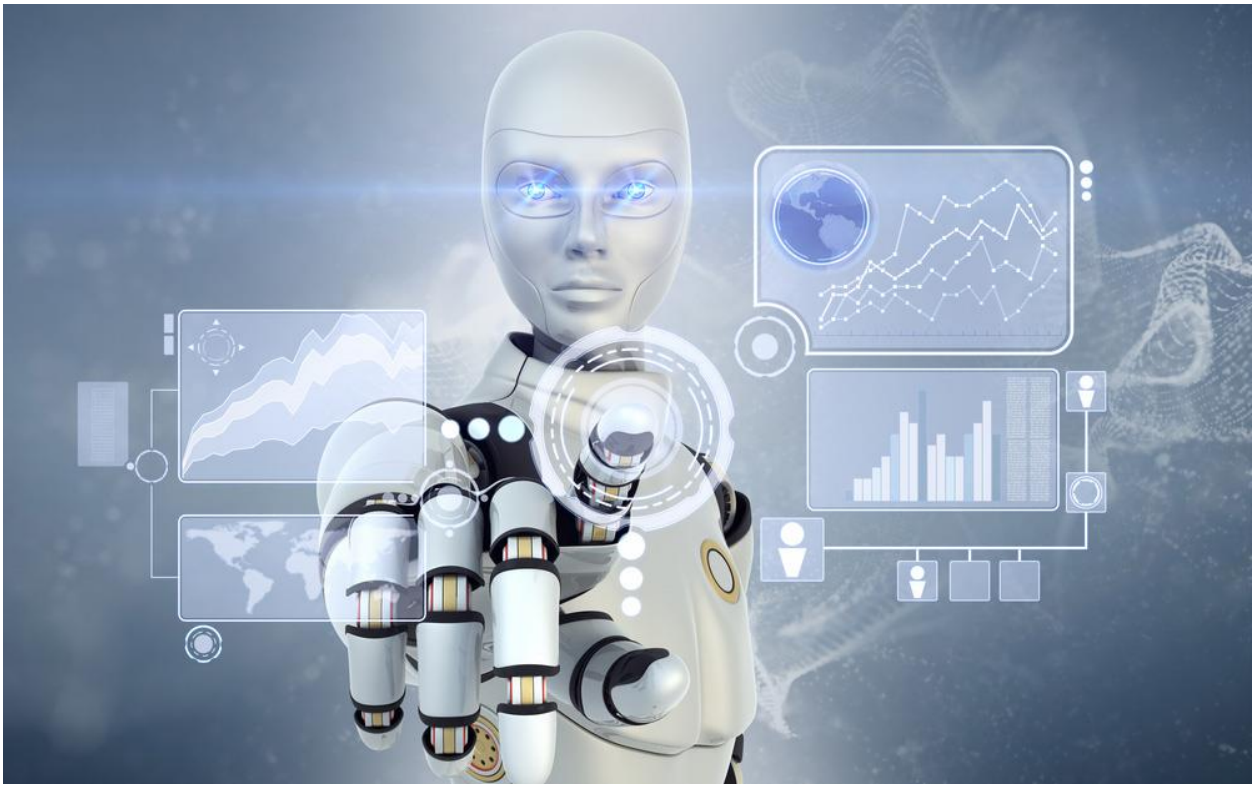
National Competency Standards Level 5 for "Robotics Technology"



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

ACKNOWLEDGEMENTS

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

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

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

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

1. Introduction

This qualification gives an introduction to robotics so that the student will have the competence to design and implement robotic systems. This is done by presenting relevant topics from geometry, kinematics, dynamics, control systems, and computer vision. Python programming is an important part of the course to ensure that the student acquires skills in kinematics and computer vision. Systems for robot control using computer vision and contact force sensors will be presented.
Students will gain hands on experience in robotic assembling, synchronization with system, repair & maintenance along with the some fabrication and machining work.

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.
The National Competency Standards could be used as a referral document for the development of curriculum to be used by training institutions.

2. Purpose of the Qualification

This qualification will help in the designing the robotic systems. The candidate will be able to perform fundamental operations of robotic logic functions, systems, understand the concepts of various digital systems, their functions and designs, grasp concepts of various memory structures, register counter and their integration with various digital system and there troubleshooting. This qualification will help candidate to assembling, synchronization and construct the robotic system, identify and implement certain robotic components, elaborate linkage between the components and their industrial workability& maintenance of various robotic devices. This course enables the youth with greater employment opportunities and entrepreneurial skills.

3. Date of Validation

The level 5 (Diploma) of National vocational qualification on "Robotics" has been validated by the Qualifications Development Committee (QDC) members on **22-24 August 2019** at Karachi and will remain valid for ten years i.e. **24 August,2029**

4. Date of Review

The level 5 (Diploma) of National vocational qualification on "Robotics" has been validated by the Qualifications Development Committee (QDC) members on **22-24 August 2019** at Karachi and shall be reviewed after three years from the date of validation i.e. **25 August,2022**

5. Codes of Qualifications

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

ISCED Classification for Robotics Technician level 5	
Code	**Description**
0714E&A(1)	1st Level D.A. E National Certificate of level-5, in " Robotics Technology"
0714E&A(2)	2nd Level D.A. E National Certificate of level-5, in "Robotics Technology"
0714E&A(3)	3rd Level D.A. E National Certificate of level-5, in "Robotics Technology"
0714E&A(4)	4th Level D.A. E National Certificate of level-5, in "Robotics Technology"
0714E&A(5)	5th Level D.A. E National Certificate of level-5, in "Robotics Technology"

6. Members of Qualification Development Committee

The following members participated in the Qualification development process.

S #	Name	Organization
1	Prof. Dr. Zeeshan Ali Memon (Chairman Qualification Development Committee)	Head of Industrial Engg. Deptt. Dawood University of Engg. & Tech.
2	Engr. Nimra Ghazal	Dawood University of Engg. & Tech.
3	Engr. Javed Larik	Mehran University of Engg. & Tech.
4	Engr. Muhammad Ismail	Dawood University of Engg. & Tech.
5	Dr. Abid Khan	APC&IC Lab, PCSIR
6	Mr. Muhammad Aasim	CASE School of Robotics.
7	Mr. Usama Khan	PCI, Automotive Pvt. Ltd.
8	Mr. Babar Sayeed	PSTC, PCSIR
9	Engr. Dr. Rana Javaid Masood	Usman Institute of Technology
10	Engr. Aurangzaib Ansari	Usman Institute of Technology
11	Engr. Talha Tariq	Dawood University of Engg. & Tech.
12	Dr. Arsalan Ansari	Head of Electronics Dawood University of Engg. & Tech.
13	Mr. Liaqat Ali Jamro	Director Academics, STEVTA
14	Mr. Shaikh Asim Qamar	Dacum Facilitator
15	Mr. Yasir	Assistant Director, NAVTTC

7. Members of Qualification Validation Committee

The following members participated in the Qualification development process.

S #	Name	Organization
1	Dr. Zeeshan Ali Memon (Chairman Qualification Development Committee)	Head of Industrial Engg. Deptt. Dawood University of Engg. & Tech.
2	Engr. Nimra Ghazal	Research Associate, Dawood University of Engg. & Tech.
3	Dr. Asif	Associate Professor, Ziauddin University Karachi
4	Mr. Liaqat Ali Jamro	Director Academics, STEVTA
	Dr. Saifullah Samo	Assistant Professor, Mechatronics Department MUET
5	Mr. Ayaz Khan	Lecturer, Govt. Advance Technical Training Centre, KP(Tevta)
6	Mr. Syed Mansoor Ahmed	Assistant IT Manager, SBTE Karachi
7	Engr. Mustafa Mohiuddin	Lab Engineer, Dawood University of Engg. & Tech.
8	Mr. Muhammad Usman	Incharge & Instructor Mechatronics, GCT Taxila(P-TEVTA)
9	Engr. Aijaz Ahmed Zia	D&A Engineer/INTECH
10	Mr. Yasir	Assistant Director, NAVTTC/ DACUM Expert

8. Entry Requirements

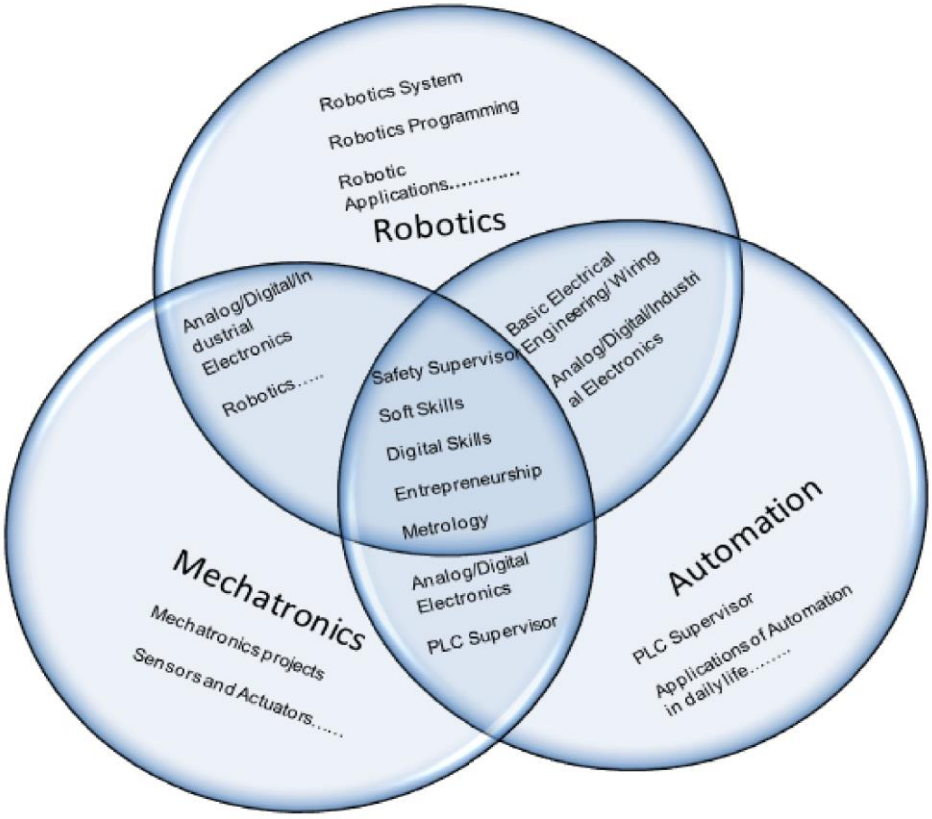
The entry for National Vocational Certificate level 5, in “Robotics” is given below**:**

Title	Entry Requirements
National Vocational Certificate level 5	Entry into training institute for this qualification is candidate having **Matriculation (Science)** and or **National Vocational Certificate level 4.**

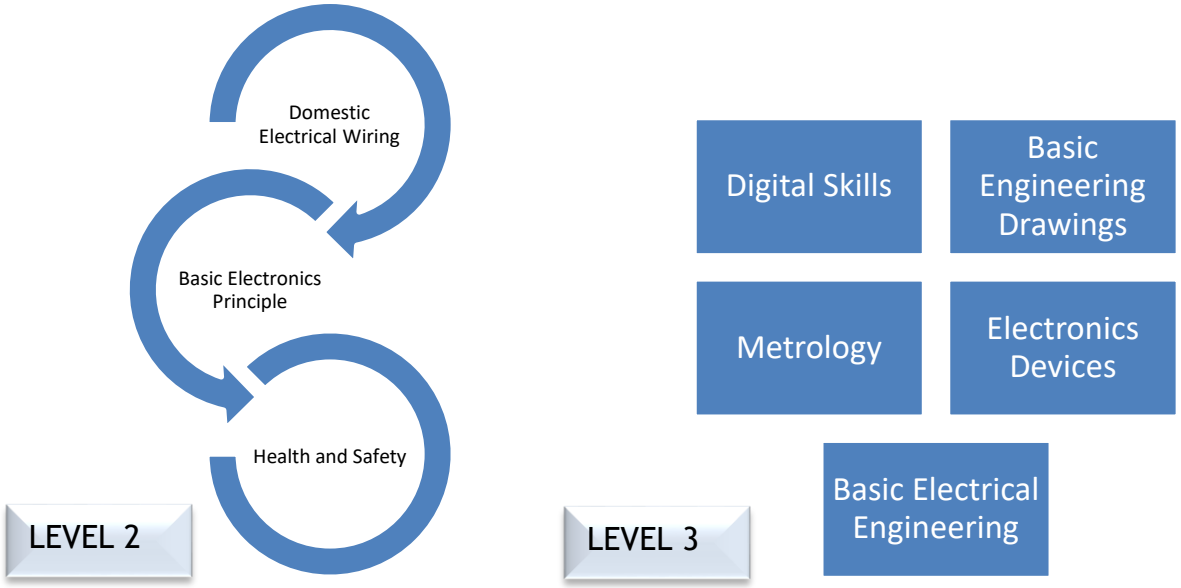
9. Regulations for the Qualification and Schedule of Units

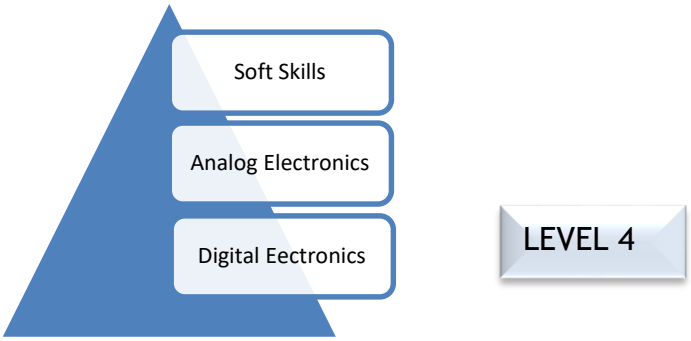
Not Applicable.

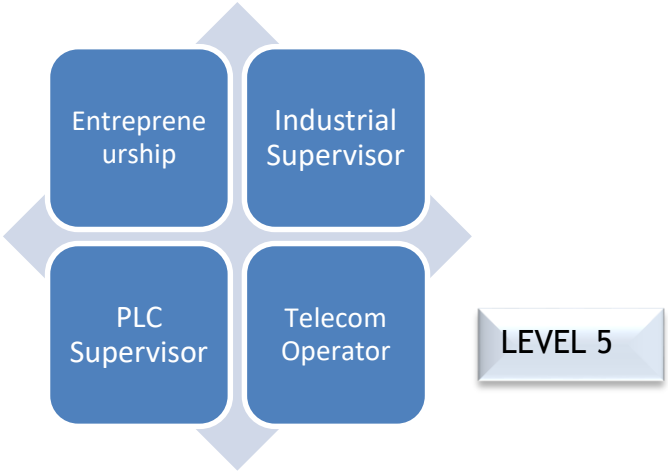
10. Mapping of the Qualification



11. Common Courses with respective levels







12. Packaging of Qualifications (with respect to occupations)

The National Vocational Qualifications have been packaged as detailed below:

Level 5

(Robotic system supervisor, Robot service technician, Associate Robot programmer)

Robotic system supervisor

1. Assemble various robotic parts
2. Perform Robot Calibration
3. Inspect Industrial sensors and actuators
4. Test/Calibrate sensors, Stepper motor& Servo Motor
5. Perform Robot Installation and Maintenance Principles
6. Perform Diagnose precise robot movement
7. Perform Diagnose Coupling Parameters
8. Robotics control Board
9. Develop robotic arm structure
10. Configure and test robotic arm
11. Develop Object recognition system
12. Ensure Product Quality as per standards
13. Develop Line Following Robot
14. Develop smart phone control robot using Bluetooth
15. Develop IoT Controlled i based home automation system
16. Develop Smart Phone Control Door Lock System
17. Develop Security System Using Motion Detection
18. Develop Water-level Detection in Tank
19. Develop Mini CNC 2D Plotter
20. Develop Voice Controlled Robot
21. Implement the performance characteristics identified in ISO9283 standards

Robot service technician

1. Assemble various robotic parts
2. Perform Robot Calibration
3. Inspect Industrial sensors and actuators
4. Test/Calibrate sensors, Stepper motor& Servo Motor
5. Perform Robot Installation and Maintenance Principles
6. Perform Diagnose precisie robot movement
7. Perform Diagnose Coupling Parameters

Associate Robot programmer

1. Basic Programming skills-I
2. Basic Programming skills-II
3. Object Oriented Programming-I
4. Object Oriented Programming-II
5. Advance Programming-I
6. Advance Programming-I
7. Develop Robot program

Level 4
(Robot installation technician, Robotic System operator)

Robot installation technician

1. Assemble various robotic parts
2. Perform Robot Calibration
3. Inspect Industrial sensors and actuators
4. Test/Calibrate sensors, Stepper motor& Servo Motor
5. Inspect the hazardous area for installation
6. Perform Robot Installation and Maintenance Principles
7. Perform Diagnose precise robot movement
8. Perform Diagnose Coupling Parameters
9. Implement the performance characteristics identified in ISO9283 standards

Robotic System operator

1. Identify various parts of robot
2. Perform Assembly and Operation of Remotely Operated Robot (ROR)

13. Summary of Competency Standards

The National Vocational Qualifications have been packaged as detailed below:

Competency Standards	NVQF Level	Category	Estimated Contact Hours			Credit Hr.
			Th	Pr	Total	
Level 2						
Safety Supervisor						
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	Functional	15	30	45	4.5
			35	**90**	**125**	**12.5**
Basic Electrical Wiring (Single Phase)						
Maintain Tools & Equipment.	Level 2	Technical	9	21	30	3
Make Cable/Wire Joints	Level 2	Technical	9	21	30	3
Prepare and Install Distribution Boards	Level 2	Technical	9	21	30	3
Carryout Basic Electrical Installation	Level 2	Technical	9	21	30	3
Install Simple Electrical Wiring	Level 2	Technical	9	21	30	3
Perform Testing of Electrical Wiring	Level 2	Technical	9	21	30	3
Repair/ Maintenance of Electrical Installations	Level 2	Technical	9	21	30	3
Carryout Electrical planning and Installation	Level 2	Technical	9	21	30	3
			72	**168**	**240**	**24**

Basic Workshop Practices						
Perform Metal/Bench Work	Level 2	Technical	6	18	24	2.4
Demonstrate general machining	Level 3	Technical	3	9	12	1.2
Perform cutting on Metal Circular/Power Heck Saw	Level 2	Technical	2	6	8	0.8
Perform Basic Lathe Machine Operations	Level 4	Technical	6	18	24	2.4
Perform Drilling Machine Operations	Level 3	Technical	2	6	8	0.8
Perform Milling Operations	Level 4	Technical	6	18	24	2.4
			25	**75**	**100**	**10**
Welding						
Interpret Drawing and Execute to Fabricate Parts	Level 2	Technical	6	18	24	2.4
Perform Pre-Welding Operations	Level 2	Technical	5	12	17	1.7
Evaluate the Use of Hand and Power Tools	Level 2	Technical	6	15	21	2.1
Perform Oxy Acetylene Welding	Level 3	Technical	12	24	36	3.6
Perform Soldering and Brazing Operations	Level 3	Technical	12	24	36	3.6
			41	**93**	**134**	**13.4**
Level 2 Total			**164**	**405**	**569**	**56.9**
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**
Metrology						
Take measurements with graduated tools	Level 3	Technical	6	12	11	1.1
Take measurements with combination set	Level 3	Technical	6	12	15	1.5
Take measurements through various gauges	Level 3	Technical	6	12	11	1.1
Perform measurements through Micrometer	Level 3	Technical	6	12	8	0.8
Measure dimensions with Vernier tools	Level 3	Technical	6	12	8	0.8
Perform different measurements	Level 3	Technical	6	12	13	1.3
			36	**72**	**66**	**6.6**
Basic Electrical Engineering						
Operate Measuring Instruments.	Level 3	Technical	6	18	24	2.4
Verify Ohm's Law & Kirchhoff's Law by Implementing Series/Parallel Circuits.	Level 3	Technical	6	18	24	2.4
Measure Electrical Power, Energy, Power Factor & Determine Phase Sequence	Level 3	Technical	6	18	24	2.4

Implement Electromagnet to See Various Effects & Verify Faradays Laws.	Level 3	Technical	6	18	24	2.4
Verify Law of Combination of Capacitor and Determine Break down voltage of Capacitor.	Level 3	Technical	6	18	24	2.4
			30	**90**	**120**	**12**
Basic Electronics (Analog)						
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**
Engineering Drawing						
Perform Basic Manual Drawing	Level 3	Technical	6	18	14	1.4
Construct different Engineering Curves	Level 3	Technical	6	18	17	1.7
Construct multi-view drawings	Level 3	Technical	9	27	25	2.5
Install CAD Software	Level 3	Technical	6	18	17	1.7
Develop 2D CAD drawings	Level 3	Technical	9	27	25	2.5
Develop 3D CAD drawings	Level 3	Technical	9	27	19	1.9
			45	**135**	**117**	**11.7**
Robotic Programming						

Basic Programming skills-I	Level 3	Technical	7	18	25	2.5
Basic Programming skills-II	Level 3	Technical	7	18	25	2.5
			14	**36**	**50**	**5**
Level 3 Total			**272**	**798**	**965**	**96.5**
Level 4						
Soft Skills						
Develop Workplace Policy and Procedures for Sustainability	Level 4	Generic	6	24	30	3
Maintain Professionalism in the Workplace	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
Undertake Project Work	Level 4	Generic	6	24	30	3
Prepare and Implement Negotiation	Level 4	Generic	6	24	30	3
Manage Meetings	Level 4	Generic	6	24	30	3
Organize Schedules	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
			60	**240**	**300**	**30**
Digital Electronics						
Design Operation Amplifier	Level 4	Technical	9	21	30	3
Verify truth tables of digital gates	Level 3	Technical	9	21	30	3
Construct & Verify Combinational logic circuit	Level 4	Technical	9	21	30	3
Construct and Verify function of Flip Flops	Level 4	Technical	9	21	30	3
Use 555 IC as Multi vibrator	Level 4	Technical	9	21	30	3

Construct Shift Registers and Counters using Flip Flops	Level 4	Technical	9	21	30	3
			54	**126**	**180**	**18**
AC & DC machines (Motor and Generator)						
Verify Basic Laws of Electrical Machines	Level 4	Technical	6	18	24	2.4
Analyze Dc Generators	Level 4	Technical	6	18	24	2.4
Perform Tests On Dc Generators	Level 4	Technical	6	24	30	3
Operate and test stepper and servo motors	Level 4	Technical	6	24	30	3
			24	**84**	**108**	**10.8**
Robotic Programming						
Object Oriented Programming-I	Level 4	Technical	22	48	70	7
Object Oriented Programming-II	Level 4	Technical	22	48	70	7
			44	**96**	**140**	**14**
Robotic System						
Identify various parts of robot	Level 3	Technical	8	18	26	2.6
Assemble various robotic parts	Level 4	Technical	6	24	30	3
Robotics control Board	Level 4	Technical	9	15	24	2.4
Develop Robot program	Level 4	Technical	8	18	26	2.6
Develop robotic arm structure	Level 4	Technical	8	15	23	2.3
Configure and test robotic arm	Level 5	Technical	8	15	23	2.3
Develop Object recognition system	Level 5	Technical	6	18	24	2.4
Perform Assembly and Operation of Remotely Operated Robot (ROR)	Level 5	Technical	6	18	24	2.4
			59	**141**	**200**	**20**

Level 4 Total			241	687	928	92.8
Level 5						
Robotic Maintenance Technician						
Perform Robot Calibration	Level 5	Technical	8	18	26	2.6
Inspect Industrial sensors and actuators	Level 5	Technical	12	24	36	3.6
Test/Calibrate sensors, Stepper motor& Servo Motor	Level 5	Technical	12	24	36	3.6
Ensure Product Quality as per standards	Level 5	Technical	8	18	26	2.6
Inspect the hazardous area for installation	Level 5	Technical	8	18	26	2.6
			48	**102**	**150**	**15**
Machine & Mechanisms						
Demonstrate Simple Mechanisms	Level 5	Technical	8	15	23	2.3
Perform Kinematic Analysis	Level 5	Technical	10	18	28	2.8
Demonstrate Mechanical Power Transmission Elements	Level 5	Technical	8	15	23	2.3
Perform Kinematic Analysis of Mechanical power Transmission Elements	Level 5	Technical	8	18	26	2.6
			34	**66**	**100**	**10**
Robotic Programming						
Advanced Programming-I	Level 5	Technical	22	48	70	7
Advanced Programming-II	Level 5	Technical	22	48	70	7
			44	**96**	**140**	**14**
Robotic System Evaluation						
Perform Robot Installation and Maintenance Principles	Level 5	Technical	7	15	22	2.2
Perform Diagnose precisie robot movement	Level 5	Technical	7	18	25	2.5

Perform Diagnose Coupling Parameters	Level 5	Technical	7	18	25	2.5
Implement the performance characteristics identified in ISO9283 standards	Level 5	Technical	10	18	28	2.8
			31	**69**	**100**	**10**
Robotic Application						
Develop Line Following Robot	Level 5	Technical	9	15	24	2.4
Develop smart phone control robot using Bluetooth	Level 5	Technical	8	15	23	2.3
Develop IoT Controlled i based home automation system	Level 5	Technical	10	18	28	2.8
Develop Smart Phone Control Door Lock System	Level 5	Technical	8	15	23	2.3
Develop Security System Using Motion Detection	Level 5	Technical	8	15	23	2.3
Develop Water-level Detection in Tank	Level 5	Technical	8	15	23	2.3
Develop Mini CNC 2D Plotter	Level 5	Technical	10	18	28	2.8
Develop Voice Controlled Robot	Level 5	Technical	10	18	28	2.8
			71	129	200	20
Industrial Electronics						
Implement diode and Thyristor in power control application.	Level 5	Technical	9	21	30	3
Implement single phase and Three phase Inverter	Level 5	Technical	9	21	30	3
Control speed of DC/AC Motor	Level 5	Technical	9	21	30	3
			27	63	90	9
Hydraulic & Pneumatic Machinery						
Operate Hydraulic Bench and Its Functions	Level 5	Technical	9	21	30	3
Analyze the performance of Pumps	Level 5	Technical	9	21	30	3
Working/operation directional control valves	Level 5	Technical	9	21	30	3

Setup a Pressure Device and Hold Specific Load on a Double Acting Cylinder	Level 5	Technical	9	21	30	3
Actuate Double Acting Hydraulic Cylinder	Level 5	Technical	9	21	30	3
Construct Circuit for Double Acting Hydraulic Cylinder	Level 5	Technical	9	21	30	3
Set Speed and Direction of a Hydraulic Actuators	Level 5	Technical	9	21	30	3
Perform Pressure measuring instruments operations	Level 5	Technical	9	21	30	3
Operate Flow Regulating Devices (Valves)	Level 5	Technical	9	21	30	3
Maintain Pneumatic System	Level 5	Technical	9	21	30	3
			90	210	300	30
Develop Entrepreneur Skills						
Investigate Microbusiness Opportunities	Level 5	Generic	6	18	24	2.4
Develop A Micro Business Proposal	Level 5	Generic	9	15	24	2.4
Develop A marketing Plan	Level 5	Generic	9	15	24	2.4
Develop And Review A Business Plan	Level 5	Generic	9	15	24	2.4
Organize Finances For The Micro Business	Level 5	Generic	6	15	21	2.1
Manage Human Resources	Level 5	Generic	6	15	21	2.1
Market Products And Services	Level 5	Generic	6	24	30	3
Monitor And Review Business Performance	Level 5	Generic	6	24	30	3
Negotiate For Resolving Business Issues	Level 5	Generic	9	21	30	3
Manage Personal Finances	Level 5	Generic	9	15	24	2.4
Coordinate A Work Team	Level 5	Generic	6	24	30	3
Lead Small Teams	Level 5	Generic	6	24	30	3
			87	**225**	**312**	**31.2**

Level 5 total			**432**	**960**	**1392**	**139.2**

14. Detail of Competency Standards

A. *Maintain Occupational Health and Safe*

0714E&A1. Maintain Health and Safety

Overview: This competency standard covers the skills and knowledge required to ensure safety of machine, knowledge of safety alarm in robotic working area, personal protective equipment (PPE), Maintain First-aid Box, Maintain Fire protection and Machines safety.

