Check the winding by using specified test instruments to detect defects.</li></ul>



	<p>P6. Diagnose the faulty components Clean the parts of the fan with specified cleaning material</p> <p>P7. Repair/replace the faulty parts as per diagnosed fault.</p> <p>P8. Rewind the winding if wind is burnt</p> <p>P9. Re assembled the juicer/grinder and check juicer in test bench as per standard.</p>
<p><b>Repair &amp; service the Refrigerator /Air conditioner</b></p>	<p>P1. Apply Occupational, Health and Safety regulations, codes and practices in the workplace</p> <p>P2. Turn off the Refrigerator /Air conditioner</p> <p>P3. Dismantle the Refrigerator /Air conditioner for internal tests/servicing/repairs according to manufacturer's instructions.</p> <p>P4. Inspect visual mechanical defect such as, loose connection, short circuit, insulation and Check the cooling system of air conditioner.</p> <p>P5. Check the thermostat glitches</p> <p>P6. check the temperature/heat or condenser coil and identify the problems</p> <p>P7. Check the Helium gas pressure with pressure gauge</p> <p>P8. check the leaking or dirty ducts</p> <p>P9. Check the drainage of water</p> <p>P10. replace dirty filters</p> <p>P11. check ducts and thermostat with specified test equipments</p> <p>P12. Diagnose the faulty components Clean the parts of the fan with specified cleaning material</p> <p>P13. Repair/replace the faulty parts as per diagnosed fault.</p> <p>P14. Refill the gas up to required standard (10 to 20 psi)</p> <p>P15. Before refilling gas create vacuum in compressor or zero gas pressure</p> <p>P16. Assembled Refrigerator /Air conditioner and performed test bench as per standard.</p>
<p><b>Repair and service the CCTV setup</b></p>	<p>P1. Apply Occupational, Health and Safety regulations, codes and practices in the workplace Inspect physical appearance of system.</p> <p>P2. Test power and cables of the system.</p> <p>P3. Test system software and update</p> <p>P4. Identify the Service and maintenance manual.</p> <p>P5. Select proper tools.</p> <p>P6. Perform de-assembling procedure</p> <p>P7. Identify major sections of the System.</p> <p>P8. Perform fault trace in different sections of system.</p> <p>P9. Replace the faulty board/part.</p> <p>P10. Apply service procedure to system.</p> <p>P11. Assemble the system.</p> <p>P12. Perform test run.</p>
<p><b>Repair and service the Microwave Oven</b></p>	<p>P1. Apply Occupational, Health and Safety regulations, codes and practices in the workplace</p> <p>P2. Dismantle the Microwave Oven for internal tests/servicing/repairs according to manufacturer's instructions</p> <p>P3. Check the continuity of wire/switch/protective device by using specified test</p> <p>P4. Inspect visual mechanical defect such as, loose connection, short circuit, insulation and temperatures.</p> <p>P5. Solve problems in D.C circuits.</p> <p>P6. Diagnose the faulty components Clean the parts of the Microwave Oven with specified cleaning material</p>

	<p>P7. Use drawings, diagrams, schedules, standards, codes and specifications.</p> <p>P8. Repair/replace the faulty parts as per diagnosed fault.</p> <p>P9. Re assembled the Microwave Oven and check Microwave Oven in test bench as per standard.</p>
<b>Repair and service the Washing/Dryer Machine</b>	<p>P1. Apply Occupational, Health and Safety regulations, codes and practices in the workplace</p> <p>P2. Dismantle the Washing Machine for internal tests/servicing/repairs according to manufacturer's instructions</p> <p>P3. Check the continuity of wire/switch/protective device by using specified test</p> <p>P4. Inspect visual mechanical defect such as, loose connection, short circuit, insulation and temperatures.</p> <p>P5. Diagnose the faulty components Clean the parts of the Washing Machine with specified cleaning material.</p> <p>P6. Use drawings, diagrams, schedules, standards, codes and specifications.</p> <p>P7. Repair/replace the faulty parts as per diagnosed fault.</p> <p>P8. Re assembled the Washing Machine and check Washing Machine in test bench as per standard.</p>
<b>Repair and service the Cellular Phone</b>	<p>P1. Apply Occupational, Health and Safety regulations, codes and practices in the workplace</p> <p>P2. Inspect physical appearance of system.</p> <p>P3. Identify the Service and maintenance manual.</p> <p>P4. Select proper tools to Perform de-assembling procedure</p> <p>P5. Identify major sections in block diagrams of System.</p> <p>P6. Perform fault trace in different sections of system.</p> <p>P7. Apply power to the system.</p> <p>P8. Test system software and update</p> <p>P9. Replace the broken\faulty board/part.</p> <p>P10. Apply service procedure to system.</p> <p>P11. Assemble the system.</p> <p>P12. Perform test run on system.</p>