Competency Unit	Performance Criteria
CU1. Ensure safeguarding devices Off condition	**P-1.** Check the alarm or indicator or devices which represent the Human Presence in the Robotic working area. **P-2.** Check and test the working of mechanical limits and Robotic working area. **P-3.** Check and test the fixed barrier devices, which prevent contact with moving parts of Robot. **P-4.** Check and test the interlock barrier and guards during off load. **P-5.** Analyze and interpret the data. **P-6.** Report the results.
CU2. Ensure Safeguarding devices in on condition	**P-1.** Locate and distinguish the various types' areas, i.e. Supervisor area, operator area, user area and restricted area for area labelling. **P-2.** Check and observe the absence of human presence in the restricted area with the naked eye and verify with the Human presence sensor output. **P-3.** Check and test the starting parameter for starting Robot, i.e. input power, frequency, lubrication, etc. **P-4.** Check and test working of the Emergency braking mechanism, while emergency power stop is not recommended. **P-5.** Analyse and interpret the data. **P-6.** Report the results.
CU3. Ensure safety	**P-1.** Check and test the ON load sensing devices,

devices during ON load condition	interlocks, ON/OFF load torque and feedback mechanism. **P-2.** Compare the on load and offload data. **P-3.** Analyze and interpret data. **P-4.** Report the results.
CU4.Ensure Personal Protective Equipment (PPE).	**P-1.** Arrange personal protective equipment as per requirements **P-2.** Wear correct personal protective equipment **P-3.** Store PPE at appropriate place after use.
CU5. Maintain First-aid Box	**P-1.** Ensure availability of first aid box **P-2.** Check first aid box for requisite emergency **P-3.** Check expiry of medicines **P-4.** Perform first aid treatment against electric shocks **P-5.** Perform first aid treatment/bandages against minor injuries.
CU6. Maintain Fire Extinguisher	**P-1.** Check expiry of fire extinguisher. **P-2.** Operate fire extinguisher. **P-3.** Replace fire extinguisher. **P-4.** Ensure that the fire brigade is at stand by(for major emergency).
CU7. Ensure Safeguard of Machines	**P-1.** Maintain radiator shield **P-2.** Maintain alternator fan shield **P-3.** Maintain heat resister material on silencer **P-4.** Cover main circuit breaker **P-5.** Lock canopy doors

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 Hazards and its types.
- Define Guarding methods.
- Differentiate between physical, chemical and electrical hazards

- Describe treatments of various hazards
- Describe Use of personal protective equipment (PPE).
- Describe occupational health & safety regulations.
- Define safe manual handling techniques.
- Describe typical worksite hazards
- Describe factors affecting health & safety in the workplace.
- Describe First-Aid-Box

Critical Evidence(s) Required

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

- Define the alarm devices indicators
- Explain various type's areas, supervisor area, operator area, user area and restricted area
- Identify Health and safety signs and precautions
- Prepare the list of PPEs.
- Demonstrate the use of PPEs while performing job at least one.
- Perform first aid treatment against electric shock/minor injury.
- Explain safety procedure at workplace
- Differentiate between safe and unsafe tools.

Tools and Equipment

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

S. No.	Items
1.	Safety Shoes
2.	Bump cap (Hard hat) / Helmet
3.	Safety gloves
4.	Appropriate safety glasses
5.	High visibility vest
6.	Safety clothes (Overall)
7.	Hearing protection Ear Plugs/Ear Mufflers
8.	Breathing apparatus
9.	Fall protection
10.	Site emergency response plan
11.	Fire extinguishers

12.	Fire blankets
13.	Respirators/ masks
14.	First aid kits
15.	Stretchers
16.	WHMIS book
17.	First Aid Kit
18.	ANSI/RIA R15.06-2012

0714E&A2. Perform safety practices at work place

Overview: This competency standard covers the skills and knowledge required to ensure safety of machine, knowledge of company policies, prepare for emergencies and able to respond emergencies.

Competency Unit	Performance Criteria
CU1. Adopt company policies and procedures	**P1.** Ensure company's safety policy. **P2.** Adopt company safety procedure. **P3.** Advocate worker with company safety policy. **P4.** Implement Safety sign board as per standard.
CU2. Attain health & safety training	**P1.** Take required health and safety training. **P2.** Implement work hazardous material information system (WHMIS). **P3.** Adopt first aid cardio respiratory, resuscitation and CPR.
CU3. Prepare for emergencies	**P1.** Check Take emergency response training. **P2.** Ensure practice of emergency exercises. **P3.** Check the emergency alarms. **P4.** Ensure regular practice of gathering the workers in assembly area during the emergency.
CU4. Respond to emergencies	**P1.** Arrange Follow emergency plan **P2.** Communicate instructions to co workers **P3.** Assess risk and determine course of action **P4.** Operate emergency equipment and supplies **P5.** Ensure that the ambulance is at stand by (for emergency)
CU5. Maintain First-aid	**P-1.** Ensure availability of first aid box

Box	**P-2.** Check first aid box for requisite emergency **P-3.** Check expiry of medicines **P-4.** Perform first aid treatment against electric shocks **P-5.** Perform first aid treatment/bandages against minor injuries.
CU6. Maintain Fire Extinguisher	**P-1.** Check expiry of fire extinguisher. **P-2.** Operate fire extinguisher. **P-3.** Replace fire extinguisher. **P-4.** Ensure that the fire brigade is at stand by(for major emergency).
CU7. Ensure Safeguard of Machines	**P-1.** Maintain radiator shield **P-2.** Maintain alternator fan shield **P-3.** Maintain heat resister material on silencer **P-4.** Cover main circuit breaker **P-5.** Lock canopy doors

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:

Types of Accidents

Robotic incidents can be grouped into four categories: a robotic arm or controlled tool causes the accident, places an individual in a risk circumstance, an accessory of the robot's mechanical parts fails, or the power supplies to the robot are uncontrolled.

- Impact or collision accidents
- Crushing and trapping accidents
- Other accidents

Sources of Hazards:

- Human
- Control errors
- Unauthorized access
- Mechanical failures
- Power systems
- Improper installation

Guarding Methods:

- Interlocked Barrier Guard
- Fixed Barrier Guard
- Awareness Barrier Device
- Presence Sensing Devices
- Emergency Robot Braking

Critical Evidence(s) Required

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

- Perform 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.

Tools and Equipment

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

S. No.	Items
1.	Safety Shoes
2.	Bump cap (Hard hat) / Helmet
3.	Safety gloves
4.	Appropriate safety glasses
5.	High visibility vest
6.	Safety clothes (Overall)
7.	Hearing protection Ear Plugs/Ear Mufflers
8.	Breathing apparatus
9.	Fall protection
10.	Site emergency response plan
11.	Fire extinguishers
12.	Fire blankets
13.	Respirators/ masks
14.	First aid kits
15.	Stretchers
16.	WHMIS book
17.	First Aid Kit
18.	ANSI/RIA R15.06-2012

0714E&A3 Develop Professionalism

Overview:

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

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

	P3. Identify and resolve potential and actual problems P4. Communicate with other site personnel P5. Complete assignment
CU7. Speak and listen effectively	P1. Listen carefully to what is said P2. Confirm understanding, such as repeat instructions P3. Communicate message clearly and accurately to others P4. Exchange information with others, such as supervisor, signaler, general public, inspectors, other operators and trade people
CU8. Interpret documentation	P1. Access and maintain documents P2. Provide complete, legible and accurate information in documents P3. Interpret equipment inspection documentation from previous shifts before conducting pre-operational inspection
CU9. Communicate with signals	P1. Identify and work with signals P2. Communicate with audible signals, such as back-up alarm, and site emergency horn P3. Communicate with hand signals
CU10. Communicate with electronic equipment	P1. Check communication devices to verify operating condition, such as complete radio checks P2. Deliver and receive messages using communication equipment P3. Follow communication protocol

Knowledge & Understanding

- Explain Principles of work ethic and expectations.
- Describe Factors/situations/conditions that cause stress in professional and personal life
- Explain working conditions on construction site
  What is the impact of fatigue on job performance?

- What are Conflict resolution techniques?
- What is the importance of effective communication?
- Define roles of individuals on job site, such as supervisor, inspector, other trades people
- Knowledge of types of documentation required, such as log books, safety reports, maintenance reports, inspection reports, time cards
- What are Audible and warning signals used on job site
- Explain the types of communication equipment used on job site

Critical Evidence(s) Required

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

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

B. *Basic Electrical Wiring (Single Phase)*

0714E&A4. Maintain Tools & Equipment.

Overview: This competency standard covers the skills and knowledge related to arrange tools/equipment, maintain tool box, insulate tools/equipment, calibrate measuring tools and manage proper inventory of used/unused tools/equipment. Trainee will be expected to follow the procedures to maintain the tools/equipment.

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

Knowledge & Understanding

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 Various tools and equipment and their functions

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

Critical Evidence(s) Required

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

- Describe functions of various tools and equipment
- Define job card
- Perform storage of tools and equipment at appropriate
- Describe Types of insulation
- Use of insulated tools and equipment
- Describe method of equipment calibration
- Perform Report writing

Tools and Equipment

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

S. No.	Items
1.	Cables
2.	Wires.
3.	Wire stripper.
4.	Solder wire.
5.	Soldering paste
6.	Plier.
7.	Nose plier.
8.	Insulation remover.
9.	Solder.

0714E&A5. Make Cable/Wire Joints

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

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

Knowledge & Understanding

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 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
- Define Britannia joint

Critical Evidence(s) Required

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

- Perform Striping of cables.
- Perform Twisting of cable.
- Perform Soldering of joints

Tools and Equipment

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

S. No.	Items
1.	Cables
2.	Wires.
3.	Wire stripper.

4.	Solder wire.
5.	Soldering paste
6.	Plier.
7.	Nose plier.
8.	Insulation remover.
9.	Solder.

0714E&A6. Prepare and Install Distribution Boards

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

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

	P3. Distribute load equally on all phases

Knowledge & Understanding

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 distribution board.
- Describe D.B. w.r.t. size, current rating, voltage, No. of C.Bs and phases etc.
- Define sensitivity of RCCB.
- Define MCB.
- Differentiate fuse and breaker.
- Define wiring accessories
- State purpose of each accessory.

Critical Evidence(s) Required

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

- Use accurate Miniature Circuit Breaker (MCB) for load.
- Make a common neutral.
- Identify parts of distribution board.
- Develop Bill of Quantity (BOQ).

Tools and Equipment

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

S. No.	Items
1.	Cables
2.	Wires.
3.	Wire stripper.
4.	Solder wire.
5.	Soldering paste
6.	Plier
7.	Nose plier.
8.	Insulation remover.
9.	Solder.
10.	MCB
11.	MCCB
12.	RCD

13.	ELCB
14.	DB
15.	Socket and switches

0714E&A7. Carryout Basic Electrical Installation

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

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

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:

- Explain Types of cables
- Explain Gauges of cables
- Define single phase connection
- Describe Types of joints
- Define conductor and insulator
- Define three phase connection
- Describe cable gauging
- Describe color code of cables / phase sequence.
- Define Methods of Wiring
- Describe Types of wiring
- Describe Types of connections
- Describe Types of wiring tests
- Describe various wiring test
- Describe Color of cables
- Distinguish between different wiring systems

- Describe necessary materials required for each type of wiring.
- Explain the uses of each type of wiring.

Critical Evidence(s) Required

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

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

Tools and Equipment

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

S. No.	Items
1.	Cables
2.	Solder
3.	Wire stripper
4.	Plier
5.	Wires
6.	Nose plier
7.	Solder wire
8.	Soldering paste
9.	Insulation remover

0714E&A8. Install Simple Electrical Wiring

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

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

	P10. Check the function of circuit after connect the main supply
CU4. Make series/test lamp circuit.	**P1.** Draw wiring diagram of series circuit. **P2.** Draw Current path diagram of series circuit. **P3.** Draw layout diagram of series circuit. **P4.** Mark on working board according to layout diagram. **P5.** Install accessories according to layout diagram. **P6.** Lay wires in duct/pipe according to layout diagram. **P7.** Make connections according to wiring diagram. **P8.** Check the circuit before connect the main supply. **P9.** Make connection with main supply. **P10.** Check the function of circuit after connect the main supply
CU5. Make intermediate switch circuit.	**P1.** Draw wiring diagram of intermediate switch circuit. **P2.** Draw Current path diagram of intermediate switch circuit. **P3.** Draw layout diagram of intermediate switch circuit. **P4.** Mark on working board according to layout diagram. **P5.** Install accessories according to layout diagram. **P6.** Lay wires in duct/pipe according to layout diagram. **P7.** Make connections according to wiring diagram. **P8.** Check the circuit before connect the main supply. **P9.** Make connection with main supply. **P10.** Check the function of circuit after connect the main supply
CU6. Make of Tunnel circuit	**P1.** Draw wiring diagram of tunnel circuit. **P2.** Draw Current path diagram of tunnel circuit. **P3.** Draw layout diagram of tunnel circuit. **P4.** Mark on working board according to layout diagram. **P5.** Install accessories according to layout diagram. **P6.** Lay wires in duct/pipe according to layout diagram. **P7.** Make connections according to wiring diagram. **P8.** Check the circuit before connect the main supply. **P9.** Make connection with main supply. **P10.** Check the function of circuit after connect the main supply
CU7. Make impulse switch circuit.	**P1.** Draw wiring diagram of impulse switch circuit. **P2.** Draw Current path diagram of impulse switch circuit. **P3.** Draw layout diagram of impulse switch circuit. **P4.** Mark on working board according to layout diagram. **P5.** Install accessories according to layout diagram. **P6.** Lay wires in duct/pipe according to layout diagram.

	P7. Make connections according to wiring diagram. **P8.** Check the circuit before connect the main supply. **P9.** Make connection with main supply. **P10.** Check the function of circuit after connect the main supply

Knowledge & Understanding

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

Critical Evidence(s) Required

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

- Perform intermediate switch circuit connections.
- Perform single pole switch circuit connections.
- Define current, voltage, power and resistance.
- Explain impulse switch circuit and its use.

Tools and Equipment

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

S. No.	Items
1.	Electrician Tool kit.
2.	PVC Pipe/Duct.
3.	PVC clamp.
4.	Wooden/PVC board.

5.	PVC wire according to load
6.	Circuit Breaker.
7.	Screw
8.	Single pole switch.
9.	Lamp holder
10.	Lamp
11.	AVO meter.
12.	Test Indicator

0714E&A9. Perform Testing of Electrical Wiring

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

Critical Evidence	Performance Criteria
CU1. Perform Open Circuit Test	**P1.** Disconnect the power supply source, neutral conductor and earth conductor from distribution fuse box. **P2.** Connect ohmmeter between starting and ending terminals of live conductor. **P3.** Ensure that the reading should be close to 0 ohm. **P4.** Repeat P2 to P3 for neutral and earth conductor.
CU2. Perform Short Circuit Test	**P1.** Disconnect the supply source, neutral conductor and earth conductor from distribution fuse box. **P2.** Connect one terminal of ohmmeter with live conductor. **P3.** Connect the other terminals of ohmmeter with neutral conductor. **P4.** Ensure the reading must be infinity (No reading). **P5.** Connect ohmmeter between live conductor and earth conductor. **P6.** Ensure the reading must be infinity (No reading)
CU3. Perform Continuity/Loop Test	**P1.** Connect all metal clad switches, metal parts, conduits with earth. **P2.** Open the main switch. **P3.** Turn on all the switches. **P4.** Connect earth continuity tester with conduit and earth. **P5.** Measure the resistance value with tester which must not be more than 1 ohm.
CU4. Perform Visual Test	**P1.** Check the wires joints. **P2.** Check if there is any spark. **P3.** Check over heating of wires. **P4.** Check all the appliances are On or fluctuating.

	P5. Check all indications of meters. **P6.** Check Voltages on all phases. **P7.** Check the DB and Breakers. **P8.** Check the main supply is coming properly.
CU5. Perform Insulation Test	**P1.** Switch off the main breaker. **P2.** Short circuit all lighting connections. **P3.** Connect megger between line and earth. **P4.** Rotate the megger to generate the voltage. **P5.** Read the megger dial and ensure that the insulation resistance should not be less than 50M ohm of any single circuit.
CU6. Perform Polarity Test	**P1.** Switch off the main switch. **P2.** Disconnect all loads. **P3.** Switch on all circuit control switches. **P4.** Connect ohm meter between main line and all the terminal of sockets and load points one by one. **P5.** Ensure meter reading value must be less than 1 ohm.
CU7. Perform Earth Resistance Test	**P1.** Place 3 electrodes in earth at distance of 10m apart between every electrode. **P2.** Connect terminal E of earth resistance tester to first electrode. **P3.** Connect terminal P of earth resistance tester to the second electrode. **P4.** Connect terminal C of the earth resistance tester with third electrode. **P5.** Measure the resistances after applying specific voltage. **P6.** Repeat P1 to P5 by interacting earthing regions. **P7.** Ensure 3 readings must be equal.
CU8. Perform Earth leakage Test.	**P1.** Ensure the socket must be at least 13A for RCD plug in ??. **P2.** Adjust the sensitivity of RCD. **P3.** Ensure tripping time should not exceed from 200 msec. **P4.** Plug the RCD in socket and switch on socket outlet. **P5.** Ensure P-N and P-E light up. **P6.** Press the test button. **P7.** Ensure that RCD will trip and reading should not be less

	than 200 msec. **P8.** Move the selection switch to 180^{o}. **P9.** Press the test button. **P10.** Ensure that RCD will trip and reading should not be less than 200msec. **P11.** Move selection switch to 0^{0}. **P12.** Press the test button. **P13.** Ensure that RCD will trip and reading must be shown less than 200msec.
CU9. Perform Murray Loop Test	**P1.** Connect galvanometer with Wheatstone bridge. **P2.** Connect positive terminal of DC source with Wheatstone bridge. **P3.** Connect negative terminal of DC source with ground. **P4.** Connect remaining two terminal of Wheatstone bridge with two cores of the cable. **P5.** Short the other end of these two cores of cable. **P6.** Note the reading of galvanometer. **P7.** Calculate Rx. **P8.** Repeat the P1 to P7 for other cores of the cable.
CU10. Perform BLAVIER & Earth Loop Test	**P1.** Connect galvanometer with Wheatstone bridge. **P2.** Connect positive terminal of DC source with Wheatstone bridge. **P3.** Connect negative terminal of DC source with ground. **P4.** Connect remaining two terminal of Wheatstone bridge with two cores of the cable. **P5.** Short the other end of these two cores of cable. **P6.** Note the reading of galvanometer. **P7.** Calculate Rx. **P8.** Repeat the P1 to P7 for other cores of the cable.

Knowledge & Understanding

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 RCD
- Define sensitivity

- Explain P-E and P-N
- Explain the function of RCD.
- Explain the function of distribution box.
- Explain the function of fuse.
- Explain which meters are used for open circuit and short circuits test.
- Explain the purpose of continuity test.
- Explain the purpose of polarity test.
- Explain the purpose of insulation resistance test.

Critical Evidence(s) Required

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

- Perform Earth leakage Test, Open Circuit Test, Short Circuit Test, Continuity/Loop Test,
- Perform Visual Test, Perform Insulation Test, Perform Polarity Test,
- Perform Earth Resistance Test, Perform Murray Loop Test,
- Perform BLAVIER & Earth Loop Test

Tools and Equipment

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

S. No.	Items
1.	Sockets
2.	RCD
3.	Loads
4.	Supply source
5.	Distribution Box
6.	Ohmmeter
7.	Earth resistance tester
8.	Continuity
9.	Tester.
10.	Breakers
11.	Magger

0714E&A10. Repair/ Maintenance of Electrical Installations

Overview: This competency standard covers the skills and knowledge required to Analyse Fault in Electrical Installations, troubleshooting of electrical equipment's and Carry out Preventive Maintenance. Carry out repair and maintenance of electrical installations at workplace in accordance with the manufacturer's instructions and organizational requirements.

Competency Unit	Performance Criteria
CU1. Analyze Fault in Electrical Installations & Troubleshooting of electrical equipment's	**P1.** Inspect visually the electrical wiring, fixtures, equipment, soldering, connection, appliances and machinery for discovering the faults and defects **P2.** Check the installation for consistency with the electrical drawing **P3.** Draw the layout of equipment's before disassembling of electrical components **P4.** Check the faulty components with scope or meter **P5.** Re assembled the components as per drawing and the installation **P6.** Check the fault indication at relay for HT installation **P7.** Test electrical equipment as specified in the manufacturer's manual and record the results **P8.** Prepare a list of items/material(s) required for repair /replacement as per specifications **P9.** Draw circuit diagram of electrical equipment be disassembling **P10.** Make necessary adjustments in the control and protective switchgear **P11.** Replace defective control & protective switch gear, cables and accessories with standard items **P12.** Replace defective earth electrode & faulty/damaged earthling conductors **P13.** Test installed electrical equipment for safe and optimum performance according to standards & regulations **P14.** Record the results of the test performed on a standard format

CU2. Carry out Preventive Maintenance	**P1.** Perform Preventive maintenance as specified by the manufacturers or SOP **P2.** Check out the equipment logging sheet and updates logging **P3.** Update Maintenance/service records as per requirement

Knowledge & Understanding

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

- Interpretation of layout diagrams, technical sketches, graphic symbols and wiring diagrams, and manufacturer's specifications etc.
- Describe types of electrical tools used for troubleshooting and preventive maintenance purposes
- Describe types of electrical measuring
- Describe instruments used in testing electrical installations
- Describe types of electrical wiring systems for domestic& industrial purposes
- Describe methods of tracing the fault
- Describe types of electrical control and protective switchgear and accessories used in electrical circuits
- Describe types and principles of operation of circuit breakers used in electrical installations and their applications
- Describe types of electrical wires and cables and their ratings
- Describe types of electrical accessories and their application on electrical installations
- Describe types of earthling systems used in domestic& industrial electrical installations
- Describe Importance of testing electrical installations Importance of corrective & preventive maintenance

Critical Evidence(s) Required

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

- Perform fault identification and take corrective action
- Carry out the preventive maintenance
- Perform service/repair record keeping

Tools and Equipment

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

S. No.	Items
1.	Specific Gravity Chart
2.	Splicing Machine
3.	Spring tension checking meter
4.	Tachometer
5.	Soldering Lead
6.	Soldering Iron
7.	Set of Screw Drivers
8.	Set of Nose Pliers
9.	Safety Shoes
10.	Ring Spanner Set
11.	RPM Meter
12.	Safety Helm
13.	Safety Goggles
14.	Safety Belt
15.	IR Temperature Gun
16.	Mini Hydraulic Press Machine
17.	OTDR Mete
18.	Multimeter
19.	Overall Combination
20.	Phase Sequence Meter
21.	Philips Screw drivers Set
22.	L Scale
23.	Lux Meter
24.	Lugs Punching Machine (Hydraulic and Manual)
25.	Medgar (Insulation Tester)
26.	Micron Meter
27.	Magnetic Conductor
28.	Ammeter
29.	Hydrometer
30.	Hole saw
31.	Handsaw
32.	Hammer
33.	Hacksaw
34.	Grinder
35.	Battery Charger
36.	Gloves
37.	Generator
38.	Flux
39.	Filler gauge
40.	Files (set)
41.	Earth Tester

42.	Battery Cleaning Ki
43.	Duct Rod
44.	Disk Grinder
45.	Combination Plier Set
46.	Clamp Meter
47.	Circuit Boards
48.	Bearing Puller
49.	Bench Vice
50.	Chisel
51.	Cells tester
52.	Cable Knife
53.	Cable / Wire Gauge

0714E&A11. Carry Out Electrical Planning and Estimation

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

Competency Unit	Performance Criteria
CU1. Analyze customer requirement and specification	**P1.** Draw the general value chain of the end user. **P2.** Highlight the various stages and set of activities in the value chain drawing **P3.** Enlist the electrical appliances/materials required in electrical development process **P4.** Identify critical stages in the development **P5.** Identify the safety aspect required in the critical stages of the development **P6.** Enlist the possible energy efficient appliance/devices and global trends in electrical works **P7.** Analyse the client requirement at broad level. **P8.** Generate a report of various stages of electrical works. **P9.** Proposed appliance/materials as per global trends and clarify the technical specification.

CU2. Plan and estimate domestic electric work	**P1.** Plan the client requirement at broad level from the proposal. **P2.** Plan the electrical appliances/materials / used in different stages of the electrical development process **P3.** Plan and estimate electrical wiring **P4.** Estimate Installation and Material Cost **P5.** Estimate Power consumption for lighting and appliances **P6.** Plan a main and sub distribution board. **P7.** Ensure safety system.
CU3. Plan and estimate commercial electric work.	**P1.** Analyse the client requirement at broad level from the proposal. **P2.** Plan the electrical equipment /appliances/materials / used in different stages of the commercial electrical work **P3.** Plan and estimate electrical wiring **P4.** Estimate Installation and Material Cost **P5.** Estimate Power consumption for centralize lighting, heating, cooling system and other appliances. **P6.** Plan a main and sub distribution board. **P7.** Ensure safety measures in development process. **P8.** Enlist the material required.
CU4. Plan and estimate industrial electric work.	**P1.** Analyse the client requirement at broad level from the proposal. **P2.** Plan the electrical equipment /appliances/materials / used in different stages of the commercial electrical work **P3.** Plan and estimate electrical wiring **P4.** Estimate Installation and Material Cost **P5.** Estimate Power consumption for centralize lighting, heating, cooling system and other appliances. **P6.** Plan 3-phase line for heavy loads **P7.** Plan a separate control panel box for heavy machinery. **P8.** **P9.** Plan a main and sub distribution board. **P10.** Design a safety system for protection of machinery and labour. **P11.** Assign colour scheme for safety measures

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 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.
- Describe how to prepare a General arrangement drawing
- Define IEC standards
- Describes the standard of electrical components.
- Describes equipment properties.
- Describe the rules and regulation of work.
- Define Electrical Specifications component used.
- Describes the input and output of tool of electronic.

Critical Evidence(s) Required

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

- Analyze customer requirement and specification
- Perform planning and estimation of domestic/commercial and industrial electric work.

Tools and Equipment

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

S. No.	Items
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.

C. ***Basic Workshop Practices***

0714E&A12. Perform Metal/Bench Work

Overview: This competency standard covers the skills and knowledge required to Develop Name Plate manually, Carry out Sawing, Prepare Inside Calliper, Prepare Bottle Opener, Prepare Dovetail Joint, Prepare Tri Square (small size), Cut Threads

on Work Piece, Prepare Funnel, Prepare Drawer Handle, Cut Pipe Threads and Prepare spanner (small size).

Competency Unit	Performance Criteria
CU1. Develop Name Plate manually	**P1.** Select marking tools **P2.** Hold the sheet in vice. **P3.** Cut sheet as per drawing **P4.** Perform surface finishing with file **P5.** Level the surface with tri-square **P6.** Mark the plate as per name requirements **P7.** Punch the marked area **P8.** Perform finishing with sand paper
CU2. Prepare Dovetail Joint	**P1.** Select marking tools **P2.** Cut sheet as per drawing **P3.** Perform surface finishing with file **P4.** Level the surface of both work pieces with tri-square **P5.** Mark both work pieces according to drawing **P6.** Create outer notch on work piece using flat file and hacksaw **P7.** Create inner notch using hacksaw and chisel **P8.** Compare both pieces by inserting outer notch into inner notch **P9.** Perform finishing with sand paper
CU3. Prepare Bottle Opener	**P1.** Select marking tools **P2.** Cut sheet as per drawing **P3.** Perform surface finishing with file **P4.** Level the surface with tri-square **P5.** Mark radius as per drawing **P6.** Develop radius as per drawing **P7.** Make the notch with round file **P8.** Perform finishing with sand paper
CU4. Cut Threads on Work Piece with tap and die	**P1.** Identify different kind of taps & die according to requirement **P2.** Identify the work piece clamping method. **P3.** Apply tap and die alignment. **P4.** Apply lubricants while threading. **P5.** Avoid unwanted engraving and slips. **P6.** Identify proper threading procedure
CU5. Cut Pipe Threads	**P1.** Select marking tools **P2.** Cut pipe as per drawing

	P3. Select die as per pipe size **P4.** Set die into die holder **P5.** Select relevant vice for pipe clamping **P6.** Perform pipe threading using appropriate method **P7.** Perform finishing with sand paper
CU6. Prepare spanner (small size)	**P1.** Select marking tools **P2.** Cut sheet as per drawing **P3.** Perform surface finishing with file **P4.** Level the surface with tri-square **P5.** Mark radius as per drawing **P6.** Develop radius as per drawing **P7.** Make the notch with round file **P8.** Perform finishing with sand paper
CU7. Prepare Funnel	**P1.** Select marking tools **P2.** Cut sheet as per drawing **P3.** Perform surface finishing with file **P4.** Mark the sheet according to drawing **P5.** Cut the sheet with hand shear **P6.** Create radius of funnel using appropriate tools **P7.** Perform flat lock seam bend using bench vice **P8.** Perform finishing with sand paper.

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 measurement
- Describe basic measuring /Marking /cutting tools
- Describe clamping/holding methods.
- Describe types of chisels
- Describe chiseling process
- Explain types of fits.
- Define of radius gauge
- Describe use of round file
- Describe different kind of taps & die according to requirement
- Describe calculation for drill size for internal threading
- Perform clamping of work piece as required
- Perform threading by hand
- Perform threading by die and taps
- Describe tap and die alignment.
- Describe basic measurement
- Describe use of round file

- Describe standard bolts
- Define proper use of hand shear
- Describe flat lock seam end in metal sheet working

Critical Evidence(s) Required

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

- Identify basic measuring /Marking /cutting tools
- Perform chiseling process
- Identify different kind of taps & die according to requirement
- Perform clamping of work piece as required
- Perform proper use of hand shear
- Identify flat lock seam end in metal sheet working

Tools and Equipment

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

S. No.	Items
1.	Work bench
2.	Bench vices
3.	Hammer
4.	Tri-square
5.	Hand hacksaw
6.	Scriber
7.	Vernier calliper
8.	Flat File
9.	Number/alphabet punch
10.	Tap set
11.	Tap handle
12.	Lubricant
13.	Work bench
14.	Bench vice
15.	Pipe vice
16.	Tri-square
17.	Verier calliper
18.	Hammer
19.	Punching tools
20.	Die handle
21.	Lubricant
22.	Work bench
23.	Bench vice

0714E&A13. Demonstrate general machining

Overview: This competency standard covers the skills and knowledge required to determine job requirements and sequence of operations, Select and mount tools, perform machining operations and Measure components, Adjust and maintain machine

Competency Unit	Performance Criteria
CU1. Determine job requirements and sequence of operations	**P1.** Interpret and understand drawings, instructions and specifications. **P2.** Determine sequence of operations including job specifications and set-up for maximum efficiency **P3.** Select appropriate material and establish datum as required
CU2. Select and mount tools	**P1.** Appropriate tools for job are selected, sharpened and shaped as required. **P2.** Tools are mounted and positioned correctly
CU3. Perform machining operations	**P1.** Basic marking out techniques are used where required **P2.** Machining parameters are set for job requirements and maximum tool life. **P3.** Work is held or correctly clamped without damage to product, and all safety requirements are met. **P4.** Machining is performed in a safe manner utilizing all guards, safety procedures and personal protective clothing and equipment
CU4. Measure components, Adjust and maintain machine	**P1.** Use appropriate instruments or gauges to check components are compliant with measurement requirements and specifications. **P2.** Carry out routine maintenance and adjustments as required including slide and collar adjustment, cleaning and lubrication

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:

- Describe basic measurement
- Describe basic measuring /Marking /cutting tools
- Describe clamping/holding methods
- Define Machine shop tool their working and safety procedure during work.
- Define Marking tools.
- Describe the safety procedure using marking tools.
- Describe machine types according to their work and rotation.
- Describe maintenance and its types.
- Describe the safety procedure during maintenance.
- Describe different type of measuring tools.
- Describe Proper Usage of Measuring Tools

Critical Evidence(s) Required

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

- Identify basic measuring /Marking /cutting tools
- Perform basic machining operation.
- Perform the safety procedure using marking tools.
- Perform the safety procedure during maintenance.

Tools and Equipment

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

S. No.	Items
1.	Measuring tools
2.	Marking tools
3.	Work holding devices
4.	Cutting tools
5.	Measuring tools
6.	Marking tools
7.	Machine tools
8.	Gauges
9.	Set of spanners
10.	Set of Allen keys

0714E&A14. Perform cutting on Metal Circular/Power Hack Saw

Overview: This competency standard covers the skills and knowledge required to Carry out Sawing and Carry out Sawing at different angles.

Competency Unit	Performance Criteria
CU1. Carry out Sawing	**P1.** Mark the job according to given drawing **P2.** Select appropriate blade according to job requirement **P3.** Set blade in frame of hacksaw as per procedure **P4.** Ensure the work piece is clamped firmly and properly **P5.** Adopt methods and techniques for sawing that is appropriate to job requirement **P6.** Follow marked line during sawing to ensure accuracy.
CU2. Carry out Sawing at differet angles	**P1.** Mark the job according to given drawing **P2.** Select appropriate blade according to job requirement **P3.** Set blade in frame of metal circular saw as per procedure. **P4.** Ensure the blade tightness and rotating side. **P5.** Ensure the work piece is clamped firmly and properly **P6.** Adopt methods and techniques for sawing that is appropriate to job requirement **P7.** Follow marked line during sawing to ensure accuracy.

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:

- Describe basic measurement
- Describe types of hacksaw frames
- Describe basic measuring /Marking /cutting tools
- Describe clamping/holding methods
- Define methods and techniques of sawing.

- Describe basic measurement
- Describe types of hacksaw frames

Critical Evidence(s) Required

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

- Perform basic measurement
- Define methods and techniques of sawing.
- Perform basic measuring /Marking /cutting tools

Tools and Equipment

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

S. No.	Items
1.	Work bench
2.	Bench vice
3.	Tri-square
4.	Hand hacksaw with blade
5.	Scriber
6.	Flat File
7.	Vernier caliper
8.	Punching tools

0714E&A15. Perform Basic Lathe Machine Operations

Overview: This competency standard covers the skills and knowledge required to Perform cantering operations, Perform facing Operations, Perform turning operations, Perform drilling or boring operations, Perform step turning operations, Perform knurling Operations, Taper turning by tail stock off-set method, Taper turning by plain taper turning attachment, Taper turning by telescopic taper turning attachment and Perform Internal and External threading Operations.

Competency Unit	Performance Criteria
CU1. Perform centering operations	**P1.** Select facing tools according to job requirement. **P2.** Mount and set the required work-holding devices, work piece and cutting tools. **P3.** Follow the correct specifications for the part or component to be produced. **P4.** Select safe procedures and tools to accomplish the work. **P5.** Adjust the operating parameters (e.g. speed and feed) of machine tool for centring the job. **P6.** Ensure all safety mechanisms are in place.
CU2. Perform facing Operations	**P1.** Select facing tools according to job requirement. **P2.** Mount and set the required work-holding devices, work piece and cutting tools. **P3.** Follow the correct specifications for the part or component to be produced. **P4.** Select safe procedures and tools to accomplish the

	work. **P5.** Adjust the operating parameters (e.g. speed and feed) of machine tool to achieve the work specification. **P6.** Ensure all safety mechanisms are in place.
CU3. Perform turning operations	**P1.** Obtain and follow work specifications, drawings or sketches to accomplish the work. **P2.** Set up and adjust the machine as per work specifications and procedures. **P3.** Ensure the components produced have the required quality and within the specified dimensional accuracy. **P4.** Shut down the machine and equipment on conclusion of the machining activities.
CU4. Perform drilling or boring operations	**P1.** Select drill or boring tools according to drawings. **P2.** Mount and set the required work-holding devices, work piece and cutting tools. **P3.** Adjust the RPM of machine according to the cutting speed. **P4.** Perform the boring operation according to the drawing. **P5.** Check quality of the component produced at different intervals. **P6.** Observe personal and workplace safety.
CU5. Perform step turning operations	**P1.** Mount and set the required work-holding devices, work piece and cutting tools. **P2.** Select and adjust appropriate speeds and feeds of turning machine. **P3.** Produce a component which matches the work specifications using appropriate methods and techniques. **P4.** Check quality of the component produced at different intervals. **P5.** Follow safety precautions to ensure safe work and to avoid any injury.
CU6. Perform knurling Operations	**P1.** Select the knurling tool according to drawing. **P2.** Set the tool and work piece in the machine according to procedure. **P3.** Adapt methods and techniques to produce proper knurling on work piece. **P4.** Select and adjust appropriate speeds and feeds of lathe machine. **P5.** Use coolants during knurling to achieve smooth impression on work piece.

	P6. Observe personal and workplace safety.
CU7. Taper turning by tail stock off-set method	**P1.** Loosen tailstock clamp out. **P2.** Offset tailstock required amount. **P3.** Centre cutting tool. **P4.** Setup cutting tool for parallel turning. **P5.** Starting at small diameter take excessive cuts until the taper is .05 to .06 in oversize. **P6.** Check taper for accuracy using a taper ring gauge. **P7.** Finish turns the taper to size and fit required.
CU8. Taper turning by plain taper turning attachment	**P1.** Remove the binding screw that cross slide to cross feed screw nut. **P2.** Tighten the lock screw and set cutting tool on centre. **P3.** Set workpiece in lathe and mark length of taper. **P4.** Use binding screw to connect sliding block to side of taper attachment. **P5.** Select depth of feed cut by compound rest feed handle. **P6.** Take a light cut and recheck taper fit. **P7.** Finish turn and fit the taper to gauge.
CU9. Taper turning by telescopic taper turning attachment	**P1.** Clean and oil the guide bar. **P2.** Loose lock screws and offset end of guide bar, **P3.** Set the bar to required taper in degrees. **P4.** Tighten the lock screw and set cutting tool on center. **P5.** Set workpiece in lathe and mark length of taper and tighten connecting screw on sliding block. **P6.** Move carriage until center of attachment is opposite to length of taper. **P7.** Lock anchor bracket to lathe bed. **P8.** Take a cut and select depth of cut. **P9.** Readjust the taper attachment, Take a light cut and recheck taper fit. **P10.** Finish turn and fit the taper to gauge.
CU10. Perform Internal and External threading Operations	**P1.** Mount and set the required work-holding devices, work piece and cutting tools. **P2.** Select and adjust appropriate speeds and feeds of turning machine. **P3.** Produce a component which matches the work specifications using appropriate methods and techniques. **P4.** Check quality of the component produced at different intervals. **P5.** Use Proper cutting tool with required dimensions.

	P6. Follow safety precautions to ensure safe work and to avoid any injury.

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:

- Describe Safety precautions involved in work.
- Define work piece setting and mounting.
- Describe adjusting speed and feed of the machine and cutting tool.
- Define Calculation of speed and feed.
- Describe work piece holding and cutting tools
- Describe Reading and interpreting work specifications, drawings and sketches.
- Define setting up and adjusting the machine.
- Describe machined work piece measurement and make a report in reference to the drawing.
- Describe shutting down of machine and equipment after closure of activities.
- Describe drilling or boring operation on lathe machine.
- Describe mounting and setting up of work-holding devices, work pieces and cutting tools.
- Define taper turning techniques.
- Define Calculation of tapers.
- Describe knurling operation.
- Describe dialing of work piece through dial indicator on lathe machine
- Define external and internal threading operation on lathe machine.

Critical Evidence(s) Required

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

- Perform Safety precautions involved in work.
- Perform work piece setting and mounting.
- Perform adjusting speed and feed of the machine and cutting tool.
- Perform Calculation of speed and feed.
- Perform work piece holding and cutting tools
- Perform Reading and interpreting work specifications, drawings and sketches.
- Perform setting up and adjusting the machine.
- Perform machined work piece measurement and make a report in reference to the drawing.

- Perform shutting down of machine and equipment after closure of activities.
- Perform drilling or boring.
- Perform mounting and setting up of work-holding devices, work pieces and cutting tools.
- Perform taper turning.
- Perform Calculation of tapers.
- Perform knurling.
- Perform dialing of work piece through dial indicator
- Perform external threading on lathe machine.

Tools and Equipment

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

S. No.	Items
1.	Lathe Machine
2.	Cutting Tools
3.	Measuring Tools
4.	Personal Protective Equipment
5.	Equipment
6.	Files
7.	Lathe Machine
8.	Cutting Tools
9.	Vernier Caliper
10.	Personal Protective
11.	Knurling Tools

0714E&A16. Perform Drilling Machine Operations

Overview: This competency standard covers the skills and knowledge required to produce holes using drilling machine, perform counter boring and counter sinking and perform machine reaming

Competency Unit	Performance Criteria
CU1. Produce holes using drilling machine	**P1.** Observe personal and work place safety. **P2.** Set up drilling machine for producing holes according to job requirement. **P3.** Manipulate the machine tool controls safely and correctly in line with operational procedures. **P4.** Produce components to the required quality and within the specified dimensional accuracy. **P5.** Carry out quality sampling checks at suitable intervals. **P6.** Shut down the equipment to a safe condition on conclusion of the machining activities.
CU2. Perform counter boring and counter sinking	**P1.** Select relevant tools according to the information given in engineering drawings and job specifications. **P2.** Ensure tooling is correct in terms of size, shape, type, and grade for the work. **P3.** Position the work-piece in the drill in such a way that it is aligned, secured and stable during drilling. **P4.** Adjust speeds and feeds of drill in accordance with the size, type, and hardness of work-piece material, so that the drill performs optimum cutting without damage to work-piece.
CU3. Perform machine Reaming	**P1.** Observe personal and workplace safety. **P2.** Clamp work-piece in the vice properly. **P3.** Select reamer according to hole size and drawing requirements **P4.** Set reamer in the drill chuck according to procedure. **P5.** Use lubricants during reaming for smooth cutting. **P6.** Ensure proper alignment of the reamer during operations.

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:

- Describe Safety precautions involved in drilling operation.
- Define of setting up of drilling machine.
- Describe Types of drilling machines.
- Define Selecting and adjusting speed and feed of drilling machine.
- Define Importance of coolants in drilling operations.
- Define Methods and techniques of quality checks.
- Define Different types of drilling tools and their implications.
- Describe Importance of selecting right drilling tool for the job specifications.
- Define reamer size selection according to hole size.
- Define Types of reamers (straight teeth or helical teeth).
- Define Method of setting reamer in the drill chuck.
- Define Importance of using lubricants during reaming.
- Define Importance of alignment of the reamer during operations

Critical Evidence(s) Required

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

- Perform Safety precautions involved in work.
- Perform setting up of drilling machine.
- Perform adjusting speed and feed of drilling machine.
- Perform measurement of the hole.
- Perform Different types of drilling tools and their implications.
- Perform reamer selection according to hole size.

Tools and Equipment

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

S. No.	Items
1.	Drilling Machines
2.	Drill chuck with Key
3.	Machine Vice
4.	Marking Tools
5.	Measuring Tools
6.	Drill Sleeve and Socket
7.	Personal Protective Equipment
8.	Counter drill
9.	Cutting oil
10.	Tri square
11.	Measuring Tool

0714E&A17. Perform Milling Operations

Overview: This competency standard covers the skills and knowledge required to Prepare Blank for Generating the Gear, Select Tools and Equipment for Gear Cutting, Produce a square shaped work piece, Generate spur gear (Direct Indexing) On Milling Machine, Generate spur gear (Differential Indexing) On Milling Machine, Generate Helical Gear On Milling Machine, Perform slotting or grooving on work piece, Perform drilling or boring using milling machine, Milling a T slot, Bevel gear cutting on milling machine, Practice of spur rack cutting and Practice of helical rack cutting.

Competency Unit	Performance Criteria
CU1. Prepare Blank for Generating the Gear	**P1.** Interpret drawing and arrange the material according to job requirement **P2.** Prepare the work-piece by required machining (sawing and filing etc.) and get it ready for turning the blank **P3.** Check and verify the dimensions of blank for generating gear as per drawing
CU2. Select Tools and equipment for Gear Cutting	**P1.** Select the material, type, shape and size of cutter(s) according to the job requirements **P2.** Arrange the measuring instruments and holding devices to attain accuracy of the work as per prescribed method
CU3. Produce a square shaped work piece	**P1.** Identify safety hazards related with milling operations and take appropriate steps to avoid any injury or accident. **P2.** Dial the machine vice according to job requirement. **P3.** Select cutters and set machine as per requirements. **P4.** Mount cutters and work piece in the machine. **P5.** Produce a part matching the process plan and the part print specifications.

	P6. Check quality of the component at suitable intervals. **P7.** Shut down the machine at safe position after finishing the work.
CU4. Generate spur gear (Direct Indexing) On Milling Machine.	**P1.** Select gear cutter and indexing plate on a milling machine **P2.** Mount indexing plate on indexing head. **P3.** Centre indexing head and its tail stock. **P4.** Fix indexing head and tail stock on milling table. **P5.** ENGAGE worm shaft from worm wheel **P6.** Adjust speed feed and direction of the cutter. **P7.** Mount Gear blank on mandrel. **P8.** Hold one side of mandrel on chuck of indexing head and other side in tail stock **P9.** Start machine and carry out cutter at zero point vertically. **P10.** Carry out cutter at zero point horizontally. **P11.** Apply depth for rough cut and engage machine automatically in longitudinal direction **P12.** Move table back at zero point. **P13.** Apply full depth for final cut and engage machine automatically in forward direction. **P14.** Repeat the process simultaneously until tooth is obtained.
CU5. Generate spur gear (Differential Indexing) On Milling Machine.	**P1.** Select gear cutter and indexing plate on a milling machine **P2.** Mount indexing plate on indexing head. **P3.** Centre indexing head and its tail stock. **P4.** Fix indexing head and tail stock on milling table. **P5.** Revolve index plate forward or backward part of turn while index crank turn to proper spacing **P6.** Choose the number close to required division that can be indexed by simple indexing **P7.** Adjust speed feed and direction of the cutter. **P8.** Mount Gear blank on mandrel. **P9.** Hold one side of mandrel on chuck of indexing head and other side in tail stock **P10.** Start machine and carry out cutter at zero point vertically. **P11.** Carry out cutter at zero point horizontally. **P12.** Apply depth for rough cut and engage machine automatically in longitudinal direction **P13.** Move table back at zero point. **P14.** Apply full depth for final cut and engage machine automatically in forward direction. **P15.** Repeat the process simultaneously until tooth is

	obtained.
CU6. Generate Helical Gear On Milling Machine	**P1.** Select a indexing plate to machine a helical gear on a manual machine, **P2.** Mount gear set to engage lead screw and indexing head spindle **P3.** Centre indexing head and its tail stock. **P4.** Fix indexing head and tail stock on milling table. **P5.** Adjust speed feed and direction of the cutter. **P6.** Mount Gear blank on mandrel. **P7.** Hold one side of mandrel on chuck of indexing head and other side in tail stock **P8.** Start machine and carry out cutter at zero point vertically. **P9.** Carry out cutter at zero point horizontally. **P10.** Apply depth for rough cut and engage machine automatically in longitudinal direction **P11.** Move table back at zero point. **P12.** Apply full depth for final cut and engage machine automatically in forward direction. **P13.** Repeat the process simultaneously until tooth is obtained.
CU7. Perform slotting or grooving on work piece	**P1.** Identify safety hazards related with milling operations and take appropriate steps to avoid any injury or accident. **P2.** Set the work piece in machine vice according to procedure. **P3.** Select the appropriate cutter as per specifications. **P4.** Adjust the milling cutter for slotting and grooving. **P5.** Determine the touching point of the work piece. **P6.** Produce slotting or grooving on the workpiece to the required quality. **P7.** Check quality of the component at suitable intervals. **P8.** Shut down the machine at safe position after finishing the work. **P9.** Observe personal and workplace safety at all time.
CU8. Perform drilling or boring using milling machine	**P1.** Identify safety hazards related with milling operations and take appropriate steps to avoid any injury or accident. **P2.** Select drill or boring tools according to drawings. **P3.** Mount and set the required work-holding devices, work piece and cutting tools. **P4.** Adjust the RPM of machine according to the standard chart.

	P5. Perform the boring operation according to the drawing. **P6.** Check quality of the component produced at different intervals. **P7.** Shut down the machine at safe position after finishing the work. **P8.** Observe personal and workplace safety at all time.
CU9. Milling a T slot	**P1.** Layout position of a T slot. **P2.** Square vertical milling machine with machine table. **P3.** Mount work in milling machine. **P4.** Machine the centre slot to proper depth of T slot by end mill. **P5.** Remove end mill and mount proper t slot cutter. **P6.** Machine lower part of the slot.
CU10. Bevel gear cutting on milling machine.	**P1.** Cut The materials to size **P2.** Cut workpiece with lathe that is shaped into a gear blank. **P3.** Cut gear with a Coniflex generator. **P4.** Remove Burrs on the teeth with a deburring machine.
CU11. Practice of spur rack cutting.	**P1.** Hold the work piece in milling machine. **P2.** Hold milling cutter in rack milling attachment. **P3.** Hold cutter at 90 degree for spur cutting. **P4.** Move the table for each tooth by rack indexing attachment. **P5.** Continue operation until required length is obtained.
CU12. Practice of helical rack cutting	**P1.** Hold the work piece in milling machine. **P2.** Hold milling cutter in rack milling attachment. **P3.** Hold cutter at some angle for helical cutting. **P4.** Move the table for each tooth by rack indexing attachment. Continue operation until required length is obtained.

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 geometrical shapes e.g. circular, square, rectangular, cylindrical, conical, profiles etc.
- Define Orthographic representation of drawings 1st angle and 3rd angle projection method
- Describe Measurement systems and their conversions
- Describe Use of Computer Aided Design (CAD) software application for making drawing(s) and designs
- Define Method for configuring CAD software
- Define User interface customization of CAD software
- Define Common commands and tools used in CAD software
- Define Surfaces and solids in CAD
- Define File management in computer system
- Define safety hazards related with the milling machine operations.
- Describe Use of dial indicator
- Define Method of mounting the cutters
- Describe Checking of right angle with the tri- square.
- Explain the procedure of slotting and grooving.
- Describe Quality checks procedures and techniques.
- Describe Types of drill or boring tools and their function.
- Define Procedure of mounting and setting up of work-holding devices, work pieces and cutting tools.
- Define Method and technique of adjusting RPM of milling machine.
- Define Safe Boring and milling procedures.
- Define Techniques of checking quality of components.
- Define bevel gear design
- Define milling machine operation
- Define Spur rack design
- Define helical rack design

Critical Evidence(s) Required

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

- Generate geometrical shapes e.g. circular, square, rectangular, cylindrical, conical, profiles etc.
- Generate Orthographic representation of drawings 1st angle and 3rd angle projection method
- Perform Measurement systems and their conversions
- Perform safe work practices related with the milling machine operations.
- Perform Identifying safety hazards associated with milling machine operations.
- Perform mounting and setting up of work-holding devices, work pieces and cutting tools.

- Perform work piece measurement and make a inspection report related to drawing

Tools and Equipment

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

S. No.	Items
1.	Computer System
2.	Multimedia Projector
3.	White Board
4.	White Board Markers/Eraser
5.	Laser Printer and Document Scanner
6.	Measuring and Marking Tools
7.	Surface Table
8.	Notebooks
9.	Pens/Pencils
10.	CAD Software
11.	Milling machine
12.	Machine Vice
13.	Tri square
14.	Vernier Caliper
15.	Dial indicator with
16.	magnet stand
17.	Milling cutters
18.	Personal Protective Equipment
19.	Milling machine and its accessories
20.	Slotting cutter
21.	Vernier caliper
22.	Depth gauge
23.	End mil cutter

D. *Welding*

0714E&A18. Interpret Drawing and Execute to Fabricate Parts

Overview: This competency standard covers the skills and knowledge required to Read and Understand Manufacturing Drawings, Interpret Welding Symbols, Recognize Material Specifications and Bill of Material (BOM) and Manufacture Parts

Competency Unit	Performance Criteria
CU1. Interpret Manufacturing Drawings	**P1.** Recognize basics of lines used in engineering drawings **P2.** Describe uses of lines in engineering drawings **P3.** Recognize and explain orthographic and isometric views of a drawing **P4.** Identify manufacturing requirements according to drawings **P5.** Prepare job layout according to manufacturing requirements
CU2. Interpret Welding Symbols	**P1.** Understand basic and supplementary welding symbols used in manufacturing drawings **P2.** Understand and differentiate between types of welds and joints **P3.** Identify welding requirements according to welding symbols given in the manufacturing drawings
CU3. Recognize Material Specifications and Bill of Material (BOM)	**P1.** Identify material specifications according to manufacturing drawing **P2.** Identify bill of material (BOM) according to manufacturing drawing
CU4. Weld Parts	**P1.** Interpret dimensional tolerances according to manufacturing drawing **P2.** Assemble and tack weld parts according to manufacturing drawing

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:

- Describe Basic elements of engineering drawing

- Describe Drawing symbols
- Explain Dimensioning techniques
- Define General tolerance
- Define Angular tolerance
- Define Geometric tolerance
- Explain Perspective
- Explain Exploded view
- Explain Hidden view technique
- Explain First angle projections
- Explain Third angle projections

Critical Evidence(s) Required

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

- Interpret and Understand Manufacturing Drawings.
- Identify Welding Symbols
- Recognize Material Specifications in drawing
- Make Bill of Material (BOM) as per drawing requirement.
- Perform weld a part/s

Tools and Equipment

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

S. No.	Items
1.	Layout tools
2.	Measuring devices
3.	Layout tools
4.	Measuring devices
5.	Hand held calculator
6.	Base metals
7.	Consumables
8.	Layout tools
9.	Measuring devices
10.	Fabrication and welding equipment
11.	Layout tools
12.	Measuring devices

0714E&A19. Perform Pre-Welding Operations

Overview: This competency standard covers the skills and knowledge required to Set Welding Equipment, Prepare materials for welding, Cut and Prepare Edge/s of Base Materials and Prepare Welding Consumables.