### Knowledge & Understanding

- Understand Type, Construction and working principle of iron
- Types of electrical measuring instruments used in testing electric iron
- Working principle of thermostat Fundamentals of transformer.
- Understand Type, Construction and working principle of fan
- Explain the working principle of capacitor
- Understand Construction and working principle of Refrigerator /Air conditioner
- Explain the working principle of electrical measuring instruments used in testing Refrigerator /Air conditioner.
- Study the working principle of condenser and compressor
- Explain the basics of helium gas
- Study about pressure gauges
- Explain the safety measures.
- Understand the function (Software and Hardware) on system
- Understand the service manual.

- Learn assembling and disassembling procedures.
- Study system function.
- Understand system part.
- Understand servicing procedure
- Understand the service manual.
- Identification of different tools.
- Knowledge of component testing.
- Knowledge of soldering.
- Knowledge of data sheets.

### **Critical Evidence(s) Required**

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

- Repair Electric iron

### **Tools and Equipment required**

The tools and equipment required for this competency standard are given below:

<b>Sr. No</b>	<b>Items</b>
1.	Electric iron
2.	Ammeter
3.	Battery charger
4.	Battery cleaning kit
5.	Bearing puller
6.	Bench vice
7.	Cable/wire gauge
8.	Cable cutter
9.	Cable tester
10.	Cable knife
11.	Chisel
12.	Cells tester
13.	Circuit board
14.	Combination plier set
15.	Clamp meter
16.	Disk Grinder
17.	Duct rod
18.	Earth tester
19.	Files set
20.	Filer gauge
21.	Flux
22.	Gloves
23.	Grinder
24.	Hydrometer
25.	IR temperature gun
26.	L Scale
27.	Lux meter
28.	Magnetic conductor
29.	Lugs Punching Machine (Hydraulic and Manual)
30.	Meggar (Insulation Tester)

31.	Micron meter
32.	Multimeter
33.	Phase sequence meter
34.	Overall combination
35.	OTDR Meter
36.	Ring spanner set
37.	RPM meter
38.	Philips Screw drivers Set
39.	Set of nose pliers
40.	Set of screw drivers
41.	All related Safety tools
42.	Soldering Lead
43.	Soldering Iron
44.	Specific Gravity Chart
45.	Splicing Machine
46.	Test lamp
47.	Tachometer
48.	Spring tension checking meter
49.	Thermometer
50.	Torque wrench
51.	Thimble Press Pliers
52.	Transformer
53.	Vernier Caliper
54.	Pressure gauge
55.	Wire Striper
56.	Gas cylinder
57.	Voltmeter

## 30. Entrepreneurial Skills

### 0713E&A93 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	<p>P1. Gather information for business ideas from appropriate sources</p> <p>P2. List details of business ideas and opportunities</p> <p>P3. Research alternative business ideas in light of the resources available</p> <p>P4. Specify and list products and services to match</p>

	<p>business ideas</p> <p>P5. .Identify and research potential customer information for business ideas</p> <p>P6. Identify and take into account financial, business and technical skills available when researching business opportunities</p>
<b>CU-2.</b> Identify market needs	<p>P1. Collect information regarding market size and potential from appropriate sources</p> <p>P2. Investigate market trends and developments to identify market needs relative to business ideas</p> <p>P3. Gather market information from primary and secondary sources to identify possible market needs in relation to business ideas</p> <p>P4. Identify ethical and cultural requirements of the market and their impact on business ideas</p> <p>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</p>
<b>CU-3.</b> Investigate factors affecting the market	<p>P1. Identify projected changes in population, economic activity and the labour force that may affect business ideas</p> <p>P2. Identify movements in prices and projected changes in availability of resources</p> <p>P3. Review trends and developments and identify their potential impact on business ideas</p>