Competency Unit	Performance Criteria
CU1. Set Welding Equipment	**P1.** Adjust pressure of both gas cylinders with the help of regulator **P2.** Open acetylene gas knob of welding torch Make carburizing flame by increasing acetylene gas quantity **P3.** Make neutral flame by adjusting both gases at same quantity **P4.** Make oxidizing flame by increasing oxygen gas quantity **P5.** Adjust pressure of both gas cylinders with the help of regulator **P6.** Select the correct size of the nozzle **P7.** Set the both gas flame of welding torch as per standard
CU2. Prepare materials for welding	**P1.** Select and obtain required material/s as per job requirements **P2.** Select appropriate marking tools as per job requirements **P3.** Mark the area to be cut as per drawing/job requirements
CU3. Cut and Prepare Edge/s of Base Materials	**P1.** Select appropriate cutting equipment as per job requirements **P2.** Set-up cutting equipment as per manufacturer's instructions/job requirements **P3.** Cut the base material as per job specifications and dimensions provided in the drawing **P4.** Prepare edges of the base materials as per drawing/WPS

	P5. Check dimensions of the prepared edges as per drawing/WPS **P6.** Select proper tools and chemicals for cleaning **P7.** Clean the edges of the base materials as per job requirements
CU4. Prepare Welding Consumables	**P1.** Select relevant welding consumables as per job requirements/WPS **P2.** Prepare consumables in accordance with required specifications

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:

- Describe about welding torch
- Identify Gas pressure regulators
- Explain temperature and its units
- Describe pre heating
- Explain importance of pre heating
- Explain metal properties
- Describe malleability
- Describe types of grinder
- Explain use of tri square
- Describe importance of filing
- Describe the filler rod
- Describe electrode baking oven
- Describe purpose of flux

Critical Evidence(s) Required

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

- Perform Welding Equipment setting
- Perform materials preparation for welding
- Perform Cut and Prepare Edge/s of Base Materials
- Prepare Welding Consumables

Tools and Equipment

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

S. No.	Items
1.	Oxygen cylinder
2.	Acetylene gas cylinder
3.	Pressure regulators
4.	Cylinder key
5.	Welding torch
6.	Rubber house pipe
7.	Back fire arrester
8.	Flash back arrester
9.	Spark lighter
10.	Steel wire brush
11.	Work bench
12.	Bench vice
13.	Hammer
14.	Tri-square
15.	Hand hacksaw
16.	Scriber
17.	Vernier calliper
18.	Pedestal grinder
19.	Disk grinder
20.	Pin grinder
21.	Flat file
22.	Welding electrode
23.	Metal Filler rod
24.	Welding flux

0714E&A20. Evaluate the Use of Hand and Power Tools

Overview: This competency standard covers the skills and knowledge required to Put on hand tools and Put on power tools.

Competency Unit	Performance Criteria
CU1. Put on hand tools	**P1.** Select hand tools appropriate to the task requirements. **P2.** Use hand tools to produce desired outcomes to job specifications which may include finish, tension, size or shape. **P3.** Adhere all safety requirements to before, during and after use. **P4.** Identify and mark unsafe or faulty tools for repair according to designated procedures before, during and after use. **P5.** Maintain tools, including hand sharpening according to standard operational procedures, principles and techniques. **P6.** Store hand tools safely in appropriate location according to standard operational procedures and manufacturers' recommendations.

CU2. Put on power tools	**P1.** Select power tools appropriate to the task requirements. **P2.** Use power tools for a determined sequence of operations-which may include clamping, alignment and adjustment to produce desired outcomes-to job specifications which may include finish, size or shape. **P3.** Adhere all safety requirements to before, during and after use. **P4.** Identify and mark unsafe or faulty tools for repair according to designated procedures before, during and after use. **P5.** Maintain tools, including hand sharpening according to standard operational procedures, principles and techniques. **P6.** Store power tools safely in appropriate location according to standard operational procedures and manufacturers' recommendations.

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:

- Describe applications of different hand and power tools in a general engineering context
- Describe Common faults and/or defects in hand and power tools
- Define Procedures for marking unsafe or faulty tools for repair
- Define Routine maintenance requirements for a range of hand and power tools
- Describe Storage location and procedures for a range of hand and power tools
- Define Hazards and control measures associated with using hand and power tools
- Describe Benefits and limits of cutting and shaping metal with auxiliary equipment
- Describe Environmental benefits of maintaining auxiliary equipment
- Define Clamping /securing methods
- Describe Adjustment/alignments to a range of power tools
- Describe Tool sharpening techniques for a range of power tools

Critical Evidence(s) Required

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

- Identify common faults and/or defects in hand and power tools
- Prepare procedures for marking unsafe or faulty tools for repair
- Prepare routine maintenance requirements for a range of hand and power tools

- Identify Storage location and storage procedures for a range of hand and power tools
- Perform Hazards and control measures associated with using hand and power tools

Tools and Equipment

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

S. No.	Items
1.	Work bench
2.	Bench vice
3.	Hammer
4.	Tri-square
5.	Hand hacksaw
6.	Scriber
7.	Vernier calliper
8.	Flat File
9.	Number/alphabet punch
10.	Scriber
11.	Vernier calliper
12.	Hand drill machine
13.	Disk grinder
14.	Pin grinder

0714E&A21. Perform Oxy Acetylene Welding

Overview: This competency standard covers the skills and knowledge required to Practice of making Tee Joint, Practice of making Lap Joint and Practice of Making Butt Joint.

Competency Unit	Performance Criteria

CU1. Practice of making Tee Joint	**P1.** Take Work piece as per drawing **P2.** Straiten it with the help of hammer and anvil **P3.** Grind the work pieces on grinding machine to prepare the edges flat and parallel to each other **P4.** Place the Bottom piece on work table and place the Top plate at 90* to each other as per drawing **P5.** Set the flame of welding torch as per standard **P6.** Complete the bead as per standard
CU2. Practice of making Lap Joint	**P1.** Take Work piece as per drawing **P2.** Straiten it with the help of hammer and anvil **P3.** Grind the work pieces on grinding machine to prepare the edges flat and parallel to each other **P4.** Place the Bottom piece on work table and place the Top plate along the marked line **P5.** Set the flame of welding torch as per standard **P6.** Complete the bead as per standard
CU3. Practice of making Lap Joint	**P1.** Take Work piece as per drawing **P2.** Straiten it with the help of hammer and anvil **P3.** Grind the work pieces on grinding machine to prepare the edges flat and parallel to each other **P4.** Place the work pieces parallel to each other **P5.** Set the flame of welding torch as per standard **P6.** Complete the bead as per standard

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:

- Explain positions of electrode according to work
- Describe the setting the current on welding machine
- Describe motion of electrode in ARC welding
- Explain importance of gap between electrode and base metal
- Describe use of tri square
- Describe importance of cleanliness of surface to be welded

Critical Evidence(s) Required

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

- Explain positions of electrode according to work
- Perform setting the current on welding machine
- Explain importance of gap between electrode and base metal
- Perform cleanliness of surface to be welded

Tools and Equipment

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

S. No.	Items
1.	Oxygen cylinder
2.	Acetylene gas cylinder
3.	Pressure regulators
4.	Cylinder key
5.	Welding torch
6.	Rubber house pipe
7.	Back fire arrester
8.	Flash back arrester
9.	Spark lighter

0714E&A22. Perform Soldering and Brazing Operations

Overview: This competency standard covers the skills and knowledge required to Soldering Operation and Brazing Operation

Competency Unit	Performance Criteria
CU1. Soldering Operation	**P1.** Perform marking as per drawing **P2.** Cut the metal sheet according to drawing using shearing machine **P3.** Straighten the material with help of hammer **P4.** File work if required **P5.** Perform soldering operation as per standard
CU2. Brazing Operation	**P1.** Perform marking as per drawing **P2.** Cut the metal sheet according to drawing using shearing machine **P3.** Straighten the material with help of hammer **P4.** File work if required **P5.** Open gas cylinder with the help of cylinder key **P6.** Adjust pressure of both gas cylinders with the help of regulator **P7.** Select the correct size of the nozzle **P8.** Set flame to carburizing flame as per standard **P9.** Use copper filler rod as filler metal **P10.** Perform brazing as per standard

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:

- Describe soldering
- Describe sheet metal gauge
- Explain disadvantages of soldering
- Describe brazing
- Define carburizing flame
- Define neutral flame
- Define oxidizing flame

Critical Evidence(s) Required

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

- Perform Soldering Operation and Brazing Operation

Tools and Equipment

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

S. No.	Items
1.	Solder gun
2.	Solder wire
3.	Oxygen cylinder
4.	Acetylene gas cylinder
5.	Pressure regulators
6.	Cylinder key
7.	Welding torch
8.	Rubber house pipe
9.	Back fire arrester
10.	Flash back arrester
11.	Marking tools
12.	Copper Filler rod
13.	Spark lighter
14.	Steel wire brush

E. *Digital Skills*

0714E&A23. Install Computer Operating Systems and Hardware

Overview :

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

Unit of Competency	Performance Criteria
CU1. Identify operating system and hardware components	**P1.** Determine ICT organizational requirements and specifications **P2.** Identify and select operating system **P3.** Identify appropriate external hardware components **P4.** Identify internal hardware components
CU2. 2. Install and configure operating system and application software with hardware components	**P1.** Install and configure operating system to meet organizational requirements **P2.** Identify the functions associated with the operating system and associated boot process **P3.** Configure power-management settings to minimize power consumption as an environmentally sustainable measure **P4.** Use both the graphical user interface and the command line interface to perform basic tasks **P5.** Install or upgrade application software onto the operating system and hardware configuration

	P6. Determine the relationship between an application program, the operating system and hardware **P7.** Identify general differences between the different computer platforms and their respective operating systems
CU3. 3. Optimize operating system and hardware components	**P1.** Optimize operating system using included tools or third-party utilities **P2.** Customize the graphical user interface **P3.** Use techniques unique to the command line interface **P4.** Set up and configure external hardware components and check functionality **P5.** Install drivers as appropriate and check functionality

Knowledge and understanding

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

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to select, configure and use computer operating systems and basic computer hardware. The evidence should integrate employability

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

Performance requirements

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

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

0714E&A24. Operate Word-Processing Applications

Overview :

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

Unit of Competency	Performance Criteria
CU1. 1. Create documents	**P1.** Open word-processing application, create document and add data according to information requirements **P2.** Use document templates as required **P3.** Use simple formatting tools when creating the document **P4.** Save document to directory
CU2. Customize basic settings to meet page layout conventions	**P1.** Adjust page layout to meet information requirements **P2.** Open and view different toolbars **P3.** Change font format to suit document purpose **P4.** Change alignment and line spacing according to document information requirements **P5.** Modify margins to suit the document purpose

	P6. Open and switch between several documents
CU3. Format documents	**P1.** Use formatting features and styles as required **P2.** Highlight and copy text from another area in the document or from another active document **P3.** insert headers and footers to incorporate necessary data **P4.** have document in another file format **P5.** have and close document to a storage device
CU4. Create tables	**P1.** Insert standard table into document **P2.** Change cells to meet information requirements **P3.** Insert and delete columns and rows as necessary **P4.** Use formatting tools according to style requirements
CU5. Add images	**P1.** Insert appropriate images into document and customize as necessary **P2.** Position and resize images to meet document formatting needs
CU6. Print documents	**P1.** Preview document in print preview mode **P2.** Select basic print settings **P3.** Print document or part of document from printer

Knowledge and understanding

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

Critical Evidence(s) Required

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

Performance requirements

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

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

0714E&A25. Operate Spreadsheet Applications

Overview :

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

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

	presentation purposes **P3.** Import objects and modify for presentation purposes **P4.** Modify slide layout, including text and colors, to meet presentation requirements **P5.** Use formatting tools as required within the presentation **P6.** Duplicate slides within and across a presentation **P7.** Reorder sequence of slides and delete slides for presentation purposes **P8.** Save presentation in another format **P9.** Save to storage device and close presentation
CU4. Add slide show effects	**P1.** Incorporate pre-set animation and multimedia effects into presentation as required to enhance the presentation **P2.** Add slide transition effects to presentation to ensure smooth progression through the presentation **P3.** Test presentation for overall effect **P4.** Use onscreen navigation tools to start and stop slide show or move between different slides as required
CU5. Print presentation and notes	**P1.** Select appropriate print format for presentation **P2.** Select preferred slide orientation **P3.** Add notes and slide numbers **P4.** Preview slides and run spell check before presentation **P5.** Print selected slides and submit presentation to appropriate person for

	feedback

Knowledge and understanding

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

Critical Evidence(s) Required

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

Performance requirements

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

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

0714E&A26. Operate Presentation Packages

Overview :

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

Unit of Competency	Performance Criteria
CU1. Create spreadsheets	**P1.** Open the spreadsheet application, create spreadsheet files and enter numbers, text and symbols into cells according to information requirements **P2.** Enter simple formulas and functions using cell referencing when required **P3.** Correct formulas when error messages occur **P4.** Use a range of common tools during spreadsheet development **P5.** Edit columns and rows within the spreadsheet **P6.** Use the auto-fill function to increment data where required **P7.** Save the spreadsheet to a folder on a storage device
CU2. Customize basic settings	**P1.** Adjust page layout to meet user requirements or special needs **P2.** Open and view different toolbars **P3.** Change font settings so they are appropriate for the document purpose

	P4. Change alignment options and line spacing according to spreadsheet formatting features **P5.** Format cell to display different styles as required **P6.** Modify margin sizes to suit the purpose of the spreadsheets **P7.** View multiple spreadsheets concurrently
CU3. Format spreadsheet	**P1.** Use formatting features as required **P2.** Copy selected formatting features from another cell in the spreadsheet or from another active spreadsheet **P3.** Use formatting tools as required within the spreadsheet **P4.** Align information in a selected cell as required **P5.** Insert headers and footers using formatting features **P6.** Save spreadsheet as another file type **P7.** Save to storage device and close spreadsheet
CU4. Incorporate object and chart in spreadsheet	**P1.** Import an object into an active spreadsheet **P2.** Manipulate imported object by using formatting features **P3.** Create a chart using selected data in the spreadsheet **P4.** Display selected data in a different chart **P5.** Modify chart using formatting features
CU5. Print spreadsheet	**P1.** Preview spreadsheet in print preview mode **P2.** Select basic printer options **P3.** Print spreadsheet or selected part of

		spreadsheet
	P4.	Submit the spreadsheet to appropriate person for approval or feedback

Knowledge and understanding

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

Critical Evidence(s) Required

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

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&A27. Perform Writing and Editing Tasks

Overview :

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

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

	quotations, and tables **P2.** Apply appropriate spelling and punctuation conventions in writing and editing tasks.
CU4. Perform editing and proofreading tasks to meet requirements	**P1.** Edit written material to ensure clear meaning through language and paragraphs, consistent voice, tone and tense **P2.** Copyedit written material by checking grammar, spelling and punctuation using standard editing conventions **P3.** Proofreading using style guides and by monitoring written material for errors

Knowledge and understanding

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

Critical Evidence(s) Required

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

Performance requirements

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

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

Follow relevant health and safety practices for writing tasks

0714E&A28. Perform Computer Operations

Overview :

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

Unit of Competency	Performance Criteria
CU1 Plan and prepare for task to be undertaken	**P1** Requirements of task are determined as per standard **P2** operating procedures **P3** Appropriate hardware and software is selected according to task assigned and required outcome **P4** Task is planned to ensure
CU2 Input data into computer	**P1** Data are entered into the computer using appropriate program/application in accordance with company procedures **P2** Accuracy of information is checked and information is saved in accordance with standard operating procedures **P3** Inputted data are stored in storage media according to requirements **P4** Work is performed within ergonomic guidelines
CU3 Access information using computer	**P1** Correct program/application is selected based on job requirements **P2** Program/application containing the information required is accessed according to company procedures

	P3 Desktop icons are correctly selected, opened and **P4** closed for navigation purposes **P5** Keyboard techniques are carried out in line with OH &S requirements for safe use of keyboards
CU4 Produce/output data using computer system	**P1** Entered data are processed using appropriate software commands **P2** Data are printed out as required using computer hardware/peripheral devices in accordance with standard operating procedures **P3** Files and data are transferred between compatible **P4** systems using computer software, hardware/ peripheral **P5** devices in accordance with standard operating **P6** procedures
CU5 Maintain computer equipment and systems	**P1** Systems for cleaning, minor maintenance and replacement of consumables are implemented **P2** Procedures for ensuring security of data, including regular back-ups and virus checks are implemented in accordance with standard operating procedures **P3** Basic file maintenance procedures are implemented in line with the standard operating procedures

Knowledge and understanding

- Basic ergonomics of keyboard and computer use

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

Critical Evidence(s) Required

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

Performance requirements

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

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

0714E&A29. Use Computer Applications

Overview :

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

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

	formatting to finalize documents **P6** Ensure the naming and storing of documents in appropriate directories or folders and the printing of documents to the required specifications
CU4 Use appropriate spreadsheet software	**P1** Select spreadsheet software appropriate to perform activity **P2** Identify document purpose, audience and presentation requirements, and clarify with personnel as required **P3** Enter simple formulas and functions using cell referencing where required **P4** Customize spreadsheet settings and format documents to meet requirements **P5** Ensure the naming and storing of documents in appropriate directories or folders and the printing of documents to the required specifications
CU5 Use appropriate presentation software	**P1** Select software application package appropriate to perform activity **P2** Identify purpose, audience and presentation requirements, and clarify with personnel as required **P3** Use technical functions, other data and formatting to finalize documents **P4** Ensure documents are named and stored in appropriate directories or folders and printed to required specifications **P5** Make a presentation

Knowledge and understanding

- Application software packages used by the organization

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

Critical Evidence(s) Required

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

Performance requirements

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

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

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

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

0714E&A30. 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
CU1 Determine documentation standards and requirements	**P1** Determine documentation requirements **P2** Investigate documentation and industry standards for requirements and determine appropriate application to user documentation **P3** Design documentation templates using appropriate software and obtain approval from appropriate person
CU2 Produce user documentation	**P1** Conduct a review of the subject system, program, network or application in order to understand its functionality **P2** Gather existing technical, design or user specifications and supporting documentation **P3** Create user documentation based on template to record the operation of the subject system, program, network or application
CU3 Review and obtain sign-off	**P1** Submit user documentation to target audience for review **P2** Gather and analyze feedback **P3** Make changes to user documentation **P4** Submit user documentation to

	appropriate person for approval

Knowledge and understanding

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

Critical Evidence(s) Required

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

Performance requirements

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

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

0714E&A31. Create Technical Documentation

Overview :

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

Unit of Competency	Performance Criteria
CU1 Identify and analyze documentation requirements and client needs	**P1** Consult with client to identify documentation requirements **P2** Interpret and evaluate documentation requirements and confirm details with client **P3** Investigate industry and documentation standards for requirements **P4** Define and document the scope of work to be produced **P5** Consult with client to validate and confirm the scope of work
CU2 Design documentation	**P1** Identify information requirements with reference to layout and document structure **P2** Create document templates and style guides consistent with information requirements **P3** Conduct a review of the system in order to understand its functionality **P4** Extract content that meets information requirements according to copyright restrictions

	P5 Develop the structure of the technical documentation giving focus to the flow of information, style, tone and content format **P6** Validate the technical documentation structure with the client
CU3 Develop documentation	**P1** Write technical documentation based on the template and scope of work using the information gathered **P2** Translate technical terminology into plain English where appropriate **P3** Apply content format and style according to documentation standards and templates
CU4 Evaluate and edit documentation	**P1** Submit technical documentation to appropriate person for review Gather and analyze feedback **P2** Incorporate alterations into the technical documentation **P3** Edit the technical documentation for technical and grammatical accuracy
CU5 Prepare documentation for publication	**P1** Check that the completed technical documentation meets client requirements and scope of work **P2** Submit the technical documentation to appropriate person for approval **P3** Prepare the technical documentation for publication and distribution using appropriate channels

Knowledge and understanding

- Content features, such as clarity and readability
- Document design, web design and usability

- Functions and features of templates and style guides
- Instructional design principles
- Organizational policies, procedures and standards that cover document design.

Critical Evidence(s) Required

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

Performance requirements

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

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

0714E&A32. Create Basic Databases

Overview :

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

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

	database server **P2** Ensure that the information represented matches the requirements

Knowledge and understanding

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

Critical Evidence(s) Required

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

Performance requirements

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

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

0714E&A33. Operate Digital Media Technology

Overview :

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

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

	P2 Test and run any incorporated graphics, video or sound as part of a digital media presentation and present designs in the appropriate format **P3** Review final product against design brief

Knowledge and understanding

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

Critical Evidence(s) Required

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

Performance requirements

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

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

0714E&A34. Use Social Media Tools for Collaboration and Engagement

Overview :

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

Unit of Competency		Performance Criteria
CU1	Describe different types of social media tools and applications	**P1** Explain characteristics of the term social media **P2** Identify different types of social-media tools and applications **P3** Illustrate some of the issues associated with the use of social media tools and applications
CU2	Compare different types of social media tools and applications	**P4** Select one social media type for review **P5** Review most popular tools and applications within that social media type **P6** Itemize benefits across a range of the most popular tools and applications **P7** Select most appropriate social media tool or application
CU3	Set up and use popular social media tools and applications	**P8** Identify social media tools and applications for possible implementation **P9** Initiate preferred social media tools and applications for use **P10** Establish social media interface using text and file content **P11** nitiate social networking interaction

	P12 Test and evaluate tools and applications for ease of use **P13** 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.

0714E&A35. E-Commerce

Overview :

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

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

Knowledge and understanding

- 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**:**

0714E&A36. Use Digital Devices

Overview :

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

Unit of Competency		Performance Criteria
CU1	Prepare to use the digital device	**P1** Review the instruction manual and ensure identified components are available **P2** Identify the physical components of the digital device **P3** Turn on and follow access procedures to activate the digital device **P4** Alter the digital device settings to best suit intended use **P5** 1Configure power management settings where appropriate to minimize power consumption, as an environmentally sustainable measure
CU2	Set up and use the digital device	**P1** Identify and set the basic operating, security and menu settings **P2** Navigate and manipulate the screen environment **P3** Customize screen icons and access to applications where applicable **P4** Use the digital device, and save and edit output where applicable **P5** Identify more advanced features available

		and use as required
CU3	Access and use basic connectivity devices	**P1** Connect to external digital devices, such as computer devices or storage devices, to retrieve, copy, move and save information **P2** Check physical connectivity of computer devices or storage devices to ensure operation and performance **P3** Connect to a printer either through a computer device or directly, and use printer settings and print data **P4** Access audio-visual devices to view and play a multimedia file
CU4	Shut down digital device	**P1** Save current work and back up important data **P2** Close open programs on the digital device and any computer device or storage device **P3** Shut down digital devices, according to manufacturer instructions

Knowledge and understanding

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

Critical Evidence(s) Required

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

Performance requirements

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

- turn on a digital device
- use the menu features and navigate a graphical user interface
- use device features to perform tasks
- Save the results of work.

F. *Metrology*

0714E&A37. Take measurements with graduated tools

Overview: This competency standard covers the skills and knowledge required to take measurements Steel rule, Take measurements Hook rule, Take measurements Folding rule and Take measurements with Trammels.

Competency Unit	Performance Criteria
CU1. Take measurements with Steel rule	**P1.** Place ruler on different work pieces. **P2.** Take dimension and record multiple readings on each work piece. **P3.** Take average of readings. **P4.** Record the results.
CU2. Take measurements with Hook rule	**P1.** Place hook rule on given different work piece. **P2.** Take dimension and record multiple readings on each work piece. **P3.** Take average of readings. **P4.** Record the results.
CU3. Take measurements with Folding rule	**P1.** Take suitable work piece for measurement. **P2.** Measure the dimensions of work pieces. **P3.** Compute surface area, volume, of given work pieces. **P4.** Record the results in data table.
CU4. Take measurements with Trammels	**P1.** Open the trammel according to required dimension. **P2.** Draw circle or arc by fixing one point in the dot and rotate.

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:

- Describe Decimal and fraction of an inch
- Define Measurement techniques
- Describe Calculation of area, volume of geometric shapes.
- Define Arc and circle

Critical Evidence(s) Required

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

- Perform to take dimensions and record multiple readings on each work piece.
- Perform to draw a circle or arc by fixing one point in the dot and rotate.

Tools and Equipment

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

S. No.	Items
1.	Steel rule
2.	Work piece
3.	Surface plate
4.	Steps and collars
5.	Hook rule
6.	Folding rule
7.	Trammel

0714E&A38. Take measurements with combination square set

Overview: This competency standard covers the skills and knowledge required to take measurements with combination square set.

Competency Unit	Performance Criteria
CU1. Take Measurement with Square head	**P1.** Place the combination set on given drawing sheet. **P2.** Draw layout of a component with the help of combination square.
CU2. Perform leveling with square head as spirit level	**P1.** Place the spirit level on horizontal work piece. **P2.** Check the deviation of bubbles **P3.** Level the surface by inserting shims. **P4.** Place square head on vertical work piece. **P5.** Note the deviation and correct the level. **P6.** Check the other geometrical shapes.
CU3. Measure depth with square head as depth gauge	**P1.** Place the square head on work piece. **P2.** Apply force at the head to retain contact with the component. **P3.** Set square head and record the depth.
CU4. Measure height with square head as height gauge	**P1.** Place the square head on work piece. **P2.** Measure height of work piece with and without the help of height gauge attachment.

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 Measurement techniques
- Define dimensioning of drawings and layouts

Critical Evidence(s) Required

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

- Perform to draw a layout of a component with the help of combination square.
- Perform marking center of the round bar (diameter)
- Perform leveling /measure angle of surfaces with protractor Head

Tools and Equipment

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

S. No.	Items
1.	Combination set
2.	Surface plate
3.	Scriber
4.	Tri square
5.	Divider
6.	Round stock

0714E&A39. Measure dimensions through various gauges

Overview: This competency standard covers the skills and knowledge required to take measurements through various gauges

Competency Unit	Performance Criteria
CU1. Take measurement with fixed gauge and plug gauge.	**P1.** Check/Compare the dimension of provided work piece against reference standard with the help of fixed gauge. **P2.** Insert plug gauge into the work piece to determine either dimension is of acceptable size or over size.
CU2. Take measurement with adjustable gauge	**P1.** Insert both “go” and “not go” gauges in the work piece. **P2.** Check the size and record the results.
CU3. Take measurement with small hole gauge	**P1.** Insert the small hole gauge of require size into the work piece **P2.** Record the result.
CU4. Take measurement with telescope gauge	**P1.** Insert the telescope gauge into the work piece **P2.** Adjust the gauge and determine the size of work piece.