### 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&A94 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	<p>P1. Identify and research key factors that influence viability of business ideas</p> <p>P2. Analyse business ideas in terms of personal or family needs and commitments</p> <p>P3. Evaluate impacts of emerging or changing technology, including e-commerce, on the business</p> <p>P4. Determine viability of business opportunity in line with perceived risks, resources available, financial returns and other outcomes sought</p> <p>P5. Assess and match personal skills/attributes against those perceived as necessary for a particular business opportunity</p> <p>P6. Identify and assess business risks according to resources available and personal preferences</p>
CU2.Detail the business idea	<p>P1. .Develop an accurate description of the business idea for key stakeholders</p> <p>P2. Develop an accurate summary of the major products and/or services required to suit personal needs and requirement</p>
CU3.Prepare the business <b>Overview</b> to suit different stakeholders	<p>P1. Present an accurate list of key stakeholders and their information requirements</p> <p>P2. Determine an acceptable method of presentation of information for each stakeholder</p> <p>P3. Provide accurate customised information to target audiences</p>

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&A95 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
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<p><b>CU-1.</b> Devise marketing strategies</p>	<p>P1. Evaluate <b>marketing opportunity options</b> that address organisational objectives, and evaluate their risks and returns in the selection process</p> <p>P2. Develop <b>marketing strategies</b> that address strengths and opportunities within the organisation's projected capabilities and resources</p> <p>P3. Develop strategies which increase resources or organisational expertise where gaps exist between current capability and marketing objectives</p> <p>P4. Develop feasible marketing strategies and communicate reasons that justifies their selection</p> <p>P5. Ensure strategies align with organisation's strategic direction</p> <p>P6. Develop a <b>marketing performance review strategy</b>, incorporating appropriate marketing metrics to review of organisational performance against marketing objectives</p>
<p><b>CU-2.</b> Plan marketing tactics</p>	<p>P1. Detail tactics to implement each marketing strategy in terms of scheduling, costing, accountabilities and persons responsible</p> <p>P2. Identify coordination and monitoring mechanisms for scheduled activities</p> <p>P3. Ensure tactics are achievable within organisation's projected capabilities and budget</p> <p>P4. Ensure tactics meeting <b>legal and ethical requirements</b></p> <p>P5. Ensure tactics provide for ongoing review of performance against objectives and budgets, and allow marketing targets to be adjusted if necessary</p>
<p><b>CU-3.</b> Prepare and present a marketing plan</p>	<p>P1. Ensure marketing plan meets organisational, as well as marketing, objectives and incorporates <b>marketing approaches</b> and a strategic <b>marketing mix</b></p> <p>P2. Ensure marketing plan contains a rationale for objectives and information that supports the choice of strategies and tactics</p> <p>P3. Present marketing plan for approval in the required format and timeframe</p> <p>P4. Adjust marketing plan in response to feedback from key stakeholders and disseminate for implementation within the required timeframe</p>

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&A96 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	<p><b>P1.</b> Determine scope of the business plan and associated systems is determined in consultation with <b>specialist personnel</b>.</p> <p><b>P2.</b> <b>Access accurate information</b> for inform business plan development</p> <p><b>P3.</b> <b>Account for and incorporate trends and seasonal variations</b> into the business plan.</p> <p><b>P4.</b> <b>Account for strategic goals, targets and directions</b> of the enterprise in the development of the business plan</p> <p><b>P5.</b> <b>Comply Legal obligations</b> in developing the business plan.</p>
CU-2. Prepare business plan	<p><b>P1.</b> <b>Develop operational goals and targets</b> to meet the enterprise strategic plan.</p> <p><b>P2.</b> <b>Identify and incorporate supply chains</b> into the business plan.</p> <p><b>P3.</b> <b>Identify risk management needs</b> are within the business plan.</p> <p><b>P4.</b> <b>Incorporate trial systems</b> in order to test budgetary impact and operational potential prior to full implementation of the business plan.</p> <p><b>P5.</b> <b>Set clear and measureable indicators of operational performance</b> to allow for realistic analysis of performance.</p>
CU-3. Document and review business plan	<p><b>P1.</b> <b>Include fiscal and operational systems</b> that enhance performance management and suit enterprise requirements.</p> <p><b>P2.</b> <b>Incorporate resource considerations</b> the business plan.</p> <p><b>P3.</b> Document accurately and clearly communicate</p>

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 andcrowbar andpinchbarfor 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&A97 Organise 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
<b>CU-1.</b> Ascertain own financial position and the ability to provide capital/equity for the business	<p>P1. Realistically detail personal, family or community financial situation in terms of funds available and commitments already incurred</p> <p>P2. Determine equity finance and assets available for micro business from personal, family or community sources</p>
<b>CU-2.</b> Determine projected cash flow for the business	<p>P1. Determine the level of forecast business activity over a year and the business mix</p> <p>P2. Estimate establishment costs for the business and repayment schedule for borrowings</p> <p>P3. Calculate the monthly variable and fixed costs needed to conduct business activity over a year</p> <p>P4. Estimate personal drawings needed to be taken from the business</p> <p>P5. Estimate the monthly income generated by the business for a year based on price per unit item or hourly charge rate for labor</p> <p>P6. Develop a cash flow budget for the first year of business operation</p> <p>P7. Seek professional advice to estimate goods and services tax and operating finance required for the business</p>
<b>CU-3.</b> Source the required funds to establish the business	<p>P1. Estimate required funding to establish and run the business based on expected sales and activity levels, available finances and commitments</p> <p>P2. Investigate methods of accessing alternative sources of finance</p> <p>P3. Identify strategies for meeting financial obligations</p> <p>P4. Implement plans to access available funds as required</p>

**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&A98 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
<b>CU-1.</b> Lead and motivate people	<p>P1. Establish goals for people and teams to optimise achievement in work tasks.</p> <p>P2. Take into account the capabilities of people and teams.</p> <p>P3. Provide advice and support sensitive to the individual's needs to people in the performance of their duties.</p> <p>P4. Undertake activities to achieve commitment to common goals.</p> <p>P5. Recognise and encourage initiative and innovation</p> <p>P6. Recognise and communicate achievements within the organisation.</p>
<b>CU-2.</b> Undertake human resource planning	<p><b>P1. Determine human resource needs</b> within the anticipated operational needs and allocated budget.</p> <p>P2. Analyse alternatives to staffing levels which clearly demonstrate returns to the organisation.</p> <p>P3. Develop contingency plans for staffing which meet key provisions of the human resources plan.</p> <p>P4. Compare existing competencies of staff with the needs of the work group.</p> <p>P5. Plan staffing levels and negotiate with <b>stakeholders</b> within the organisational framework to achieve maximum efficiency of operations.</p>
<b>CU-3.</b> Develop and facilitate performance	<p>P1. Negotiate <b>Performance Criteria</b> individuals, teams and work groups.</p> <p>P2. Review <b>Performance Criteria</b> as circumstances change.</p> <p>P3. Conduct <b>performance appraisal</b> based on clearly established and agreed <b>Performance Criteria</b>.</p>

	<p>P4. Identify and propose the total performance development system strategies to rectify performance shortfalls and recognise success.</p> <p>P5. Address performance problems confidentially and in a constructive and timely manner, in line with relevant organisational procedures.</p> <p>P6. Make <b>selections, transfers and promotions</b> in accordance with organisation policies and supported with documented information.</p> <p>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.</p>
<p><b>CU-4. Facilitate training, education and development opportunities</b></p>	<p>P1. Make information on planned training events widely available throughout the organisation.</p> <p>P2. Include training, education and development plans as part of individual/team performance plans.</p> <p>P3. Facilitate individual/team access to, and participation in, training, education and development opportunities.</p> <p>P4. Contribute coaching and mentoring effectively to the training, education and development of personnel in an environment of change.</p> <p>P5. <b>Enhance training, education and development opportunities</b> of individual, team and organisational performance.</p> <p>P6. Create workplace environment in which facilitates training, education and development</p>

#### 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&A99 Market Products and Services

### Overview :

This competency standard covers the skills and knowledge required to market products and services

Competency Unit	Performance Criteria
<p><b>CU-1.</b> Analyze market information</p>	<p>P1. Identify, research and analyse existing or new markets for existing or new products or services using techniques to ensure reliable data</p> <p>P2. Analyse past trends and developments to determine market variability and associated risks</p> <p>P3. Develop gross margin budgets to account for market variability</p> <p>P4. Identify and evaluate competing products to determine strengths and weaknesses of own products</p> <p>P5. Monitor market environment to ensure information is current and reliable</p> <p>P6. Identify the legal, ethical and environmental constraints of the markets and their effect on the enterprise</p> <p>P7. Identify product specifications that suit market requirements and price advantage at the time</p> <p>P8. Present clear and concise information to the enterprise management team.</p>
<p><b>CU-2.</b> Identify and evaluate factors to include in a marketing plan</p>	<p>P1. Identify and evaluate production processes to ensure required product specifications are met</p> <p>P2. Identify and assess alternative selling strategies and techniques to identify marketing targets and methods</p> <p>P3. Identify and assess distribution channels and their role in your marketing strategies</p> <p>P4. Ensure the data used is reliable and the market environment and trends are substantiated</p> <p>P5. Evaluate the role of marketing professionals in providing advice</p>
<p><b>CU-3.</b> Develop a marketing plan for your products and</p>	<p>P1. Establish marketing objectives based on current and potential product specifications</p> <p>P2. Select appropriate production processes to ensure product specifications are met</p>