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 dimensioning and measurement techniques
- Define dedifferentiate the gauges.

Critical Evidence(s) Required

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

- Perform measurement with radius gauge.
- Perform measurement with angle gauge.
- Perform measurement with ring and plug gauge.

Tools and Equipment

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

S. No.	Items
1.	Fix gauge
2.	Surface plate
3.	Surface gauge
4.	Dial indicator
5.	Radius gauge
6.	Ring Gauge
7.	Plug Gauge
8.	Angle gauge
9.	Adjustable gauge
10.	Telescope

0714E&A40. Perform measurements through Micrometer

Overview: This competency standard covers the skills and knowledge required to take measurements through micrometre

Competency Unit	Performance Criteria
CU1. Take measurement with outside micro-meter	**P1.** Clean the gauge and surface of work piece **P2.** Open slightly larger than the part to be measured **P3.** Set anvil squarely against reference surface of part **P4.** Using ratchet, slowly until it click once **P5.** Record reading and make average.
CU2. Take measurement with inside micrometer	**P1.** Clean the gauge and surface of work piece. **P2.** Open gauge slightly smaller than the part to be measured **P3.** Set anvil squarely against reference surface of part with ratchet, slowly until it click once. **P4.** Record reading and make average.

CU3. Take measurement with depth micrometer	**P1.** Clean the gauge and surface of work piece. **P2.** Access the depth of groove by steel rule **P3.** Insert the suitable insertion rod **P4.** Place the depth micrometre gauge on the deeper groove and take reading.
CU4. Measure threads with micrometer	**P1.** Clean the gauge and the threads of work piece. **P2.** Use the suitable set of thread shape tips according to thread size which is to be measured. **P3.** Record the reading.
CU5. Take measurement with Vernier micrometer	**P1.** Clean the surface. **P2.** Place specimen on the surface plate **P3.** Take reading accurately. **P4.** Calculate mean reading.

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:

- Measurement techniques
- Knowledge of dimensioning of drawings and layouts

Critical Evidence(s) Required

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

- Perform measurement with outside micrometer.
- Perform measurement with inside micrometer
- Perform measurement with depth micrometer.

Tools and Equipment

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

S. No.	Items
1.	Outside Micrometer

2.	Inside Micrometer
3.	Depth Micrometer
4.	Screw thread Micrometer

0714E&A41. Measure dimensions with Vernier tools

Overview: This competency standard covers the skills and knowledge required to take measurements through Vernier calliper

Competency Unit	Performance Criteria
CU1. Take measurement with Vernier caliper	**P1.** Clean the gauge and surface of work piece. **P2.** Place the work piece on surface plate. **P3.** Open the lock screws. **P4.** Slide the jaws up to the width or size of jaws. **P5.** Open slightly larger than the part to be measured. **P6.** Set anvil squarely against reference surface of part

	P7. Maintain the proper pressure on the jaws with screw. **P8.** Lock the movable jaw with knurled screw **P9.** Measure and record the dimensions.
CU2. Take measurement with height gauge	**P1.** Clean the gauge and surface of work piece **P2.** Hold the work piece on angle plate. **P3.** Open the lock screws. **P4.** Set the height gauge on stud to check it with fine adjusting screw. **P5.** Lock the measuring head. **P6.** Record the reading.
CU3. Take measurement with Vernier depth gauge	**P1.** Clean the gauge and surface of work piece **P2.** Hold the work piece on sample plate. **P3.** Open the lock screws. **P4.** insert the gauge inside the work piece with fine adjusting screw. **P5.** Lock the measuring head. **P6.** Record the reading

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:

- Differentiate Vernier callipers, height gauge and Vernier depth gauge
- Define different type of Measurement techniques
- Define Dimensioning

Critical Evidence(s) Required

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

- Define dimensions
- Define how to operate Vernier caliper

Tools and Equipment

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

S. No.	Items
1.	Vernier Caliper
2.	Height Gauge

0714E&A42. Perform Measurements using various instruments

Overview: This competency standard covers the skills and knowledge required to take measurements through different measurement instruments.

Competency Unit	Performance Criteria

CU1. Take measurement with dial calliper	**P1.** Set the pointer on zero properly **P2.** Set the work piece correctly **P3.** Read the dial scale accurately **P4.** Record the results
CU2. Take measurement with dial thickness gauge	**P1.** Remove zero error **P2.** Set the work piece properly **P3.** Measure the size accurately **P4.** Record the results
CU3. Take measurement with dial Indicator	**P1.** Set the Indicator on magnetic stand **P2.** Set the pointer on zero **P3.** Set the pointer on work piece **P4.** Read the dial scale
CU4. Exercise on gauge blocks	**P1.** Adjust the gauge block as per desired size **P2.** Hold the specimen in position **P3.** Measure the angle accurately sine bar and gauge blocks
CU5. Exercise on tool makers microscope	**P1.** Prepare the microscope for examining the job **P2.** Hold the job on anvil **P3.** Observe the size and profile of the job by setting eye piece **P4.** Record the observations
CU6. Practice on Profile Projector	**P1.** Make complete setting of work piece on Profile Projector **P2.** Set the axis **P3.** Observe the size
CU7. Practice Of Digital Instruments	**P1.** Select digital instrument and specimen for measurement. **P2.** Take measurement of specimen with digital instrument
CU8. Measure with coordinate measuring machine	**P1.** Hold the job properly. **P2.** Set and locate zero point. **P3.** Take the dimensions for different coordinates properly. **P4.** Take point to point/linear measurements. **P5.** Take measurements profile in 2D and 3D.

CU9. Calculate tolerance and allowances	**P1.** Measure the job for upper and lower limits. **P2.** Calculate the maximum and minimum size. **P3.** Calculate tolerance and allowance **P4.** Represent tolerance in results.

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:

- Measurement techniques
- Digital measuring instruments
- Measurement techniques
- Knowledge of dimensioning and layouts
- ISO standards of fits and tolerance
- Measurement techniques
- ISO systems of fits and limits
- Knowledge of components e.g. shafts, holes etc

Critical Evidence(s) Required

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

- Define different type of measuring techniques
- Perform to operate dial indicator
- Define how to operate Vernier caliper
- Define how to adjust the gauge block as per desired size

Tools and Equipment

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

S. No.	Items
1.	Vernier caliper
2.	Dial thickness gauge
3.	Dial indicator
4.	Gauge blocks
5.	Tool makers microscope
6.	Coordinate measuring machines
7.	ISO tables of fits and tolerance

8.	Measurement tools

G. *Basic Electrical Engineering*

0714E&A43. Operate Measuring Instruments

Overview: This competency standard covers the skills and knowledge related to Calibration in measurement technology and metrology is the comparison of measurement values delivered by a device under test with those of a calibration standard of known accuracy. The term calibration means just the act of comparison, and does not include any subsequent adjustment.

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

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 current and its unit.
- Describe series circuit.
- Enlist the name of various meters
- Describe purpose of ampere meter
- Describe how ampere meter is connected in the circuit.
- Define voltage and its unit.
- Describe parallel circuit.
- Describe purpose of volt meter
- Describe how voltmeter is connected in the circuit.
- Define resistance and its unit
- Describe purpose of ohm meter

Critical Evidence(s) Required

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

- Perform turn on the supply and note the reading of current/voltage against each resistor.
- Perform to Adjust the scale for measurements.
- Perform probe selection for appropriate measurement.

Tools and Equipment

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

S. No.	Items
1.	Voltmeters
2.	Ammeter
3.	Ohmmeters
4.	Multi meters.
5.	Resistors of different values.

0714E&A44. Verify Ohm's Law & Kirchhoff's Law by Implementing Series/Parallel Circuits

Overview: This competency standard covers the skills and knowledge related 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 Unit	Performance Criteria

Competency Unit	Performance Criteria
CU1. Make series circuit and measure voltage and verify KVL	**P1.** Construct series circuit with different resistors on bread board and give supply voltage. **P2.** Measure the voltage across each resistor. **P3.** Record the reading. **P4.** Sum the voltage drop across each resistor. **P5.** Compare the total voltage with the applied voltage
CU2. Make parallel circuit and measure current and verify KCL	**P1.** Construct parallel circuit with different resistors on bread board. **P2.** Connect ampere meter in series to each resistor to measure the current. **P3.** Record the reading. **P4.** Sum the current of each resistor **P5.** Compare the sum with total consumed current.
CU3. Verify resistance of a resistor using color codes	**P1.** Select the 4 colour band resistor. **P2.** Determine the value of resistor using colour code. **P3.** Connect ohm meter across the resistor. **P4.** Record reading form ohm meter. **P5.** Compare both reading.
CU4. Measure resistance of incandescent lamp.	**P1.** Take 40 W lamp and 1 digital or analogy ohmmeter. **P2.** Adjust zero with shortening the ohmmeter leads. **P3.** Connect the ohmmeter with lamp terminal and note resistance **P4.** Repeat this method for 60 & 100 W lamp

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 Describe characteristics of series circuit
- Describe the use of volt meter
- Describe characteristics of parallel circuit
- Describe the use of ampere meter
- Describe color codes and its use.
- Describe the purpose of ohm meter
- Explain Kirchhoff's voltage law.
- State Kirchhoff's current law

Critical Evidence(s) Required

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

- Adjust zero error with shortening the analog ohmmeter leads.
- Perform series circuit and measure voltage across each resistor and verify KVL
- Perform parallel circuit and measure current of each resistor and verify KCL
- Verify resistance of a resistor using color code and verify using ohmmeter.

Tools and Equipment

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

S. No.	Items
1.	Voltmeters
2.	Ammeter
3.	Ohmmeters
4.	Multi meters.
5.	Resistors of different values.
6.	Battery
7.	Copper wire.
8.	Rheostat
9.	Incandescent lamp

0714E&A45. Measure Electrical Power, Energy, Power Factor & Determine Phase Sequence

Overview: This competency standard covers the skills and knowledge required to Measure single phase and poly-phase electrical para meters using Volt-Ampere meter, watt meter & Measure consumed energy with Energy meter.

Competency Unit	Performance Criteria
CU1. Measure power using Multimeter method	**P1.** Construct Select the load to calculate the power and give supply. **P2.** Measure the voltage and current by using Multimeter. **P3.** Find power using power formula.
CU2. Measure power using watt meter	**P1.** Construct Select a load to calculate the power and connect watt meter across the load. **P2.** Power-ON the supply and measure the power.
CU3. Measure single phase AC Power	**P1.** Select a load to calculate the power and appropriate supply. **P2.** Measure the voltage and current using Multimeter. **P3.** Calculate the power using power.
CU4. Measure three phase AC Power	**P1.** Select a load to calculate the power with appropriate supply. **P2.** Measure the voltage, current using Multimeter for each phase. **P3.** Calculate the power using power formula.
CU5. Measure consumed energy with Energy meter	**P1.** Connect phase line of AC supply to the energy meter. **P2.** Connect AC load to the output terminals of energy meter. **P3.** Power up the supply and take reading of energy in terms of unit after few minutes form display.
CU6. Measure power factor with voltmeter, ampere meter and watt meter	**P1.** Connect voltmeter & ampere meter with inductive load (Motor) **P2.** Connect watt meter and measure. **P3.** Connect AC supply and take the readings of volt, ampere and watt meter. **P4.** Utilize the above readings and calculate power factor using power formula P=VI Cos Ø
CU7. Measure power factor	**P1.** Connect current coil of power factor meter in series to

with power factor meter	the load. **P2.** Voltage coil of power factor meter in parallel to the load. **P3.** Power the supply and measure the value of power factor form the meter.

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 AC/D.C power.
- Explain how to measure power of the circuit with meter.
- Differentiate between electrical and mechanical power.
- Define three phase system
- Define wattmeter
- Define relationship between the individual wattmeter readings and the total three phase power
- Use of wattmeter to measure three phase load.
- Explain advantages of three wattmeter method.
- Explain measurement of power in delta and star connection
- Define power factor
- Effect of improved power factor on load Current

Critical Evidence(s) Required

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

- Adjust Measure single phase power using Volt-Ampere meter method, watt meter & Measure consumed energy with Energy meter.
- Perform electrical connection verification as per observation.

Tools and Equipment

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

S. No.	Items
1.	Voltmeter.
2.	Ammeter
3.	Wattmeter.
4.	Connecting Leads.
5.	Power Supply.
6.	Screw Driver & Plier.

7.	Single Phase Load or 100 watt lamp.
8.	Single phase Energy Meter with connecting leads.
9.	Ammeter & Voltmeter
10.	Capacitor bank
11.	Single phase power factor meter
12.	Connecting leads as per required.
13.	Three phase supply source.
14.	Safety switch
15.	Phase sequence meter
16.	Change over switch
17.	Three phase supply

0714E&A46. Demonstrate Electromagnetism to See Various Effects & Verify Faradays Law

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

Competency Unit	Performance Criteria
CU1. Demonstrate Electromagnetism	**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 demonstrate the observation.
CU2. Implement circuit to determine the effect on current carrying conductor in magnetic field.	**P1.** Take copper rod (5 cm 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. **P4.** De assembles the Simple DC motor and connects the power leads directly to the electrodes of the armature and observes the rotation.
CU3. Determine the effect on conductor by varying the current with the help of rheostat.single phase AC Power	**P1.** Reduce the rheostat resistance **P2.** Record the effect on copper rod. **P3.** Increase the rheostat resistance **P4.** Record the effect on copper rod.
CU4. Plot magnetic lines of	**P1.** Place a bar magnet on paper and outline its boundary

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

Knowledge & Understanding

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:

- Describe magnet and magnetism
- Describe function of iron core
- Explain how to find the movement of current caring conductor which is placed in magnetic field
- Explain Fleming's left-hand rule
- Define magnetic lines of force.

- Define magnetic field.
- Explain How magnetic lines of force travel with respect to each other
- Explain first law of Michal Faraday
- Explain law of Faraday
- Explain how to find the direction of induced EMF
- Describe role of magnetic strength in Faraday's Law
- Describe role of conductor's length or turns in Faraday's Law
- Define Lenz's Law
- Explain Faraday's first law of Electro-Magnetic Induction

Critical Evidence(s) Required

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

- Measure the AC voltage, current, frequency, time period with oscilloscope, RMS value and average value of AC signal with oscilloscope

Tools and Equipment

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

S. No.	Items
1.	Iron nail (as core)
2.	Thin coated copper wire
3.	Rheostat
4.	Current carrying conductor
5.	Horse shoe magnet.
6.	Dry cell battery
7.	Magnet.
8.	Connecting leads.
9.	Transformer
10.	Compass needle
11.	Coil
12.	Bar Magnet
13.	Paper
14.	Lead pencil.
15.	Galvanometer

0714E&A47. Verify Series and Parallel Combination of Capacitors & Determine Break Down Voltage of Capacitor.

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

Competency Unit	Performance Criteria
CU1. Implement a series circuit of capacitors.	**P1.** Assemble a series circuit of capacitors with 3 different values. **P2.** Connect the battery and apply 10 voltages to the combination of capacitors **P3.** Measure the voltage across each capacitor connected in series **P4.** Add the voltage of each capacitor and verify is it equal to applied voltage. **P5.** Use voltage of each capacitor and its value to find the charge on each capacitor.
CU2. Implement a parallel circuit of capacitors.	**P1.** Assemble a parallel circuit of capacitors with 3 different values. **P2.** Connect the battery and apply 10 voltages to the combination of capacitors.

	P3. Use applied voltage and value of capacitor to find the charge on each capacitor. **P4.** Use total voltage and total capacitance to verify the net charge on the capacitor.
CU3. Determine the breakdown voltage of low voltage capacitor	**P1.** Take a capacitor of 6.3 rated volts. **P2.** Connect it across a 0-30 volts D.C variable supply **P3.** Very slowly increased the voltage of variable supply from zero to rated 6.3v, and then higher than rated, and observed carefully the capacitor and to voltmeter reading. **P4.** After slowly increasing at critical position of voltage, the capacitor will be burnt, and smoked. Note that voltages.

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:

- Describe breakdown of capacitors
- Describe breakdown voltage of capacitors
- Describe the factor affecting the life of a capacitor
- Describe what is charging of capacitor

Critical Evidence(s) Required

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

- Determine the breakdown voltage of capacitor

Tools and Equipment

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

S. No.	Items
1.	Capacitors, 4.7 µF
2.	Capacitors, 10, 100 & 8.2 µF.
3.	Voltmeter
4.	D.C. power supply unit
5.	Bridging plugs

6.	Connecting leads
7.	Multimeter. (With option of Capacitance measurement).
8.	Variable D.C powers supply 0-30 Voltas.
9.	Capacitor (Sanyo Operated Volts 6.3 V, SE 30)
10.	D.C Analog or Preferably Digital Voltmeter Range 0-50V.
11.	L.E.D (3 to 9 V) Optional.
12.	Connecting Leads

H. *Basic Electronics (Analog)*

0714E&A48. Identify Basic Electronics Components

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

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

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:

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

Critical Evidence(s) Required

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

- Identify Various Diodes, Identify Resistors in circuit
- Identify Capacitor in circuit
- Identify Inductor in circuit
- Identify IC's Packages
- Identify variety of basic electronic components

Tools and Equipment

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

S. No.	Items
1.	Multimeter
2.	Power supply
3.	Trainer
4.	Resistor
5.	Inductor
6.	ICs
7.	Capacitor
8.	Source of data sheets

0714E&A49. Design a Rectifier using Diode

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

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

	P5. Calculate output voltage

Knowledge & 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 basic of diodes, & their applications in circuits
- Describe the basic electronics
- Describe Multimeter & power Supply
- Explain basics of diodes, AC & DC
- Explain Voltages, transformers & Rectifiers.
- Explain the uses of multimeter
- Describe the data sheets
- Explain the AC & DC voltages
- Explain the uses of oscilloscope and power Supply

Critical Evidence(s) Required

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

- Identify the parameter of Diode and Draw the characteristic curve of Diode
- Design Full Wave Rectifier (two diode rectifier)
- Design Full Wave Rectifier using Diode Bridge

Tools and Equipment

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

S. No.	Items
1.	Multimeter
2.	Power supply
3.	Trainer (Equipment)
4.	Diodes
5.	Digital
6.	Oscilloscope
7.	Datasheets

0714E&A50. Demonstrate Diode Applications

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

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

	P5. Generate the output report

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:

- Describe basic knowledge offender Diode& its applications
- Describe the use oscilloscope & power Supply
- Describe the data sheets
- Describe the basic of LED & its applications
- Describe the use of power Supply
- Explain the Soldering to Components

Critical Evidence(s) Required

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

- Perform basic operations of Seven Segment Display and Verify the required output
- Draw the Seven Segment Display Circuit
- Draw the voltage Regulator circuit

Tools and Equipment

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

S. No.	Items
1.	Oscilloscope
2.	Zener diode
3.	Resistor,
4.	Variable DC power supply, Millimeter
5.	Soldering iron
6.	Connecting wire
7.	Resistor
8.	Variable DC power supply, Millimeter
9.	Voltmeter
10.	Light Emitting diode
11.	Soldering iron
12.	Connecting wire

0714E&A51. Implement Bipolar Junction Transistor (BJT) in Different Applications

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

Competency Unit	Performance Criteria

CU1. Perform the Biasing of Transistors	**P1.** Identify the Transistor& its types. **P2.** Identify the base collector & Emitter of transistors **P3.** Perform the standard Biasing of PNP & NPN Transistor
CU2. Implement Transistor as an amplifier using CB Configuration.	**P1.** Draw the Circuit of CB configuration of transistor **P2.** Select the components for CB configurations. **P3.** Place the components for CB amplifier **P4.** Calculate the gain of transistor in CB modes. **P5.** Draw VI characteristics curve for CB
CU3. Implement Transistor as an amplifier using CC Configuration.	**P1.** Draw the Circuit of CC configuration of transistor **P2.** Select the components for CC configurations. **P3.** Place the components for CC amplifier **P4.** Calculate the gain of transistor in CC modes. **P5.** Draw VI characteristics curve for CC
CU4. Implement Transistor as an amplifier using CE Configuration.	**P1.** Draw the Circuit of CE configuration of transistor **P2.** Select the components for CE configurations. **P3.** Place the components for CE amplifier **P4.** Calculate the gain of transistor in CE modes. **P5.** Draw VI characteristics curve for CE
CU5. Design the circuit of Class A Power Amplifier	**P1.** Identify the Class a Power Amplifier **P2.** Select the component for Class “A” Power Amplifier **P3.** Implement the circuit of PNP OR NPN transistor in Class a Power Amplifier Configuration **P4.** Analyse the different parameter of Class “A” Power Amplifier **P5.** Monitor the Output waveform on oscilloscope **P6.** Draw the characteristic curves of Class “A” Power Amplifier **P7.** Calculate the Voltage gain and Power Gain of Class “A” Power Amplifier **P8.** Generate the Lab report
CU6. Implement BJT as a switch.	**P1.** Draw the Circuit of transistor in switching configuration. **P2.** Select the components for switching circuits **P3.** Place the components **P4.** Operate an LED using transistor as a switch **P5.** Measure the output and generate the report

Knowledge & Understanding

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 basic concepts of transistor & Biasing
- Describe semiconductor theory
- Describe Doping Procedure.
- Explain the datasheet of transistor
- Describe basic concepts & working principles of transistor
- Define semiconductor theory
- Explain basics of Coupling Capacitor.
- Describe the V-I Characteristics
- Explain basic working principles of transistor
- Explain basic of BJTs, & their applications in circuits
- Describe basic electronics
- Define Multimeter, Oscilloscope
- Describe the data sheets
- Describe basic concepts of transistor

Critical Evidence(s) Required

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

- Implement Transistor as an amplifier using **CB** Configuration.
- Implement Transistor as an amplifier using **CC** Configuration
- Implement Transistor as an amplifier using **CE** Configuration
- Design the circuit of Class A Power Amplifier and Implement BJT as a switch.

Tools and Equipment

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

S. No.	Items
1.	Power
2.	Oscilloscope
3.	Supplies
4.	Resistors
5.	Datasheets
6.	Transistors
7.	Trainer (Equipment)
8.	MultiMate
9.	Capacitors

0714E&A52. Implement Field Effect Transistor (FET) in Different Applications

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

Competency Unit	Performance Criteria
CU1. Perform the Biasing of FET	**P1.** Identify the FET & its types. **P2.** P2. Identify the Drain, Gate & Source of FET **P3.** P3. Perform the standard Biasing of MOSFET (N-channel, P-channel) **P4.** Measure the Gate-Source voltage & Threshold Voltage
CU2. Implement Transistor as switch	**P1.** Identify N-Type BJT **P2.** Bias transfer **P3.** Connect switch of base **P4.** Check o/p voltage when switch ON **P5.** Check o/p voltage when switch OFF
CU3. Design a switching Circuit Using MOSFET	**P1.** Identify the MOSFET and there terminal (gate, drain and Sources) whit the Help of Datasheet **P2.** Select the components for Switching Circuit **P3.** Implement Switching Circuit using MOSFET **P4.** Perform the operation of switching **P5.** Monitor the Output **P6.** Generate the Lab report
CU4. Draw the VI characteristics curves for FETs	**P1.** Construct an amplifier circuit using FETs **P2.** Apply Vds & Vgs **P3.** Measure the drain current **P4.** Draw VI characteristic curves
CU5. Design the circuit of Common Drain (CD) Amplifier	**P1.** Identify the FET and there terminal (gate, drain and Sources) whit the Help of Datasheet **P2.** Select the components for Common Drain (CD) amplifier **P3.** Implement the circuit of Common Drain (CD)

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

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:

- Describe basics of FET
- Describe the concept of FET Biasing.
- Describe the power rating of FET
- Describe datasheet of FET
- Explain Switching theory
- Describe the behavior of current and voltage in FET's
- Describe biasing mechanism and basic formulae of FET's
- Describe the vgs, VDs, Idss & Rds as per datasheet.
- Describe the basic of FETs, & their applications in circuits
- Explain basic electronics
- Describe Multimeter & power Supply

- Explain the basic of BJTs, ICs & their applications in circuits
- Describe basic electronics and amplifier
- Describe Multimeter and Oscilloscope

Critical Evidence(s) Required

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

- Perform the Biasing of FET, Implement MOSFET as a switch
- Draw the VI characteristics curves for FETs
- Design the circuit of Common Drain (CD) Amplifier
- Design the circuit of Common Gate (CG) Amplifier
- Design a Low voltage transistor based regulated power supply
- Design the circuit of Class A Power Amplifier and Implement BJT as a switch.

Tools and Equipment

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

S. No.	Items
1.	FET Transistors
2.	Multimeter
3.	Capacitors
4.	Resistors
5.	Power Supplies
6.	Trainer (Equipment)
7.	Simple FET
8.	Digital
9.	MOSFET

0714E&A53. Implement (Uni Junction Transistor, Silicon Control Rectifier, Diac and Triac) in various application

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

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

	P4. Construct the dimmer circuits. **P5.** Control the load using dimmer **P6.** Generate the lab report

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:

- Explain the basics of UJT
- Describe the uses of oscilloscope and power Supply
- Describe the use of hand tools
- Explain basics of SCR
- Describe the data sheets
- Explain the basics of diac & triac

Critical Evidence(s) Required

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

- Implement the UJT in electronic circuits as switch
- Implement the SCR in electronic circuits as switch
- Construct the dimmer circuit using Diac & Triac.
- Install Uni junction Transistor (UJT), Silicon-controlled rectifier (SCR) in power Control Application.

Tools and Equipment

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

S. No.	Items
1.	Oscilloscope
2.	UJT,
3.	Resistor
4.	Variable DC power supply,
5.	Multimeter
6.	Soldering iron, wire

7.	Breadboard or trainer
8.	Supply
9.	Trainer/Breadboard
10.	SCR, Diodes, Resistors, Inductors, Capacitors & connecting wire

I. *Engineering Drawing*

0714E&A54. Perform Basic Manual Drawing

Overview: This competency standard covers the skills and knowledge required to Draw single stroke capital vertical lettering, Draw single stroke capital inclined lettering, Draw horizontal, vertical and inclined lines, Use of compass, circles, half circles, radius, Drawing Centre lines, centres, curves, and crossing of lines, Construction of parallel-lines, perpendicular, bisects line, angles and equal division of lines, Draw round corners, circles elements, quadrilaterals inside and outside circle and Construction of angles and triangles.