services	<p>P3. Select selling strategies to ensure required prices are achieved</p> <p>P4. Select appropriate distribution channel options to ensure access to target markets is achieved efficiently and appropriately</p> <p>P5. Establish time-frames for production, distribution and selling activities</p> <p>P6. Develop a gross margin budget to demonstrate the cost effectiveness of the marketing plan</p> <p>P7. Develop partial gross margin budgets to account for market variability</p>
<p><b>CU-4.</b> Determine promotional strategies</p>	<p>P1. Prepare and record detailed plans for promotional activities</p> <p>P2. Outline objectives, level of exposure and available markets</p> <p>P3. Ensure strategies take account of time management and scheduling issues, and resource constraints</p> <p>P4. Create promotional materials that enhance the product and commercial presentation</p> <p>P5. Record and communicate priorities, responsibilities, timelines and budgets for promotional activities.</p>
<p><b>CU-5.</b> Implement marketing activities</p>	<p>P1. Schedule planned marketing activities within appropriate timeframes</p> <p>P2. Develop measurable performance targets that meet business plan objectives</p> <p>P3. Organise distribution channels and ensure product and service information is accurate and readily available to clients</p> <p>P4. Implement marketing activities within budgetary constraints to meet legal, ethical and enterprise requirements</p>
<p><b>CU-6.</b> Evaluate marketing performance.</p>	<p>P1. Review the established marketing objectives to ensure they remain viable</p> <p>P2. Make an objective assessment of the marketing plan and its implementation by a comparison of valid and reliable data against the established objectives</p> <p>P3. Assess product, pricing and distribution policies in relation to market changes, marketing objectives and enterprise requirements</p>

- 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 Lightning 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&A100 Monitor and Review Business Performance

### Overview :

This competency standard covers the skills and knowledge required to monitor and review business performance

Competency Unit	Performance Criteria
<b>CU-1.</b> Evaluate commercial performance	<p>P1. Gather and analyse data relating to enterprise performance to identify historical and current performance.</p> <p>P2. Review and analyse operational structures to determine the suitability of organisational processes to enterprise objectives.</p> <p>P3. Evaluate enterprise strengths and weaknesses against market conditions to determine current and future capacities.</p> <p>P4. Evaluate enterprise objectives are to identify variations and scope for future development.</p>
<b>CU-2.</b> Allocate and co-ordinate business resources	<p>P1. Identify and communicate roles and responsibilities of personnel.</p> <p>P2. Identify resource requirements for enterprise and cost them using standard financial analysis techniques.</p> <p>P3. Calculate costs of ensuring sustainability of enterprise operations and factor into business planning for the enterprise.</p>
<b>CU-3.</b> Identify performance requirements	<p><b>P1.</b> Develop realistic performance indicators within available timeframes and resources</p> <p><b>P2.</b> Identify and minimize factors inhibiting performance against objectives.</p> <p><b>P3.</b> Monitor and assess market conditions based on relevant data.</p> <p><b>P4.</b> Prepare and incorporate strategies and programs to promote the sustainability of operations into enterprise procedures.</p>
<b>CU-4.</b> Review business performance	<p><b>P1.</b> Review regularly enterprise operations to identify opportunities for improvements in performance.</p>

- 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&A101 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
<p><b>CU-1.</b> Develop and implement issue resolution and grievance procedures</p>	<p>P1. Establish problem solving/issue resolution procedures within legislative requirements and organisation's guidelines.</p> <p>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.</p> <p>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.</p> <p>P4. Conduct hearings, interviews and meetings within the principles of industrial democracy and participative, consultative processes.</p> <p>P5. Identify and invite all relevant industrial parties to participate in the resolution process.</p>
<p><b>CU-2.</b> Manage disciplinary matters</p>	<p>P1. <i>Implement disciplinary matters</i> in accordance with organisation's procedures.</p> <p>P2. Conduct investigations in a caring and confidential manner to maintain performance and morale.</p> <p>P3. Provide feedback promptly.</p> <p>P4. Institute appeals processes in accordance with organisational procedures.</p> <p>P5. Recognize and recommend deficiencies in procedures for changes made</p>