Competency Unit	Performance Criteria
CU1. Draw single stroke capital vertical lettering	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Use Proper pencil for lettering with holding techniques. **P4.** Draw Boundaries lines as per standards. **P5.** Make title bar **P6.** Draw upper and lower lines for lettering according to standards. **P7.** Start Writing Vertical Lettering with different style like Gothic, Roman and free hand lettering.
CU2. Draw single stroke capital inclined lettering.	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Draw upper and lower lines for lettering according to standards. **P6.** Start Writing inclined Lettering with different style like Gothic, Roman and free hand lettering.
CU3. Draw horizontal, vertical and inclined lines.	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw lines at 30°, 45°, 60°, 90° and 120° angles.
CU4. Draw circles, half circles, radius with compass	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar

	P5. Divide the sheets in different equal parts. **P6.** Make different dia meter circles and half circles.
CU5. Draw Lines	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw Centre lines, **P7.** Draw parallel-lines, **P8.** Draw perpendicular & bisects line, **P9.** Draw equal division of lines **P10.** Make different angle curves. **P11.** Draw crossing line
CU6. Draw round corners, circles elements, quadrilaterals inside and outside circle.	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Make different dia circles. **P7.** Make inside and outside different types of diagrams that touch the circles at the tangent points.
CU7. Construct angles and triangles	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw Equilateral Triangle, Isosceles triangle, Scalene Triangle, Right Triangle, Obtuse Triangle, Acute Triangle.

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 Importance of Technical Drawing.
- Describe Language of engineering terminology.
- Define application of Technical Drawing
- Describe Type of Drawing
- Describe Drawing Pencil, their grading, sharpening and using techniques.
- Describe Style of letters.

- Define General rules for lettering
- Describe List of drawing equipment's
- Define Basic lines
- Describe Importance of lines
- Describe Common Types of lines and correct line weightage.
- Define Application of lines.
- Describe Introduction to geometry
- Define Introduction to sketching techniques.
- Describe Techniques of sketching straight lines in different directions.
- Define Triangles, Quadrilateral, and Polygons.

Critical Evidence(s) Required

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

- Perform to draw single stroke capital vertical lettering
- Perform to draw single stroke capital inclined lettering
- Perform to draw circles, half circles, radius with compass
- Perform to construct angles and triangles
- Explain Different types of Technical Drawing methods and engineering terminology.
- Explain application of Technical Drawing
- Identify common Types of lines and correct line weightage.
- Identify Triangles, Quadrilateral, and Polygons.

Tools and Equipment

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

S. No.	Items
1.	Tool & Equipment
2.	Graph and drawing sheet.
3.	Drawing Board/Table.
4.	T-Square
5.	Set Square.
6.	Templets.
7.	Geometry Box.
8.	Tee-square and compass.
9.	Geometry Box.

0714E&A55. Construct different Engineering Curves

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

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

CU3. Construct pentagon, Hexagon and Octagon by inscribe method	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw pentagon, Hexagon and Octagon.
CU4. Construct Tangents of circles (Inside & Outside)	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw Tangents Inside of a circle When the centre of the circle is known. **P7.** Draw Tangents Inside of a circle When the centre of the circle is unknown **P8.** Draw Tangents outside of a circle When the centre of the circle is known **P9.** Draw Tangents outside of a circle When the centre of the circle is unknown
CU5. Construct Ellipse	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw an Ellipse by Concentric Circle. **P7.** Draw an Ellipse by Rectangle Method **P8.** Draw an Ellipse by Oblong Method **P9.** Draw an Ellipse by Arcs of Circle Method **P10.** Draw an Ellipse by Rhombus Method. **P11.** Draw an Ellipse by Basic Locus Method
CU6. Construct a parabola curve	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw a parabola curve by Rectangle **P7.** Draw a parabola curve by Method of Tangents(Triangle Method) **P8.** Draw a parabola curve by Basic Locus Method
CU7. Construct a hyperbola	**P1.** Prepare Drawing sheet. **P2.** Select the tools.

curve	**P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw a hyperbola curve.
CU8. Construct a Archimedean Spiral curve	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw spiral curve.
CU9. Construct involute curve	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw involute curve by square **P7.** Draw involute curve by rectangle **P8.** Draw involute curve by hexagon **P9.** Draw involute curve by circle.
CU10. Construct of cycloid, epicycloid, and hypocycloid	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw the generating circle and the base line equal to the circumference of the generating circle **P7.** Divide the circle and the base line in to equal number of parts **P8.** Complete the cycloid, epicycloids, and hypocycloid.

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:

- Describe techniques of sketching straight lines in different directions
- Define Triangles, Quadrilateral and Polygons
- Describe circular arc using different line method
- Describe circular arc
- Define types of Geometric Shape
- Define two-dimensional shapes

- Define three-dimensional shapes
- Define types of Geometric Shape
- Define regular Polyhedrons
- Define methods of drawing Tangents & Normal
- Describe ellipse
- Describe different methods of sketching ellipse
- Describe parabola
- Describe different methods of parabola
- Describe hyperbola curve
- Describe different methods of hyperbola curve.
- Describe spiral curve
- Describe involute curve
- Describe cycloid
- Describe epicycloids
- Describe hypocycloid

Critical Evidence(s) Required

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

- Explain different techniques of sketching.
- Perform to Construct Ellipse.
- Perform to Construct Tangent of circles (Inside & Outside)
- Perform to Construct pentagon, Hexagon and Octagon by inscribe method
- Identify different types of 2D/3D geometric shapes.
- Explain different methods of sketching ellipse, parabola etc.

Tools and Equipment

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

S. No.	Items
1.	Drawing Board/Table
2.	Set Square
3.	Geometry Box
4.	Graph and drawing sheet
5.	Tea-Square
6.	Templets Construct multi-view drawings
7.	French Curve

0714E&A56. Construct multi-view drawings

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

Competency Unit	Performance Criteria
CU1. Sketch Orthographic projection in 1st angle of Projection	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in equal parts. **P6.** Draw plan view **P7.** Draw front view

	P8. Draw side view
CU2. Sketch Orthographic projection 3rd angle of Projection	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in equal parts. **P6.** Draw plan view **P7.** Draw front view **P8.** Draw side view
CU3. Sketch Oblique Drawing	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in equal parts **P6.** Draw the front or side view of the object.
CU4. Construct multi view drawing of Simple Bearing.	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in equal parts. **P6.** Draw plan view of simple bearing **P7.** Draw front view of simple bearing **P8.** Draw side view of simple bearing
CU5. Construct multi view drawing of Open Bearing	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in equal parts. **P6.** Draw plan view of open bearing **P7.** Draw front view of open bearing **P8.** Draw side view of open bearing
CU6. Sketch prism	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in equal parts. **P6.** Sketch prism

CU7. Sketch cone	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in equal parts. **P6.** Start with a horizontal oval **P7.** draw the two sides of a triangle which meets at a common point
CU8. Draw pyramid	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in equal parts. **P6.** Sketch pyramid

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:

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

Critical Evidence(s) Required

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

- Perform read and Construct multi-view drawings.
- Perform read and Construct Orthographic projection 1st angle.
- Perform read and Construct Orthographic projection 3rd angle.

Tools and Equipment

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

S. No.	Items
1.	Graph and drawing sheet.
2.	Drawing Board/Table.

3.	Tea-Square
4.	Set Square.
5.	Templets.
6.	Geometry Box.
7.	French Curve

0714E&A57. Draw basic drawings using CAD software

Overview: This competency standard covers the skills and knowledge required to install CAD software and create new file and create basic drawing.

Competency Unit	Performance Criteria
CU1. Install software and Create New File	**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
CU2. Create Basic Drawings	**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-P 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:

- This competency standard will provide knowledge related to
- Basic Drawing Settings
- Unit setting
- Limits setting
- User coordinate system Workspace setting
- Object Snap Settings
- Basic Commands and Concepts Angles and lines in CAD software.
- Differentiate between absolute, relative and polar system
- DIMSTYLE and MTEXT commands
- HATCHING concepts in CAD
- Differentiate between CHAMFER and FILLET command
- Types of Array
- OFFSET, CIRCLE and ROTATE short commands
- Zooming options
- Tools palettes window

Critical Evidence(s) Required

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

- Perform Install CAD software and Create New File
- Perform Create Basic Drawings.

Tools and Equipment

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

S. No.	Items
1.	Computer with all accessories
2.	AutoCAD software disk
3.	Models

0714E&A58. Develop 2D drawings using CAD software

Overview: This competency standard covers the skills and knowledge required to Develop and prepares 2D objects

Competency Unit	Performance Criteria
CU1. Develop 2D Objects	**P1.** Setup drawing interface for required specifications **P2.** Setup user interface settings for required specifications **P3.** Save CAD drawing files in different file formats (DWG/IGS/etc., PDF, and JPG). **P4.** Create 2D Objects with given measurements **P5.** Edit 2D Objects to meet set standards
CU2. Prepare Final Set of 2D Drawings	**P1.** Use appropriate command and tools to develop 2D Drawing **P2.** Develop 2D Drawing with given project specifications and measurements **P3.** Create title block layout as required **P4.** Plot drawing on scale according to required size and orientation

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:

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

- Describe Modify dimension style and text size according to paper size
- Describe Backup file

Critical Evidence(s) Required

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

- Create 2D drawing
- Develop 2D Drawing with given project specifications and measurements

Tools and Equipment

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

S. No.	Items
1.	Computer with all accessories
2.	AutoCAD software disk
3.	Models

0714E&A59. Develop 3D drawings using CAD software

Overview: This competency standard covers the skills and knowledge required to develop 3D objects, manipulate and Edit 3D objects and render 3D objects.

Competency Unit	Performance Criteria
CU1. Develop 3D Objects	**P1.** Setup & save 3D drawing interface for required specifications. **P2.** Setup 3D user interface settings for required specifications. **P3.** Create 3D objects with given measurements.
CU2. Manipulate 3D objects using 3D Editing Tools	**P1.** Modify 3D objects in line with the requirements. **P2.** Make customized 3D models according to the requirement of given job. **P3.** Convert 3D Face objects into a single mesh objects.
CU2. Render 3D Model	**P1.** Apply material to required 3D Model as per given specification **P2.** Apply lights to get the requisite scene of required 3D model **P3.** Assign cameras to execute different views of required 3D Model. **P4.** Render and print the 3D model according to required size & orientation. **P5.** Apply texture to 3D model as per given specification.

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:

- Describe 3D modeling in CAD
- Describe 3D solids,
- Describe surfaces, meshes, and Wireframe objects.

- Describe Difference between Surface Modeling and Solid Modeling.
- Define 3D face and Edges
- Define Boolean operation concepts
- Describe Subtraction
- Describe Intersection
- Describe Union
- Define 3D Navigate control
- Describe functions of different camera settings.
- Define Importance of scene creation
- Describe preset views such as isometric, top, bottom, front, left, etc.
- Describe perspective projection and parallel projection
- Define Walk
- Describe Constrained Orbit
- Describe Material and light control
- Describe Planner mapping
- Describe Texture map
- Describe Opacity control
- Define Render context
- Describe Render sampling

Critical Evidence(s) Required

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

- Develop 3D Objects
- Manipulate 3D objects using 3D Editing Tools
- Perform Render a 3D Model

Tools and Equipment

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

S. No.	Items
4.	Computer with all accessories
5.	AutoCAD software disk
6.	Models

J. *Robotic Programming*

0714E&A60. Object Oriented Programming-I

Overview: This competency standard covers the skills and knowledge on C, Classes, Object and Inheritance..

Competency Unit	Performance Criteria
CU1. Developing object oriented programs (OOP) by making simple class.	**P1.** Open OOP IDE for coding **P2.** Code a simple program and create simple class **P3.** Create object of that class **P4.** Create variable of object **P5.** Compile a code **P6.** Debug the code (in case of error) **P7.** Run a code
CU2. Develop OOP based program by using inheritance	**P1.** Open OOP IDE for coding **P2.** Create a class **P3.** Create inherited class. **P4.** Create object for inherited class **P5.** Utilize data type of inherited class **P6.** Utilize data type of parent class **P7.** Compile and run the code
CU3. Develop a program using operator overloding	**P1.** Open OOP IDE for coding **P2.** Create class **P3.** Create object of that class **P4.** Create variable of object **P5.** Utilize overloading **P6.** Compile a code **P7.** Debug the code (in case of error) **P8.** Run a code

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 object oriented programming (OOP).
- Define the characteristics of OOP
- Differentiate between object and class

- Define a Class
- Define Object
- Define Constructors and Destructors by using programming examples
- Define operator overloading using different operators.
- Define access specifiers
- Define Inheritance
- Define types of inheritance

Critical Evidence(s) Required

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

- Develop simple program using object oriented basic techniques

Tools and Equipment

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

S. No.	Items
1.	Computer System
2.	C language Packages
3.	Object Oriented based C++ compiler

0714E&A61. Object Oriented Programming - II

Overview: This competency standard covers the skills and knowledge on C, Classes, Object, Polymorphism, Encapsulation and Interfaces.

Competency Unit	Performance Criteria
CU1. Develop a Class in OOPs using polymorphism technique	**P1.** Open OOP Compiler **P2.** Create class **P3.** Create Objects in classes **P4.** Create function in class for polymorphism **P5.** Call polymorphism functions with specific object **P6.** Compile and run the code
CU2. Develop program using Encapsulation technique	**P1.** Open OOP Compiler **P2.** Create class **P3.** Create Objects in classes **P4.** Apply encapsulation on defining class **P5.** Call protected, public and private data with object **P6.** Compile and run the code
CU3. Develop Interface	**P1.** Create the interface unit **P2.** Declare the reference variable of the object class **P3.** Make the methods for child object using encapsulation

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 object oriented programming (OOP).
- Define the characteristics of OOP
- Differentiate between different OOP techniques
- Define Polymorphism
- Define Parent class and child class

- Define and understand Encapsulation
- Define protected, public and private data.
- Define and understand interfaces

Critical Evidence(s) Required

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

- Develop program using object oriented techniques (polymorphism, encapsulation and interfaces)

Tools and Equipment

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

S. No.	Items
4.	Computer System
5.	C language Packages
6.	Object oriented based C++ compiler

K. *Soft Skills*

0714E&A62. Develop workplace policy and procedures for sustainability

Overview: This competency standard covers 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.

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

sustainability policy	**P2.** Implement strategies for continuous improvement in resource efficiency **P3.** Establish and assign responsibility for recording systems to track continuous improvements in sustainability approaches
CU4. Review workplace sustainability policy implementation	**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 & 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 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
- Describe organizational systems and procedures that relate to sustainability
- Describe typical barriers to implementing policies and procedures in an organization and possible strategies to address them.

Critical Evidence(s) Required

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

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

Performance requirements

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

- Scope and develop organizational policies and procedures that comply with legislative requirements and support the organization s sustainability goals covering at a minimum:
    - minimizing resource use
    - resource efficiency
    - reducing toxic material and hazardous chemical use
    - employing life cycle management approaches
    - continuous improvement

- Plan and implement sustainability policy and procedures including:
    - agreed outcomes
    - performance indicators
    - activities to be undertaken
    - assigned responsibilities
    - record keeping, review and improvement processes
- Consult and communicate with relevant stakeholders to generate engagement with sustainability policy development, implementation and continuous improvement
- Review and improve sustainability policies.

0714E&A63. Maintain Professionalism in the Workplace

Overview: This competency standard covers the skills and knowledge required to maintain a professional image in the workplace, including behaving ethically, demonstrating motivation, respecting timeframes and maintaining personal appearance.

Competency Unit	Performance Criteria
CU1. Respect work timeframes	**P1.** Demonstrate punctuality in meeting, set working hours and times. **P2.** Utilize working hours only for working and follow company regulations. **P3.** Complete work tasks within deadlines according to order of priority **P4.** Supervisors are informed of any potential delays in work times or projects.
CU2. Maintain personal	**P1.** Clean hair, body and nails regularly.

appearance and hygiene	**P2.** Wear suitable cloths for the workplace, and respect local and cultural contexts **P3.** Meet specific company dress code requirements
CU3. Maintain adequate distance with colleagues and clients	**P1.** Respect personal space of colleagues and clients with reference to local customs and cultural contexts. **P2.** Keep sufficient distance from others **P3.** Avoid cross transmission of infections (especially through respiration).
CU4. Work in an ethical manner	**P1.** Follow company values/ethics codes of ethics and/or conduct, policies and guidelines. **P2.** Use company resources in accordance with company ethical standards. **P3.** Conduct personal behavior and relationships in accord with ethical standards and company policies. **P4.** Undertake work practices in compliance with company ethical standards, organizational policy and guidelines. **P5.** Instruct co-workers on ethical, lawful and reasonable directives. **P6.** Share Company values/practices with co-workers using appropriate behaviour and language. **P7.** Report work incidents/situations and/or resolved in accordance with company protocol/guidelines.

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 outline the environmental or sustainability legislation, regulations and codes of practice 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
- Describe the company code of conduct/values
- Describe the Company regulations, performance and ethical standards
- Explain work responsibilities/job functions
- Describe communication skills
- Describe workplace hygiene standards

Critical Evidence(s) Required

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

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

Performance requirements

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

- 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&A64. Manage personal work priorities and professional development

Overview: This competency standard covers 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 behaviour of others as managers at this level are role models in their work environment.

Competency Unit	Performance Criteria
CU1. Establish personal work goals	**P1.** Serve as a positive role model in the workplace through personal work planning **P2.** Ensure personal work goals, plans and activities reflect the organization s plans, and own responsibilities and accountabilities **P3.** Measure and maintain personal performance in varying work conditions, work contexts and when contingencies occur
CU2. Set and meet own work priorities	**P1.** Take initiative to prioritize and facilitate competing demands to achieve personal, team and organizational goals and objectives **P2.** Use technology efficiently and effectively to manage work priorities and commitments **P3.** Maintain appropriate work-life balance, and ensure stress is effectively managed and health is attended to
CU3. Develop and maintain professional competence	**P1.** Assess personal knowledge and skills against competency standards to determine development needs, priorities and plans **P2.** Seek feedback from employees, clients and colleagues and use this feedback to identify and develop ways to improve competence **P3.** P3 Identify, evaluate, select and use development opportunities suitable to personal learning style/s to develop competence **P4.** Participate in networks to enhance personal knowledge, skills and work relationships **P5.** Identify and develop new skills to achieve and maintain a competitive edge

Knowledge & 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 principles and techniques involved in the management and organization of:
- Define performance measurement

- Describe personal behavior, self-awareness and personality traits identification
- Describe personal development plan
- Describe personal goal setting
- Describe time management
- Describe management development opportunities and options for self
- Describe methods for achieving a healthy work-life balance
- Define organization policies, plans and procedures
- Explain types of learning style/s and how they relate to the individual
- Describe types of work methods and practices that can improve personal performance.

Critical Evidence(s) Required

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

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

Performance requirements

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

- Demonstrate use business technology to create and use systems and processes to organize and priorities tasks and commitments
- measure and maintain personal work performance including assessing competency against competency standards and seeking feedback
- maintain an appropriate work-life balance to manage personal health and stress
- participate in networks
- develop a personal development plan which includes career objectives and an action plan
- Develop new skills.

0714E&A65. Manage workforce planning

Overview: This competency standard covers 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.

Competency Unit	Performance Criteria
CU1. Research workforce requirements	**P1.** Review current data on staff turnover and demographics **P2.** Assess factors that may affect workforce supply **P3.** Establish the organization's requirements for a skilled and diverse workforce
CU2. Develop workforce objectives and strategies	**P1.** Review organizational strategy and establish aligned objectives for modification or retention of the workforce **P2.** Consider strategies to address unacceptable staff turnover, if required **P3.** Define objectives to retain required skilled labour **P4.** Define objectives for workforce diversity and cross-cultural management **P5.** Define strategies to source skilled labour **P6.** Communicate objectives and rationale to relevant stakeholders **P7.** Obtain agreement and endorsement for objectives and establish targets **P8.** Develop contingency plans to cope with extreme situations
CU3. Implement initiatives to support workforce planning objectives	**P1.** Implement action to support agreed objectives for recruitment, training, redeployment and redundancy **P2.** Develop and implement strategies to assist workforce to deal with organizational change **P3.** Develop and implement strategies to assist in meeting the organization's workforce diversity goals **P4.** Implement succession planning system to ensure desirable workers are developed and retained **P5.** Implement programs to ensure workplace is an employer of choice
CU4. Monitor and evaluate	**P1.** Review workforce plan against patterns in exiting

workforce trends	employee and workforce changes **P2.** Monitor labour supply trends for areas of over- or under-supply in the external environment **P3.** Monitor effects of labour trends on demand for labour **P4.** Survey organizational climate to gauge worker satisfaction **P5.** Refine objectives and strategies in response to internal and external changes and make recommendations in response to global trends and incidents **P6.** Regularly review government policy on labour demand and supply **P7.** Evaluate effectiveness of change processes against agreed objectives.

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:

- Explain current information about external labor supply relevant to the specific industry or skill requirements of the organization
- Describe industrial relations relevant to the specific industry
- Describe labor force analysis and forecasting techniques

Critical Evidence(s) Required

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

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

Performance requirements

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

- Review and interpret information from a range of internal and external sources to identify:
    - current staff turnover and demographics

- labor supply trends factors that may affect workforce supply
- organization's workforce requirements objectives and strategies

- Manage workforce planning including developing, implementing, monitoring and reviewing strategies to meet workforce needs
- Review relevant trends and supply and demand factors that will impact on an organization's workforce
- Develop a workforce plan that includes relevant research and specific strategies to ensure access to a skilled and diverse workforce.

0714E&A66. Undertake project work

Overview: This competency standard covers 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.

Competency Unit	Performance Criteria
CU1. Define project	**P1.** Access project scope and other relevant documentation **P2.** Define project stakeholders **P3.** Seek clarification from delegating authority of issues related to project and project parameters **P4.** Identify limits of own responsibility and reporting requirements **P5.** Clarify relationship of project to other projects and to the organization's objectives **P6.** Determine and access available resources to undertake project
CU2. Develop project plan	**P1.** Develop project plan in line with the project parameters **P2.** Identify and access appropriate project management tools **P3.** Formulate risk management plan for project, including Work Health and Safety (WHS) **P4.** Develop and approve project budget

	P5. Consult team members and take their views into account in planning the project **P6.** Finalize project plan and gain necessary approvals to commence project according to documented plan
CU3. Administer and monitor project	**P1.** Take action to ensure project team members are clear about their responsibilities and the project requirements **P2.** Provide support for project team members, especially with regard to specific needs, to ensure that the quality of the expected outcomes of the project and documented time lines are met **P3.** Establish and maintain required recordkeeping systems throughout the project **P4.** Implement and monitor plans for managing project finances, resources and quality **P5.** Complete and forward project reports as required to stakeholders **P6.** Undertake risk management as required to ensure project outcomes are met **P7.** Achieve project deliverables
CU4. Finalize project	**P1.** Complete financial recordkeeping associated with project and check for accuracy **P2.** P2 Ensure transition of staff involved in project to new roles or reassignment to previous roles **P3.** P3 Complete project documentation and obtain necessary sign-offs for concluding project

Knowledge & 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:

- Describe examples of project management tools and how they contribute to a project
- Describe 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
- Describe the organization's mission, goals, objectives and operations and how the project relates to them

Critical Evidence(s) Required

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

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

Performance requirements

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

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

Review and document the project outcomes.

0714E&A67. Prepare and implement negotiation

Overview: This competency standard covers the skills and knowledge required to prepare for and participate in a process of negotiation.

Competency Unit	Performance Criteria
CU1. Prepare for the negotiation	**P1.** Identify objectives and preferred outcome of the negotiation and determine minimum acceptable outcome **P2.** Understand in relation to what can be offered and what is needed from the other party **P3.** Gather information regarding the other party – objectives, **P4.** needs, preferences, resources, what they want to

	achieve - in **P5.** order to determine best negotiating points **P6.** List and rank the issues to consider concessions that may be made. **P7.** Find examples and refine negotiation argument. **P8.** Check information to ensure it is correct and up-to-date. **P9.** Develop a negotiation plan that includes information about the other party and its interests and a set of responses and strategies to the anticipated tactics. **P10.** Prepare an agenda in advance, which includes discussion topics, participants, location and schedule
CU2. Participate in negotiations	**P1.** Analyse all aspects of the incident for degree of hazard, priorities, optional outcomes and appropriate strategies **P2.** Analyse and determine strategies and priorities on the incident sought from a range of sources **P3.** Assess long term objectives against resources and priorities **P4.** Apply a range of communication techniques to make and maintain contact with the key people **P5.** Provide clear and factual information to enable an honest and realistic assessment of the interests of the key people and their positions **P6.** Resolve the conflict and express their likely consequences clearly and do an analysis of the benefits **P7.** Reassess points of disagreements for common positive positions
CU3. Coordinate support services	**P1.** Assess the need for support services in terms of the determined strategies and priorities **P2.** Negotiate the resources of support services according to established procedures and availability **P3.** Provide information on strategies to support services and maintain the communication **P4.** Delegate roles and responsibilities according to expertise and resources
CU4. Restore order	**P1.** Assess the incidents for degree of risk and take appropriate action to reduce and remove the impact of the incident and restore order **P2.** Take action designed to minimize risk and the preserve the safety and security of all involved **P3.** Take action to prevent the escalation of the incident

	appropriate to the circumstances and agreed procedures. **P4.** Carry out the use of force for the restoration of control and the maintenance of security in the least restrictive manner. **P5.** Complete reports accurately and clearly provided to the appropriate authority promptly **P6.** Review, evaluate and analyse the incident and the organizational response to it and report it promptly and accurately.
CU5. Provide leadership, direction and guidance to the work group	**P1.** Link between the function of the group and the **P2.** goals of the organization **P3.** Participate in decision making routinely to develop, implement and review work of the group and to allocate responsibilities where appropriate **P4.** Give opportunities and encouragement to others to develop new and innovative work practices and strategies **P5.** Identify conflict and resolve with minimum disruption to work group function **P6.** Provide staff with the support and supervision necessary to perform work safely and without risk to health **P7.** Allocate tasks within the competence of staff and support with appropriate authority, autonomy and training **P8.** Supervise appropriately the changing priorities and situations and takes into account the different needs of individuals and the requirements of the task

Knowledge & 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 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
- Define the principles of effective communication
- Describe the guidelines for use of equipment and technology
- Explain code of conduct

Critical Evidence(s) Required

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

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

Performance requirements

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

- 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&A68. Manage Meetings.

Overview :

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

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

	P4 Brief minute-taker on method for recording meeting notes in accordance with organizational requirements and conventions for type of meeting
CU3 Follow up meetings	**P1** Check transcribed meeting notes to ensure they reflect a true and accurate record of the meeting and are formatted in accordance with organizational procedures and meeting conventions **P2** Distribute and store minutes and other follow-up documentation within designated timelines, and according to organizational requirements **P3** Report outcomes of meetings as required, within designated timelines

Knowledge and understanding

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

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

Critical Evidence(s) Required

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

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

Performance requirements

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

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

0714E&A69. Organize schedules

Overview: This competency standard covers 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.