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
- Forecasting
- Organizational procedures
- Business communication

## 0713E&A102 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
<b>CU1</b> Develop a personal budget	<p><b>P1</b> Calculate current living expenses using available information to prepare a personal budget.</p> <p><b>P2</b> Keep a record of all income and expenses for a short period of time to help estimate ongoing expenses.</p> <p><b>P3</b> Subtract total expenses from total income to determine a surplus or deficit budget for the specified period.</p> <p><b>P4</b> Find reasons for a deficit budget and ways to reduce expenditure identified.</p> <p><b>P5</b> Identify ways to increase income, if possible</p>
<b>CU2</b> Develop longer term personal budget	<p><b>P1</b> Analyze income and expenditure and set longer term personal, work and financial goals.</p> <p><b>P2</b> Develop a longer-term budget based on the outcomes of short-term budgeting, and adjust to meet living, work and future career requirements.</p> <p><b>P3</b> Identify obstacles that might affect finances such as job loss, sickness or unexpected expenses contingency savings</p> <p><b>P4</b> Formulate a regular savings plan based on budget, using secure savings products and services.</p> <p><b>P5</b> Monitor expenditure against budget and identify areas of possible expenditure saving</p>
<b>CU3</b> Identify ways to maximize future finances	<p><b>P1</b> Determine sources and ways to maximize personal income, including from work, investments or available government payments/allowances.</p>

- 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&A103 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
<b>CU1</b> Develop and maintain a cooperative work group	<b>P1</b> Work contributions and suggestions from staff are <b>P2</b> continually sought and encouraged <b>P3</b> Contributions to work group operations are acknowledged and suggestions are dealt with constructively <b>P4</b> Develop staff skills according to work requirements <b>P5</b> Implement new work practices <b>P6</b> Address conflict between staff members in accordance with current personnel practices.
<b>CU2</b> Communicate objectives and required standards	<b>P1</b> Inform the staff of the objectives and standards <b>P2</b> required <b>P3</b> Commit to objectives and standards <b>P4</b> Practices of safe, fair and participative work principles are and promote to staff
Provide feedback on performance	<b>P1</b> Give constructive feedback on all aspects of work performance provided to individuals and team <b>P2</b> Access and address performance in a fair and timely manner in accordance with relevant guidelines, procedures and natural justice
<b>CU3</b> Support and participate in development activities	<b>P1</b> Assess training needs of all staff, implemented and promoted <b>P2</b> Devise an action plan to meet individual and group training <b>P3</b> and development needs is

	<p>collaboratively developed,</p> <p><b>P4</b> agreed to and implemented</p> <p><b>P5</b> Identify specific training needs of individuals</p> <p><b>P6</b> Encourage staff in applying skills and knowledge in the workplace</p> <p><b>P7</b> Provide training to the required standard on the job</p> <p><b>P8</b> Support and encourage staff to attend training courses and to take up other development opportunities.</p>
<p><b>CU4</b> Provide leadership. direction and guidance to the work group</p>	<p><b>P1</b> Link between the function of the group and the</p> <p><b>P2</b> goals of the organization</p> <p><b>P3</b> Participate in decision making routinely to develop, implement and review work of the group and to allocate responsibilities where appropriate</p> <p><b>P4</b> Give opportunities and encouragement to others to develop new and innovative work practices and strategies</p> <p><b>P5</b> Identify conflict and resolve with minimum disruption to work group function</p> <p><b>P6</b> Provide staff with the support and supervision necessary to perform work safely and without risk to health</p> <p><b>P7</b> Allocate tasks within the competence of staff and support with appropriate authority, autonomy and training</p> <p><b>P8</b> Supervise appropriately the changing priorities and situations and takes into account the different needs of individuals and the requirements of the task</p>