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

Knowledge & 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:

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

Critical Evidence(s) Required

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

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

Performance requirements

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

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

0714E&A70. Identify and communicate trends in career development

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

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

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

Knowledge & 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:

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

  - context
  - participants
  - rules
  - messages
  - channels
  - noise
  - feedback
- Describe communication barriers and resolution strategies, including:
  - environmental
  - physical
  - individual perceptions
  - cultural issues
  - language
  - age issues
  - disability
- Describe observational techniques including:
  - facial expressions
  - non-verbal behavior
  - posture
  - silence
- Describe ways in which different people absorb information, including:
  - visual
  - auditory
  - kinesthetic
  - obstacles to the counseling process
- Define impacts of trauma and stress on the communication process, including on:
  - concentration and attention
  - memory
  - use of verbal and written language
  - use of body language
  - challenging within the counseling session
  - self-evaluation practices, including:
  - how to recognize own biases
  - Impact of own values on the counseling relationship

Critical Evidence(s) Required

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

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

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

Performance requirements

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

- Perform interviewed at least 3 different clients using specialized interpersonal communication and counseling interviewing skills, including:
- Perform 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
- Perform specialized counseling interviewing skills, including:
    - challenging
    - reframing
    - focusing
- Perform integrated clear case note taking into the interview process

0714E&A71. Apply Specialist Interpersonal and Counselling Interview Skills

Overview :

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

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

	techniques based on their impacts and potential to enhance client development and growth P4 Identify and respond appropriately to strong client emotional reactions
CU3. Evaluate own communication	P1 Reflect on and evaluate own communication with clients P2 Recognize the effect of own values and beliefs on communication with clients P3 Identify and respond to the need for development of own skills and knowledge

Knowledge and understanding**:**

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

- Legal and ethical considerations for communication in counseling practice, and how these are applied in individual practice**:**
- codes of conduct/practice
- discrimination
- duty of care
- human rights
- practitioner/client boundaries

- privacy, confidentiality and disclosure
- rights and responsibilities of workers, employers and clients
- work role boundaries responsibilities and limitations of the counselor role
- work health and safety
- principles of person-centered practice
- key objectives of counseling interviewing
- stages of a counseling interview
- potential impacts of using different communication skills and techniques in counseling contexts
- communication techniques and micro-skills including**:**
- attending behaviors active listening, reflection of content feeling, summarizing
- questioning skills open, closed, simple and compound questions
- client observation skills
- noting and reflecting skills
- providing client feedback
- specialized counseling communication techniques, and how they are used, including**:**
- challenging
- reframing
- focusing
- components of the communication process including**:**
- encoder
- decoder
- primary factors that impact on the communication process including**:**
- context
- participants
- rules
- messages
- channels
- noise
- feedback

- communication barriers and resolution strategies, including:
- environmental
- physical
- individual perceptions
- cultural issues
- language
- age issues
- disability
- observational techniques including:
- facial expressions
- non-verbal behavior
- posture
- silence
- ways in which different people absorb information, including:
- visual
- auditory
- kinesthetic
- obstacles to the counseling process
- impacts of trauma and stress on the communication process, including on:
- concentration and attention
- memory
- use of verbal and written language
- use of body language
- challenging within the counseling session
- self-evaluation practices, including:
- how to recognize own biases
- Impact of own values on the counseling relationship

Critical Evidence(s) Required

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

:

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

Performance Requirements

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

- interviewed at least 3 different clients using specialized interpersonal communication and counseling interviewing skills, including:
- micro-skills and communication techniques, including:
    - attending behaviors active listening,
    - reflection of content, summarizing
    - questioning skills open, closed, simple and compound questions
    - client observation skills
    - noting and reflecting skills
    - providing client feedback
- specialized counseling interviewing skills, including:
    - challenging
    - reframing
    - focusing
- integrated clear case note taking into the interview process
- Completed a structured process of self-reflection and evaluation of own communication used during the 3 interviews.

L. *Digital Electronics*

0714E&A72. Design Operation Amplifier

Overview: This competency standard covers the skills and knowledge required to Construct a Non-inverting amplifier using operational amplifier, construct an Inverting amplifier using and Construct a differentiator circuit using operational amplifier. Construct Operation Amplifier.

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

	P5. Measure the output, frequency response & gain **P6.** Draw the characteristic curves of differentiator circuit. **P7.** Generate the Output report

Knowledge & 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:

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

Critical Evidence(s) Required

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

- Construct a Non-inverting amplifier using operational amplifier
- Construct an Inverting amplifier
- Construct a differentiator circuit using operational amplifier.

Tools and Equipment

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

S. No.	Items
1.	Functions Generator
2.	Datasheets
3.	Digital Oscilloscope
4.	Capacitors
5.	Inductors
6.	Op-Amp
7.	Power supply
8.	Trainer
9.	Multimeter

10.	Resistors

0714E&A73. Verify Truth Tables of Digital Gates

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

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

CU4. Verify the truth table of NAND gate	**P1.** Identify the symbol of logic gate, IC & logic function. **P2.** Place (NAND gate IC) on bread board. **P3.** Identify the input, output, Vcc and ground pin. **P4.** Connect LED to the output pin of IC and apply different logics ant input pins. **P5.** Record & verify the output result against each given input.
CU5. Verify the truth table of NOR gate	**P1.** Identify the symbol of logic gate, IC & logic function. **P2.** Place (NOR gate IC) on bread board. **P3.** Identify the input, output, Vcc and ground pin. **P4.** Connect LED to the output pin of IC and apply different logics ant input pins. **P5.** Record & verify the output result against each given input.
CU6. Verify the truth table of XOR gate	**P1.** Identify the symbol of logic gate, IC & logic function. **P2.** Place (XOR gate IC) on bread board. **P3.** Identify the input, output, Vcc and ground pin. **P4.** Connect LED to the output pin of IC and apply different logics ant input pins. **P5.** Record & verify the output result against each given input.
CU7. Verify the truth table of XNOR gate	**P1.** Identify the symbol of logic gate, IC & logic function. **P2.** Place (NOR gate IC) on bread board. **P3.** Identify the input, output, Vcc and ground pin. **P4.** Connect LED to the output pin of IC and apply different logics ant input pins. **P5.** Record & verify the output result against each given input.

Knowledge & Understanding

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:

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

Critical Evidence(s) Required

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

- Construct a Non-inverting amplifier using operational amplifier
- Construct an Inverting amplifier
- Construct a differentiator circuit using operational amplifier.

Tools and Equipment

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

S. No.	Items
1.	AND gate (7408 2-input Quad)
2.	OR gate (7432 2-input Quad)
3.	NOT gate (7404 Hex)
4.	NAND gate (7400 2-input Quad)
5.	NOR gate (7402 2-input Quad)
6.	X-OR gate (7486 2-input Quad)
7.	X-NOR gate (74266 2-input Quad)
8.	Bread board
9.	DC supply (5 V)
10.	LED
11.	Connecting leads

0714E&A74. Construct & Verify Combinational logic circuit

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

Competency Unit	Performance Criteria
CU1. Apply Karnaugh mapping & Boolean algebra to simplify logic expressions	**P1.** Identify the SOP & POS **P2.** Apply Boolean algebra & Karnaugh mapping to simplify SOP & POS. **P3.** Construct logic circuits with simplified SOP & POS.
CU2. Construct & verify the	**P1.** Place (AND gate IC) & (XOR gate IC) on bread board.

truth table of Half adder	**P2.** Identify the input, output, Vcc and ground pin. **P3.** Connect LED to the output pin of IC and apply different logics at input pins. **P4.** Record & verify the output result against each given input **P5.** Design, Construct, and test a half-adder circuit using one XOR gate and two NAND gates.
CU3. Construct & verify the truth table of Full adder	**P1.** Place (AND gate IC) & (XOR gate IC) on bread board. **P2.** Identify the input, output, Vcc and ground pin. **P3.** Connect LED to the output pin of IC and apply different logics at input pins. **P4.** Record & verify the output result against each given input **P5.** Design, Construct, and test a full-adder circuit using two ICS, &7486 and &7400.
CU4. Construct & verify the truth table of Half Subtraction	**P1.** Place (AND, NOT&XOR gate IC) on bread board. **P2.** Identify the input, output, Vcc and ground pin. **P3.** Connect LED to the output pin of IC and apply different logics at input pins. **P4.** Record & verify the output result against each given input
CU5. Construct & verify the truth table of Full Subtraction	**P1.** Place (AND, NOT&XOR gate IC) on bread board. **P2.** Identify the input, output, Vcc and ground pin. **P3.** Connect LED to the output pin of IC and apply different logics at input pins. **P4.** Record & verify the output result against each given input.
CU6. Verify Decoder	**P1.** Place (Decoder IC) on bread board. **P2.** Identify the input, output, Vcc and ground pin. **P3.** Connect LED to the output pin of IC and apply different logics at input pins. **P4.** Record & verify the output result against each given input.
CU7. Operate seven segment display with seven segment decoder.	**P1.** Insert (7 segment decoder IC) and 7 segment display on bread board. **P2.** Identify the input, output, Vcc and ground pin. **P3.** Connect segment display with seven segment decoder input output pins. **P4.** Record & verify the output result against each given

	input.
CU8. Verify Encoder	**P1.** Place (Encoder IC) on bread board. **P2.** Identify the input, output, Vcc and ground pin. **P3.** Connect LED to the output pin of IC and apply different logics at input pins. **P4.** Record & verify the output result against each given input.
CU9. Verify multiplexer and DE- multiplexer	**P1.** Implement following function with multiplexer F(ABC)=∑ (0,2,3,4,5,6): **P2.** Implement 4-to-1 mux and one 2-to-1 mux. **P3.** Implement 1-to-4 dmux using 1-to-2 dmux.

Knowledge & Understanding

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:

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

Critical Evidence(s) Required

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

- Apply Karnaugh mapping & Boolean algebra to simplify logic expressions
- Operate seven segment display with seven segment decoder

- Construct & verify the truth table of Full Subtraction, Verify Encoder, and Verify Encoder.

Tools and Equipment

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

S. No.	Items
1.	AND gate (7408 2-input Quad)
2.	OR gate (7432 2-input Quad)
3.	NOT gate (7404 Hex)
4.	NAND gate (7400 2-input Quad)
5.	NOR gate (7402 2-input Quad)
6.	X-OR gate (7486 2-input Quad)
7.	X-NOR gate (74266 2-input Quad)
8.	Bread board
9.	DC supply (5 V)
10.	LED
11.	Connecting leads
12.	Bread board
13.	Resistances (1K ohm)
14.	Connecting leads
15.	DC supply (5 V)
16.	Mux KL-33006 block e
17.	Seven segment display
18.	74LS47 IC
19.	Mux KL-33006 block

0714E&A75. Construct and Verify function of Flip Flops

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

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

Knowledge & Understanding

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 Latch
- Define, How many inputs are given to SR Latch

- Define, which IC is used for NAND and NOR gate
- Define, what is clocked RS flip flop.
- Define, what is difference between Latch and flip flop
- Describe Symbols for Combinational Elements (Symbols for Flip-Flops.)
- Define D flip flop.
- Define clock pulse.
- Define, difference between synchronous & asynchronous input
- Define JK/T flip flop.
- Exercise to draw the symbol of JK flip flop
- Define, which IC is used for JK flip flop

Critical Evidence(s) Required

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

- Construct and verify the truth table of RS latch using NAND gate
- Construct and verify the truth table of clocked RS latch using NAND gate
- verify the truth table of RS latch using NAND gate, clocked RS latch using NAND gate, D flip flop and JK flip flop.

Tools and Equipment

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

S. No.	Items
1.	AND gate (7408 2-input Quad)
2.	OR gate (7432 2-input Quad)
3.	NOT gate (7404 Hex)
4.	NAND gate (7400 2-input Quad)
5.	NOR gate (7402 2-input Quad)
6.	X-OR gate (7486 2-input Quad)
7.	X-NOR gate (74266 2-input Quad)
8.	Digital clock
9.	DC supply (5 V)
10.	LED
11.	Connecting leads

0714E&A76. Use 555 IC as Multivibrator

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

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

Knowledge & Understanding

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:

- Describe basic elements of 555 timer IC.
- Describe Name pins of 555 timer IC.
- Describe function of voltage control input
- Define stable Multivibrator
- Define non stable Multivibrator
- Define beatable Multivibrator

Critical Evidence(s) Required

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

- Construct 555 IC as Actable Multivibrator
- Construct 555 IC as Mono-stable Multivibrator
- Construct 555 IC as Bi-stable Multivibrator
- Construct 555 IC as Actable, nonstable & beatable Multivibrator and observe their outputs.

Tools and Equipment

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

S. No.	Items
1.	DC supply (5 V
2.	Connecting leads
3.	555 Timer IC
4.	Capacitor 0.1µF
5.	Resistors 10 KΩ
6.	dual trace Oscilloscope 0-20MHZ
7.	Capacitor 0.01µF
8.	Bread board

0714E&A77. Construct Shift Registers and Counters Used Flip Flops

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

Competency Unit	Performance Criteria
CU1. Construct a 4 bit shift register by Using Flip Flops	**P1.** Draw circuit diagram 4-bit register. **P2.** Make connection of D-Flip Flop as per diagram to construct 4-bit shift register. **P3.** Apply data at the input of register and give clock pulse **P4.** Recode the output according to the input.
CU2. Construct a4-bit binary counter Using Flip Flops	**P1.** Draw circuit diagram counter. **P2.** Make connection of JK-Flip Flop as per diagram to construct 4-bit binary counter. **P3.** Connect LEDs to the outputs pins. **P4.** Apply the clock pulse and record the output.
CU3. Construct 4-bitsynchronous Counter with D flip-Flops	**P1.** Draw circuit diagram synchronous counter. **P2.** Make connection of JK-Flip Flop as per diagram to construct 4-bit synchronous counter.

	P3. Connect LEDs to the output pins. **P4.** Apply the clock pulse and record the output.
CU4. Repair & Troubleshoot combinational logic circuits	**P1.** Identify principles and operations of types of logic gates **P2.** Locate drawing and diagrams. **P3.** Check the grounding system in electronic equipment. **P4.** Locate external and internal digital IC faults

Knowledge & Understanding

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 symbols for Combinational Elements (Symbols for Registers, Counters, RAM.)
- Describe the function of registers, and counters in digital circuits
- Describe basic computer memories and its types.
- Explain precautions when handling components.
- Describe proper use of ESD equipment.
- Explain how to distinguish hardware from software issues
- Describe 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 candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Identify symbols for Combinational Elements (Symbols for Registers, Counters, RAM.)
- Explain basic computer memories and its types.
- Demonstrate safety precautions when handling components.
- Demonstrate proper use of ESD equipment.

Tools and Equipment

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

S. No.	Items
1.	Software Simulator and IDE's.
2.	DLD trainer
3.	Multimeter

4.	IC's and Components
5.	Logic tester

M. *AC & DC machines (Motor and Generator)*

0714E&A78. Verify Basic Laws of Electrical Machines

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

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

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

Knowledge & Understanding

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 first law of Faraday
- Define second law of Faraday
- Define to find the direction of induced emf
- Define the role of magnetic strength in Faraday's Law
- Define the role of conductor's length or turns in Faraday's Law
- Define the Lenz's Law
- Define the torque
- Define force produce on current carrying conductor.
- Define, what is core
- Define, what is induction
- Define Faraday's first law of Electro-Magnetic Induction
- Define the meaning of coupled coils.
- Define the emf induced in 2nd coil, when voltage is applied to 1st coil.
- Define, what is mutual induction?
- Define, Which machine work on the principle of mutual induction

Critical Evidence(s) Required

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

- Describe magnetic strength in Faraday's Law
- Explain the Lenz's Law
- Explain Faraday's first law of Electro-Magnetic Induction
- Describe mutual induction

Tools and Equipment

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

S. No.	Items
1.	Coil
2.	Galvanometer.
3.	Voltmeter
4.	Transformer
5.	Connecting leads.
6.	Magnet.
7.	Connecting leads.
8.	Transformer
9.	DC source
10.	Rheostat
11.	Coils
12.	Loop
13.	Voltmeter
14.	Rheostat
15.	Connecting leads

0714E&A79. Analyse Electrical Generators

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

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

CU3. Develop Double Layer Wave Winding	**P1.** Count the number of slot in armature core and numbering on it. **P2.** Calculate total number of conductors (Z) **P3.** Calculate average pitch, back pitch and commentator pitch. **P4.** Start winding from slot no 1. **P5.** Add the value of back pitch in conductor. **P6.** Connect conductor 1 from back side to the added value. **P7.** Add the value of front pitch in previous added value. **P8.** Continue this process till completion of all conductors. **P9.** Connect armature segment with armature conductor. **P10.** Insert brushes in proper position.
CU4. Measure the resistance of field winding, armature winding and terminal polarity	**P1.** Open the terminal box. **P2.** Connect the ohm meter with the terminal of both winding. **P3.** Read down ohm meter reading. **P4.** Connect the probe of galvanometer with any terminal and touch other probe to other terminals one by one. **P5.** Rotate the generator slowly by hand. **P6.** Touch the probe of galvanometer with each winding. **P7.** Identify armature with the deflection of galvanometer pointer. **P8.** Mark the polarity of terminals with the deflection of galvanometer.
CU5. Identify DC shunt generator	**P1.** Measure the terminal resistance of generator with ohm meter. **P2.** Identify DC shunt generator from measured value of resistance. **P3.** Disconnect both windings. **P4.** Identify the shunt field winding of shunt generator. **P5.** Identify armature of shunt generator. **P6.** Measure the resistance of both winding separately. **P7.** Record the resistance of armature winding and field winding. **P8.** Compare the resistance of armature winding and field winding to identify the difference between them.
CU6. Identify DC series generator	**P1.** Measure the terminal resistance of generator with ohm meter. **P2.** Identify DC series generator from measured value of resistance. **P3.** Disconnect both windings. **P4.** Identify the series field winding of series generator.

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

Knowledge & 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 term armature slots.
- Define the pole pitch (Y).
- Define the coil span/pitch
- Define the Back pitch (Yb)
- Define the Front pitch (Yf)
- Define the Resultant Pitch (YR)
- Define the commutation pitch (Yc)
- Define the lap winding
- Define, How many parallel paths in lap winding
- Define the meaning by single layer winding
- Define the wave winding
- Define how many parallel paths in wave winding.
- Define the meaning by double layer winding
- Perform the reading on the scale of galvanometer

- Define the difference between field winding and armature winding
- Explain, which winding having low resistance and why
- Explain the technique to identify the terminal polarity
- Explain the number of winding in shunt generator
- Explain the different between field winding and armature winding
- Explain, which winding having low resistance and why.
- Explain, how to disconnect both winding of shunt generator
- Explain, how many winding in series generator
- Explain the different between field
- Explain winding and armature winding.
- Explain which winding having low resistance and why.
- Explain how to disconnect both winding of series generator.
- Explain which conduction you follow at the time of reconnection of both winding.
- Define the Type of DC machines
- Explain the principle of simple loop generator.

Critical Evidence(s) Required

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

- Perform Armature winding of DC machines
- Perform Single Layer Lap Winding
- Perform Double Layer Wave Winding
- Perform measure the resistance of field winding
- Identify DC series generator
- Identify DC compound generator

Tools and Equipment

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

S. No.	Items
1.	Ohm meter
2.	Galvanometer
3.	DC machine
4.	Connecting wires
5.	Galvanometer
6.	Sleeve
7.	Armature
8.	Winding machine
9.	Insolating paper
10.	Carbon brushes

11.	Stator frame
12.	Soldering wire
13.	Soldering iron
14.	Stator frame

0714E&A80. Perform tests on DC Motors

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

Competency Unit	Performance Criteria

CU1. Plot the load characteristics of D.C shunt motor	**P1.** Couple electro dynamo meter to the DC motor with belt **P2.** Connect shunt motor according to the diagram. **P3.** Set the dynamo meter control knob in such position to produce a minimum starting load. **P4.** Turn on the power supply **P5.** Run the motor at rated RPM. **P6.** Apply a load to DC motor by varying the dynamo meter control knob. **P7.** Measure and calculate the current, speed and torque. **P8.** Plot the load characteristics on DC shunt motor..
CU2. Plot the load characteristics of D.C series motor.	**P1.** Select DC series motor and achieve connection as per diagram. **P2.** Turn on DC power supply and increase the load to full value. **P3.** Record the value of speed and current on each load. **P4.** Draw the graph between load current and speed
CU3. Plot the load characteristics of D.C compound motor	**P1.** Couple electro dynamo meter to the DC motor with belt **P2.** Connect compound motor according to the diagram. **P3.** Set the dynamo meter control knob in such position to produce a minimum starting load. **P4.** Turn on the power supply **P5.** Run the motor at rated RPM. **P6.** Apply a load to DC motor by varying the dynamo meter control knob. **P7.** Measure and calculate the current, speed and torque. **P8.** Plot the load characteristics on DC compound motor..
CU4. Control the speed of DC series motor.	**P1.** Make the connection as per circuit diagram. **P2.** Insert external resistances in series to armature and field coil. **P3.** Switch on the supply and increase the voltage gradually to its rated voltage. **P4.** Record speed at different supply voltages. **P5.** Make graph between speed and applied voltage.
CU5. Control the speed of DC shunt motor.	**P1.** Make the connection as per circuit diagram. **P2.** Switch on the supply and increase the voltage gradually to its rated voltage. **P3.** Record speed at different field current. **P4.** Make graph between speed and field current **P5.** Fixed the field current and very armature current

	P6. Record the speed at different armature current. **P7.** Make graph between speed and armature current
CU6. Start DC shunt motor with 3 point starter.	**P1.** Make the connection as per circuit diagram. **P2.** Switch on the supply and move starter handle from off position to position 1. **P3.** Move the starter arm from position 1 to position 2 and continue this process till starter arm reach at its extreme position.
CU7. Identify the effect of back EMF in DC motor.	**P1.** Select DC series motor and make connection as per diagram. **P2.** Turn on DC power supply and increase the load 0 to full value. **P3.** Record the value of speed and current on each load. **P4.** Calculate back EMF by using the recoded values and appropriate formula. **P5.** Make graph between speed and back EMF and interpret the result.
CU8. Calculate Brake Horse Power (BHP) of motor by Brake test.	**P1.** Connect the spring balance with one end of the rope. **P2.** Connect other end of rope with weight (W1). **P3.** Measure the radius of the pulley. **P4.** Hang the weight on the pulley of the motor and fix the spring balance end with earth. **P5.** Run the motor. **P6.** Measured the RPM of the motor. **P7.** Adjust the weight to pass full load current from motor. **P8.** Calculate spring balance weight and hanged weight (W1) **P9.** Calculate shaft torque. **P10.** Calculate BHP of motor by shaft torque.
CU9. Calculate efficiency of the motor by Swinburne Test	**P1.** Perform DC test to find the value armature resistance and field resistance **P2.** Run the motor at rated voltage without load. **P3.** Adjust the value of shunt regulator to attain rated speed. **P4.** Measure Field current and No load current with ampere meter. **P5.** Calculate total copper losses and iron losses. **P6.** Calculate input and output power. **P7.** Calculate efficiency from calculated power.

CU10. Perform Regenerative / Hopkinson/ Back to back Test	**P1.** Identify two shunt machines. **P2.** Couple the shafts of both machines. **P3.** Connect the machines electrically in such a way that one machine work as a motor and other as a generator. **P4.** Connect external power supply to the machines to overcome the machine losses. **P5.** Run the both machine at no load. **P6.** Reduce the field excitation of one machine which work as a motor. **P7.** Increase the field excitation of one machine which work as a generator. **P8.** Adjust the field winding so that voltage of generator becomes equal to the applied voltage which result the machines runs in parallel **P9.** Calculate the efficiency by using reading of voltmeter and ammeter.

Knowledge & 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 number of winding in compound generator
- Explain the different between field winding and armature winding
- Define, which winding having low resistance and why.
- Explain the technique to identify the terminal polarity.
- Explain how to disconnect both winding of series generator.
- Explain why series winding having low turns.
- Explain the effect of field current on motor speed.
- Explain the effect of load on motor speed.
- Explain why we never start DC series motor without load.
- Explain why series winding having low turns and shunt winding having high number of turns.
- Explain the effect of field current on motor speed.
- Explain the effect of load on motor speed.
- Describe the different between shunt, series and compound motor load characteristics?
- Explain speed control of DC motor with applied voltage.
- Describe why we control the speed of DC motor.
- Define the techniques to control the speed of DC shunt motor
- Explain the effect of field current changes on motor speed.
- Describe what is 3-point starter
- Explain what is back EMF
- Explain generator action in motor.

- Explain the effect of motor
- Explain the speed on back EMF
- Perform the RPM measurement of the motor
- Explain what is shaft torque
- Perform the calculation of BHP from shaft torque
- Explain the what is iron loss
- Explain the what is copper loss
- Explain which loss having maximum value and why.
- Explain why we connect external source with motor generator set.
- Explain what is mean by field excitation

Critical Evidence(s) Required

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

- Plot the load characteristics of D.C shunt motor, load characteristics of D.C series motor, load characteristics of D.C compound motor
- Demonstrate the speed control of DC series motor or DC shunt motor
- Perform Regenerative / Hopkinson/ Back to back test.

Tools and Equipment

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

S. No.	Items
1.	DC shunt motor
2.	Tachometer
3.	Voltmeter
4.	Ammeter
5.	Connecting wire
6.	Wattmeter
7.	Spring balance
8.	Rope
9.	DC series motor
10.	Ohm meter
11.	Belt
12.	Electro dynamo meter
13.	DC compound motor

0714E&A81. Operate and test stepper and servo motors

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

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

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:

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

Critical Evidence(s) Required

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

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

Tools and Equipment

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

S. No.	Items
1.	AC series motor
2.	Tachometer
3.	Connecting wires
4.	Reluctance motor
5.	Hysteresis motor
6.	Tachometer
7.	Connecting wires
8.	Stepper motor
9.	Control unit
10.	Tachometer
11.	Connecting wires
12.	Servo motor
13.	Control circuit

N. *Robotic Programming*

0714E&A82. Basic Programming skills-I

Overview: This competency standard covers the knowledge and skills required for basic robotic programming.

Competency Unit	Performance Criteria
CU1. Develop a computer program (simple)	**P1.** Analyze a given problem **P2.** Open the IDE for coding **P3.** Code a simple program **P4.** Compile a code **P5.** Debug the code (in case of error) **P6.** Run a code
CU2. Develop a program based on control structures	**P1.** Identify the keywords and identifiers **P2.** Perform comments, indentation and statements **P3.** Recognize variables and data types in C/C++ **P4.** Check standard Input and Output **P5.** Use Operators **P6.** Use IF statement **P7.** Use IF ELSE statement **P8.** Use SWITCH statement
CU3. Develop program using loop structures	**P1.** Use FOR loop **P2.** Use WHILE loop **P3.** Use DO-WHILE loop **P4.** Use nested loop **P5.** Use Break and Continue.
CU4. Develop a program using Arrays	**P1.** Initialize Arrays **P2.** Use array with loops. **P3.** Use array with conditional statements. **P4.** Access elements of array. **P5.** Use Two dimension array.

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 a given problem
- Describe the basic programming concept
- Define IDE
- Define basics of C language
- Define Data Types, Variables, Constants and Variables.
- Define basic input and output statements.
- Define debugging of a code
- Define IF statement
- Define IF ELSE statement
- Describe the use of SWITCH statement
- Define loop structure
- Define FOR loop
- Define WHILE loop
- Define DO-WHILE loop
- Define nested loop
- Define language translator

Critical Evidence(s) Required

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

- Develop program by using loops or Arrays.

Tools and Equipment

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

S. No.	Items
1.	Computer
2.	IDE

0714E&A83. Basic Programming skills-II

Overview: This competency standard covers the knowledge and skills required for basic robotic programming skill second part having some knowledge required for data handling.