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&A104 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
<p><b>CU1</b> Facilitate team Development</p>	<p><b>P1</b> Identify work requirements, standards and purpose to team members.</p> <p><b>P2</b> Assist team to develop objectives, targets and key performance indicators relevant its purpose and workplace goals.</p> <p><b>P3</b> Allocate duties regard to the skills required to properly</p> <p><b>P4</b> undertake the assigned task and according to company policy</p> <p><b>P5</b> Identify roles, responsibilities and expectations of each team member</p> <p><b>P6</b> Disseminate and discuss performance expectations to individual team members.</p>
<p><b>CU2</b> Motivate and build the Team</p>	<p><b>P1</b> Develop positive and constructive relationships with and between team members</p> <p><b>P2</b> Facilitate team communication processes</p> <p><b>P3</b> Involve team members in the process of examining risks and options and making decisions, to ensure acceptance and support.</p> <p><b>P4</b> Encourage individual and team efforts and contributions</p> <p><b>P5</b> Strengths and weaknesses of team members are determined and sharing of work tasks is promoted to up skill team members.</p> <p><b>P6</b> Recognize team members' queries and discuss and deal with it.</p>
<p><b>CU3</b> Facilitate and monitor</p>	<p><b>P7</b> Monitor the implementation of work plan and team and individual performance</p>



team  
effectiveness

against agreed strategies, targets and standards, according to workplace policies and procedures.

- P1** Monitor performance against defined **Performance Criteria** and/or assignment instructions and corrective action taken if required.
- P2** Support team in identifying and resolving problems that may impede performance and to suggest improvements in team Performance.
- P3** Consult team members in any review and revision of team objectives and goals.
- P4** Address performance issues which cannot be rectified within the team to appropriate personnel according to employer policy.
- P5** Refer concerns of a team and individual are referred to next level of management or appropriate specialist and conduct negotiations on their behalf.
- P6** Keep team members inform of any changes in the priority allocated to assignments, or tasks which might impact on client/customer needs and satisfaction.
- P7** Monitor team operations to ensure that internal or external employer/client needs and requirements are met.
- P8** Provide follow-up communication on all issues affecting the team
- P9** Conduct team meetings to review work operations and address issues according to workplace policies and procedures.
- P10** Support team in identifying and resolving problems that may impede performance and to suggest improvements in team performance.
- P11** Consult team members in any review and revision of team objectives and goals.
- P12** Raise any inappropriate values and standards exhibited in the workplace with

### 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.

**NOTIFICATION**

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

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

2. All the TVET related institutions / organizations are required to implement aforementioned qualifications so that a uniform and standardized TVET qualification

system is established in Pakistan and efforts are made for international equivalence / recognition of these qualifications.

3. Competency Standards of the above enlisted qualifications can be accessed at NAVTTC's website ([www.navttc.org](http://www.navttc.org)).



**(Muqem Islam)**

Director General (Skill Standards & Curricula)

Phone: 051-9215385

**Distribution:**

1. Federal Secretary, Ministry of Federal Education & Professional Training, Govt of Pakistan
2. Federal Secretary, Ministry of Overseas Pakistanis and Human Resource Development, Govt of Pakistan, Islamabad
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4. Federal Secretary, Ministry of Textile Industry, Govt of Pakistan, Islamabad
5. Federal Secretary, Ministry of Commerce, Govt of Pakistan, Islamabad
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8. Federal Secretary, Ministry of Religious Affairs, Govt of Pakistan, Islamabad
9. Federal Secretary, Ministry of Communication, Govt of Pakistan, Islamabad
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11. Federal Secretary, Ministry of Science & Technology, Govt of Pakistan, Islamabad
12. Chairperson, Punjab Technical Education and Vocational Training Authority (P-TEVTA), Lahore
13. Managing Director, Khyber Pakhtunkhwa Technical Education and Vocational Training Authority (KP-TEVTA),
14. Managing Director, Sindh Technical Education and Vocational Training Authority (S-TEVTA), Karachi
15. Chairman, Azad Jammu & Kashmir, Technical Education and Vocational Training Authority (AJ&K TEVTA), Muzafarabad
16. Director TVET Cell, Gilgit Baltistan, Gilgit
17. Director General, Punjab Vocational Training Council (PVTC), Punjab
18. Managing Director, Technology Upgradation and Skill Development Company (TUSDEC) Lahore
19. Project Director, Punjab Skill Development Program (PSDP) Lahore
20. CEO, Punjab Skill Development Fund, Lahore
21. Rector, UNTECH University Islamabad

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

**Copy for information to: -**

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