Competency Unit	Performance Criteria
CU1. Develop a computer program using pointer.	**P7.** Analyze a given problem of Pointer **P8.** Open the IDE for coding **P9.** Initialize array **P10.** Initialize pointer **P11.** Use pointer to point address of array. **P12.** Compile and run code **P13.** Debug the code (in case of error)
CU2. Develop a program using string library	**P9.** Analyze a given problem which utilizing String data type **P10.** Include String library **P11.** Create variable and define size for string data. **P12.** Save string in variable **P13.** Print string data **P14.** Compile and run the code **P15.** Debug the code (in case of error)
CU3. Develop program using Structure	**P6.** Analyze given problem in which structure is use. **P7.** Initialize structure and define data types **P8.** Create structure variable **P9.** Take input from user in structure variable **P10.** Perform manipulation of data **P11.** Print variable of structure **P12.** Compile and run the code **P13.** Debug the code (in case of error)

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 a given problem of specific task
- Describe the basic programming concept
- Define compiler of C
- Define Pointer
- Understand pointer and its address handling
- Understanding of pointer utilization with arrays.
- Understanding of String library
- Define string data type
- Understanding of String data handling with operators
- Understanding of Structure
- Understanding of structure and array differences
- Understanding of structure variable
- Understanding of structure operation

Critical Evidence(s) Required

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

- Develop program by using pointers, structure and string data.

Tools and Equipment

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

S. No.	Items
3.	Computer
4.	IDE, C++ cmopiler

O. *Robotic System*

0714E&A84. Identify various parts of Robotics.

Overview: This competency standard covers the skills and knowledge related to fundamental of robots, Identification of sensors and controller used in robot design and the software development environment to program controller and interfacing of robot parts.

Competency Unit	Performance Criteria
CU1. Identify Various types of Sensors	**P1.** Identify temperature sensors. **P2.** Identify sound sensors. **P3.** Identify proximity sensors. **P4.** Identify pressure sensors. **P5.** Identify light sensors. **P6.** Identify position sensors. **P7.** Identify voltage sensors. **P8.** Identify current sensors. **P9.** Identify the vision sensors. **P10.** Identify power rating of each sensor. **P11.** Identify the signal input/output of each sensor using datasheet.
CU2. Identify Various Controllers/Microprocessors	**P1.** Identify the open loop controllers. **P2.** Identify the closed loop controllers. **P3.** Identify the algorithms for both controllers. **P4.** Identify the components of both controllers. **P5.** Draw circuit diagram for controllers. **P6.** Draw the block diagram and flow charts of both controllers. **P7.** Identify the power supply for controllers.
CU3. Identify Designing and Development Software	**P1.** Identify the programming languages. **P2.** Identify the program development architecture for the robot. **P3.** Identify the software tools for the different types of controllers.

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:

- Understand the usage of temperature sensor
- Understand the operating principles of sound sensor.
- Understand the operation of proximity sensor.
- Understand the usage of robotic tool kit.
- Understand the movement position sensor.
- Learn to identify the types of controller
- Lean to identify requirement of power supply.
- Understand the value of programming software.
- Understand the usage of software tools.
- Understand software tools for different types of controller

Critical Evidence(s) Required

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

- Identify the major parts and main body of the Robot.

Tools and Equipment

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

S. No.	Items
1.	Manipulator links and joints
2.	Measuring tool kit
3.	Robotic fastening tool kit.
4.	Trainer
5.	Manipulator links and joints
6.	End Effectors
7.	Mounting accessories
8.	Actuators
9.	Multimeter
10.	Computer System
11.	Software
12.	Sensors

13.	Base for the manipulator
14.	Electrical Wiring

0714E&A85. Assemble various Robotic parts.

Overview: This competency standard covers the skills and knowledge related to fundamental of robots, Identification of sensors and controller used in robot design and the software development environment to program controller and interfacing of robot parts.

Competency Unit	Performance Criteria
CU1. Assemble the different types of Manipulators or Rovers.	**P1.** Identify parts and main body and of the manipulator. **P2.** Identify the links and joints. **P3.** Assemble links, joints and overall assembly of the manipulator. **P4.** Identify the kinematics (movement) of a manipulator.
CU2. Set up Various Types of End Effectors with the Robot.	**P1.** Identify the types of End Effectors. **P2.** Assemble the End Effectors. **P3.** Assembly of the End Effectors with the manipulator. **P4.** Drives for the End Effector. **P5.** Identify the kinematics (movement) of the end effectors.
CU3. Assemble various Actuators/Drives with the Robot.	**P1.** Identify Hydraulic Actuators. **P2.** Identify Electrical Actuators. **P3.** Identify Pneumatic Actuators. **P4.** Identify Mechanical Actuators. **P5.** Identify Locomotive Actuators. **P6.** Identify Manipulation Actuators. **P7.** Identify the power supply for each actuator. **P8.** Assemble actuators with manipulators and end effectors.

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:

- Understand the movement of an end effector.
- Learn the operation of hydraulic actuators.
- Learn the operation of electrical actuators.
- Learn the operation of pneumatic actuators.
- Learn the operation of mechanical actuators.
- Understand the circuit diagram of actuators.
- Learn and understand the concept of degree of freedom.
- Learn and understand the assembly of actuators with manipulators and end effectors.
- Learn the operating principles of the actuators.

Critical Evidence(s) Required

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

- Perform assemble/integrate the parts and the main body of the Robot.

Tools and Equipment

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

S. No.	Items
1.	Manipulator links and joints
2.	Measuring tool kit
3.	Robotic fastening tool kit.
4.	Trainer
5.	Manipulator links and joints
6.	End Effectors
7.	Mounting accessories
8.	Actuators
9.	Multimeter
10.	Computer System
11.	Software
12.	Sensors
13.	Base for the manipulator
14.	Electrical Wiring

0714E&A86. Robotics Control Boards

Controller Boards

Raspberry pi

Overview: This competency standard covers the skills and knowledge required to install, run, interface and application.

Competency Units	Performance Criteria
Perform installation of operating system.	**P1.** Insert memory card in pc. **P2.** Download and mount Raspbian operating system on SD card. **P3.** Insert SD card in raspberry pi and turn it on. **P4.** Connect HDMI to LCD. **P5.** Run installation on Raspberry pi. **P6.** After completing installation restart raspberry pi/
Run Python on Raspberry pi	**P1.** Download and install Python on raspberry pi. **P2.** Open python shell compiler on Raspberry pi. **P3.** Design code on Python shell. **P4.** Compile code and see output.
Control GPIO.	**P1.** Open python shell program on Raspberry pi operating system. **P2.** Design program on python to cntroll GPIO. **P3.** Run compiler and operate actuator.
Interface sensors and actuators	**P1.** Open python shell program on Raspberry pi operating system. **P2.** Connect jumpers with GPIO pins and sensor/actuators. **P3.** Design program on python to control GPIO. **P4.** Run compiler and operate actuator.

Tool and Equipment

SN	Tools
1	Raspberry pi
2	Jumpers
3	SD card
4	LED
5	Actuators
6	Power Adaptor

Critical Evidence(s) Required

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

- Identify components.
- Installation of Raspbian software.
- Run Raspberry pi and control GPIOs
- Interface sensors and actuators with GPIOs of Raspberry pi.

Programmable Logic controller PLC

Overview: This competency standard covers the skills and knowledge required to install, run, simulate and use in real world application.

Competency Units	Performance Criteria
Installation of PLC programming software	**P1.** Download and open setup file for software installation on windows PC. **P2.** Configure installation setup. **P3.** Install all parts of software. **P4.** Complete installation and restart the PC
Design Basic logic program on Ladder logic.	**P1.** Open software GUI. **P2.** Design basic logical ON/OFF operation in Ladder logic programming. **P3.** Run simulator software to verify program. **P4.** Upload that program on PLC hardware.
Apply timers on ladder logic program	**P1.** Open software GUI. **P2.** Design program and insert timers. **P3.** Configure timer block according to requirement. **P4.** Run simulator software to verify this program. **P5.** Upload this program and run on PLC
Apply counters on Ladder logic program.	**P1.** Open software GUI. **P2.** Design program and insert counters. **P3.** Configure counter block according to requirement. **P4.** Run simulator software to verify this program. **P5.** Upload this program and run on PLC

Critical Evidence(s) Required

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

- Identify components.

- Installation of PLC software.
- Design ladder logic program.
- Interface sensors and actuators with PLC.
- **Tool and Equipment**

SN	Tools
1	Programming logic controller
2	Computer
3	Programming software.
4	Simulation software
5	Communication cable.
6	Power Adaptor

Field Programmable logic controller

Overview: This competency standard covers the skills and knowledge required to install, run, simulate and apply on field work.

Competency Units	Performance Criteria
Installation of Xilinx ISE programming software	**P1.** Download and open setup file for software installation on windows PC. **P2.** Configure installation setup. **P3.** Install all parts of software. **P4.** Complete installation and restart the PC
Design Basic logic program Hardware description language.	**P1.** Open software GUI. **P2.** Design basic logical ON/OFF operation in hardware description language. **P3.** Synthesize program to verify it.
Simulate timing diagram of designed program	**P1.** Open software GUI. **P2.** Design logical operation on hardware description language. **P3.** Synthesize program and apply pin mapping **P4.** Simulate timing diagram. **P5.** Apply input and set simulation time.

Implement logic on hardware	**P1.** Open software GUI. **P2.** Design logical operation on hardware description language. **P3.** Synthesize program and apply pin mapping **P4.** Simulate timing diagram. **P5.** Apply input and set simulation time. **P6.** After varication start mapping, routing and placement process. **P7.** Connect FPGA hardware with PC. **P8.** Upload program in FPGA.

Tool and Equipment

SN	Tools
1	FPGA
2	Computer
3	Programming software.
4	Simulation software
5	Communication cable.
6	Power Adaptor

Arduino Development Board

Overview: This competency standard covers the skills and knowledge required to install, run, simulate and apply on field work.

Competency Units	Performance Criteria
1. Introduction to Arduino Development Board.	**P1.** Identify the different models. **P2.** Identify Analog Input and Output Pinouts. **P3.** Identify Digital Input and Output Pinouts. **P4.** Identify the PWM Pins. **P5.** Identify the UART Pins. **P6.** Identify the I2C pins.
2. Introduction to Arduino IDE	**P1.** Performed Arduino IDE Installations. **P2.** Open software and **P3.** Introduce all libraries and functions.
3. Interface Analog Sensor	**P1.** Open Arduino IDE software. **P2.** Connect analog sensor with any Analog Input Pin. **P3.** Make a source code **P4.** Compiling and Debugging **P5.** Run Program.
4. Interface Digital Sensors.	**P1.** Open Arduino IDE software. **P2.** Connect Sensor with any Digital Input Pin. **P3.** Make a source code. **P4.** Compiling and Debugging. **P5.** Run Program.
5. Interface Serial (UART) based communication	**P1.** Open Arduino IDE software. **P2.** Connect module serial out TX pin with Arduino board serial RX pin and connect module serial RX pin with Arduino board TX pin. **P3.** Make a source code and set baud rate. **P4.** Compiling and Debugging.

	P5. Run Program.
6. Interface I2C based communication	**P1.** Open Arduino IDE software. **P2.** Connect two wires of sensor with SCL and SDA pins of Arduino board. **P3.** Make a source code using two wire library. **P4.** Compiling and Debugging. **P5.** Run Program.

Critical Evidence(s) Required

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

- Identify components.
- Installation of Arduino IDE software.
- Run Arduino IDE and design source code.
- Interface sensors and actuators.

Hardware and Tools

SN	Tools
1	Arduino development board
2	Computer
3	Programming software.
4	Simulation software
5	Communication cable.
6	Power Adaptor

0714E&A87. Develop Robot program.

Overview: This competency standard covers the skills and knowledge related to fundamental of
Programming and interfacing of sensor and actuators as they are essential in robot designing.
Programming involved interfacing SONAR, temperature sensors and generation of PWM signal that is used to control the speed of DC motor.

Competency Unit	Performance Criteria
CU1. Develop program tointerface temperature sensor LM35 with Arduino	**P1.** Identify the pin configuration of Arduino and LM 35 temperature sensor **P2.** Make connection of power , ground and analog pin of LM 35 with Arduino **P3.** Connect Arduino with computer(PC) and open Arduino IDE and select port and Devices **P4.** Write and upload the code of LM35 into Arduino **P5.** Observe the value of temperature in serial monitor Screen in PC **P6.** Measure the temperature of ice and calibrate reading by tuning in programming.
CU2. Develop program to operate DC motor with PWM based speed control	**P1.** Identify the components and connection of circuits. **P2.** Connections the potentiometer to analog pins and connects the MOSFET to digital Pin of Arduino. **P3.** Connect the DC motor with separate Power Supply unit with MOSFET as switch. **P4.** Write code to take value of voltage and make switch case statements to generate PWM signal of multiple Duty cycle. **P5.** Upload the code and run DC motor.
CU3. Develop program to operate SONAR and measure distance with Arduino	**P1.** Identify the Pin configuration of Sonar and Arduino. **P2.** Make connection according to circuit diagram. **P3.** Connection Arduino with PC and open Arduino IDE. **P4.** Write and upload the code in Arduino. **P5.** Run the code and measure value at serial monitor. **P6.** Verify measured value of distance with Scale.

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:

- Learn and understand the connections and application of LM35
- Learn and understand the application of PWM technique
- Learn and understand the principle of SONAR sensor.
- Learn and understand the control data structure in different software.
- Learn and understand the packages, libraries and data handling in software.

Critical Evidence(s) Required

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

- Identify and Assemble parts of robot.
- Describe the programing Algorithm and Operation Logic with various sensors.

Tools and Equipment

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

S. No.	Items
1.	Trainer
2.	Computer system
3.	CAD software
4.	Measuring tool kit
5.	Basic Robotic components
6.	Complete design of the Robot
7.	Robotic fastening tool kit
8.	Computer system

0714E&A88. Develop Robotic arm structure

Overview: This competency standard covers the skills and knowledge related to fundamental of robots arm and assembling of robot the various End effector used to perform different kinds of mechanical jobs, and the development of robot structure.

Competency Unit	Performance Criteria
CU1. Design the Robotic Arm	**P1.** Specify the types of robotic arms. **P2.** Select the links and joints type for robotic arm. **P3.** Plan the axes of motion (rotation and straight line movement) of robotic arm. **P4.** Specify the degrees of freedom for end effector. **P5.** Specify the reach envelope for robotic arm. **P6.** Identify the speed and payload for robotic arm. **P7.** Design the model of links, joints and overall assembly of the manipulator.
CU2. Develop the structure of Robotic Arm	**P1.** Assemble manipulators. **P2.** Assemble End Effectors with the manipulators. **P3.** Assemble actuators with manipulators and end effectors. **P4.** Assemble Controller with actuators and power supply.

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:

- Understand the usage of different types of robotic arm.
- Understand the operating principles of a robotic arm.
- Understand the development of computer aided design (CAD) model.
- Understand the kinematic structure ad workspace of robotic arm.
- Understand the movement and design of a manipulator.
- Learn to identify the type of manipulators for the Robotic Arm.
- Lean to identify the drive for the End Effector.
- Understand the development of computer aided design (CAD) model.
- Understand the usage of robotic fastening tool kit.

- Understand the movement of an end effector.
- Understand the movement of manipulator.
- Learn and understand the controller for robotics arm applications in the industries.
- Learn and understand the categories, components, and advantages of various controllers.

Critical Evidence(s) Required

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

- Perform the Integrate a part to form structure of Robot.

Tools and Equipment

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

S. No.	Items
1.	Manipulator links and joints
2.	Measuring tool kit
3.	Robotic fastening tool kit.
4.	Trainer
5.	Manipulator links and joints
6.	Computer system
7.	Mounting accessories
8.	Complete design of the sensor assembly

0714E&A89. Configure and test robotic arm

Overview: This competency standard covers the skills and knowledge related to configuration of Robotic Arm and selection and configuration controller for specific industrial process, it also includes testing of various parts of robot.

Competency Unit	Performance Criteria
CU1. Select parts of Robotic Arm	**P1.** Select Controller. **P2.** Select Manipulator. **P3.** Select Effector. **P4.** Select Actuators. **P5.** Select Software. **P6.** Select power supply. **P7.** Select connecting wires. **P8.** Identify the components (Resistor, Capacitor and Potentiometer). **P9.** Identify electric wiring of actuators, controllers and power supply.
CU2. Program the controller	**P1.** Assemble the system according to circuit diagram **P2.** Open IDE for controller. **P3.** Develop the algorithm flowchart to implement on controller **P4.** Upload the prepared code
CU3. Test the Robotic Arm	**P1.** Identify movement of robotic arm. **P2.** Perform the arm movement detection test **P3.** Check the robotic arm System feasibility and manipulability for end effectors. **P4.** Check of Robotic arm operating conditions. **P5.** Check all the connections of the components. **P6.** Recognize the program algorithm for the robotic arm.

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:

- Understand types of controller.
- Understand types of manipulator.
- Understand types of End effector.
- Understand power supply and required power according to application.
- Learn and understand the problem solving techniques and error identification.
- Learn and understand robot System feasibility.
- Learn and understand program algorithm.

Critical Evidence(s) Required

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

- Perform the configure and test Robotic arm.

Tools and Equipment

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

S. No.	Items
1.	Manipulator links and joints
2.	Measuring tool kit
3.	Robotic fastening tool kit.
4.	Trainer
5.	Power supply and wires
6.	Computer system
7.	Mounting accessories
8.	Complete design of the sensor assembly
9.	Robot operating software

0714E&A90. Develop Object Recognition System

Overview: This competency standard covers the skills and knowledge related to introduce the student to the machine vision system's design and development for object recognition. Explore the extraction of object from video feed using artificial intelligence algorithm to command the actuator according to its application.

Competency Unit	Performance Criteria
CU1. Develop the object recognition system	**P1.** Specify the types of object recognition system. **P2.** Identify camera for real time video feed. **P3.** Identify the actuators for object recognition system. **P4.** Select the components types. **P5.** Plan the maneuverability of end effectors.
CU2. Implement Vision Algorithm	**P1.** Get the Video sequence **P2.** Identify the background subtraction from video by programming algorithm **P3.** Identify the Noise filtration from video by programming algorithm. **P4.** Calculate the field of view of vision system. **P5.** Identify the frame grabber for vision system. **P6.** Detect the object **P7.** Techniques used for 3D vision **P8.** Object location and orientation measurement results store it in memory **P9.** Data transmission to controller **P10.** Identify actuator to perform task according to object detection.
CU3. Configure the object recognition system.	**P1.** Select the Controller. **P2.** Identify the components (Resistor, Capacitor and Potentiometer) **P3.** Draw the circuit diagram **P4.** Electric wiring of actuators and controller. **P5.** Design the algorithm flowchart to implement on controller.

	P6. Recognize the power supply for controllers.
CU4. Program the object recognition system.	**P1.** Program the controller to lift the object from one point and move it to another point. **P2.** Program the controller to read the values from potentiometer. **P3.** Program the controller to map the values to actuator to move manipulator and end effector. **P4.** Program the movements and positions of actuators. **P5.** Program the angle of end effector to determine grabbing of object.
CU5. Test and Evaluate the object recognition system.	**P1.** Identity and check the proper data feed. **P2.** Recognize the data points for image recognition system. **P3.** Verify the pattern for image recognition. **P4.** Check the performance accuracy of trained module. **P5.** Verify the reliability, maintenance and safety measures for object recognition system.

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:

- Understand the usage of different types of object recognition system.
- Understand the operating principles of an object recognition system.
- Understand the workspace of object recognition system.
- Understand the design of an object recognition system.
- Understand and learn the application of sensors.
- Understand and learn the programming libraries and package for collecting data of video.
- Understand and learn the type of modules of camera for different purposes.
- Understand and learn the artificial intelligence algorithm.
- Understand and learn the neural network for the object recognition.
- Understand and learn the principles for classification of object

- Understand and learn the testing and training of neural network model for specific object.
- Understand and learn the predictive model for object
- Understand the application of object recognition that is presence of object, localization of object, counting of object, determining the types of object, dimensions of object and tracking.
- Learn and understand the controller ROV applications in industry.
- Learn and understand the categories, components, and advantages of various controllers.
- Learn and Understand principles of algorithms control and describe how algorithms and flowcharts can be applied to design, problem-solving and troubleshooting techniques.
- Learn and understand the operating principles of the controllers.
- Learn and understand the connections and configuration of controller
- Learn and understand the connections and configuration of controller and sensors
- Learn and understand the programming principle languages.
- Learn and understand the various programming techniques associated with industrial object recognition system.
- Learn and understand the control data structure in different software.
- Learn and understand the control data acquisition principles.
- Learn and understand the control data transmission medium.
- Learn and understand the packages, libraries and data handling in software.
- Learn and understand the algorithm for the specified movement
- Learn and understand to check the proper data feed.
- Understand the data points for image recognition system.
- Learn and understand pattern for image recognition
- Learn and understand the performance accuracy measure of trained module.
- Learn and understand reliability, maintenance and safety measures for object recognition system.

Critical Evidence(s) Required

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

- Design an object recognition system and plan the maneuverability of end effectors.
- Perform Program for the controller to lift the object from one point and move it to another point.
- Explain the reliability, maintenance and safety measures for object recognition system.

Tools and Equipment

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

S. No.	Items
1.	Manipulator links and joints
2.	Basic object recognition system components
3.	Complete design of the object recognition system
4.	Trainer•
5.	Manipulator links and joints
6.	Computer system
7.	Mounting accessories
8.	Complete design of the sensor assembly
9.	Camera
10.	Controller
11.	Software
12.	Sensors
13.	Trainer
14.	Wiring and accessories

0714E&A91. Perform Assembly and Operation of Remotely Operated Robot

Overview: This competency standard covers the skills and knowledge related to introduce the student to the one most use category of robot that remotely operated vehicle's design and development for specific purposes. This module covers operating principles of remotely operated vehicles and describes types of remotely operated vehicles found in industry. Explore the main consideration that's is mobile base, actuator ,sensors, transmission medium for data, and assembling it with links and joints for remotely operated vehicle. Also introduce to the applications of remotely operated vehicle in different sectors.

Competency Unit	Performance Criteria
CU1. Design the Remotely Operated Robot	**P1.** Specify the types of remotely operated mobile robot. **P2.** Identify mobile base of the ROR. **P3.** Identify the actuators for ROR. **P4.** Select the components type for ROR. **P5.** Plan the maneuverability (mobility and severability) of ROR. **P6.** Determine the sensor for positioning. **P7.** Identify the sensors to avoid obstacles. **P8.** Design the model and overall assembly of the ROV.
CU2. Develop the structure of Remotely Operated Vehicle	**P1.** Identify the design of the ROV. **P2.** Assembly of the parts of ROV. **P3.** Assembly of the base with actuator. **P4.** Mount and assemble actuators with base and sensors. **P5.** Identify the fastener and accessories of ROV.
CU3. Installation of Sensors	**P1.** Installation of positioning sensor

	P2. Installation of robot vision (camera). **P3.** Installation of distance sensors. **P4.** Setting the transmitter/receiver **P5.** Setting the monitor. **P6.** Shape and design of the sensors. **P7.** Types and application and sensors.
CU5. Configure the ROR	**P1.** Identify and Select the Controller. **P2.** Identify the components (Resistor, Capacitor, and Motor Controller). **P3.** Data acquisition from sensor and display on monitor. **P4.** Draw the circuit diagram. **P5.** Electric wiring of sensors, camera, receiver, actuators and controller. **P6.** Design the algorithm flowchart to implement on controller. **P7.** Recognize the power supply for controllers.
CU5. Program the ROR	**P1.** Program the controller to change direction of robot according to the receive signal. **P2.** Program the controller to get the live camera display on monitor. **P3.** Get the values from positioning sensor to map the location and send it to monitor. **P4.** Program the distance measuring sensor for collision avoidance and distance measurement from object. **P5.** Program to display the all sensors values on monitor.
CU6. Test and Evaluate the ROR	**P1.** Identification of movement of the ROR. **P2.** Preform the robot movement detection test **P3.** Check the ROR System feasibility and manipulability. **P4.** Check of ROR operating conditions **P5.** Check the condition of each component and overall assembly of the ROR.

	P6. Check all the connections of the components. **P7.** Recognize the program algorithm for the ROV.

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:

- Understand the usage of different types of remotely operated mobile robot
- Understand the operating principles of a ROV.
- Understand the development of computer aided design (CAD) model.
- Understand the kinematic structure ad workspace of ROV.
- Understand the movement and design of a ROV.
- Understand the sensors.
- Learn to identify the type of manipulators for the ROV.
- Learn to identify the type of base/platforms for the ROV.
- Lean to identify drive of end effector for the ROV.
- Understand the development of computer aided design (CAD) model.
- Understand the usage of robotic fastening tool kit.
- Understand the movement of an end effector.
- Learn and understand the operation of each sensor.
- Learn and understand the use of each sensor for industrial operations.
- Learn and understand the circuit diagram of each sensor.
- Understand Multimeter& Power Supply
- Learn and understand the connections and assembly of sensors.
- Learn and understand the operating principles of the sensors.
- Learn and understand the controller for r ROV applications in industry.
- Learn and understand the categories, components, and advantages of various controllers.
- Learn and Understand principles of algorithms control and describe how algorithms and flowcharts can be applied to design, problem-solving and troubleshooting techniques.
- Learn and understand the operating principles of the controllers.

- Learn and understand the connections and configuration of controller
- Learn and understand the programming principle languages.
- Learn and understand the various programming techniques associated with industrial Remotely Operated Vehicle
- Learn and understand the control data structure in different software.
- Learn and understand the control data acquisition principles.
- Learn and understand the control data transmission medium.
- Learn and understand the packages, libraries and data handling in software.
- Learn and understand the algorithm for the specified movement
- Understand the performance measurement criteria.
- Learn and understand to check the proper data feed.
- Understand the Point-To-Point (PTP) control mode and Continuous-Path (CP) control mode.
- Learn and understand motion and tasks
- Learn and understand reliability, maintenance and safety measures for ROV.

Critical Evidence(s) Required

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

- Integrate the structure of Remotely Operated Vehicle
- Determine the principles of algorithms control and describe how algorithms and flowcharts can be applied to design, problem-solving and troubleshooting technique.
- Program the Remotely Operated Vehicle for the distance measuring sensor from collision avoidance and measuring distance from object.

Tools and Equipment

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

S. No.	Items
1.	Manipulator links and joints
2.	Measuring tool kit
3.	Robotic fastening tool kit.
4.	Trainer

5.	Manipulator links and joints
6.	Computer system
7.	Mounting accessories
8.	Complete design of the sensor assembly
9.	Basic ROV components
10.	Complete design of the ROV
11.	Software
12.	Sensors
13.	Trainer
14.	Wiring and accessories

P. *Robotic Maintenance Technician*

0714E&A92. Perform Robot Calibration

Overview:

*Level-1 calibration only models differences between actual and reported joint displacement values, (also known as mastering). Level-2 calibration, also known as kinematic calibration, concerns the entire geometric robot calibration which includes angle offsets and joint lengths. Level-3 calibration, also called a non-kinematic calibration, models errors other than geometric defaults such as stiffness, joint compliance and friction

This competency standard covers the skills and knowledge related to Calibration in measurement technology and metrology is the comparison of measurement values delivered by a device under test with those of a calibration standard of known accuracy. The term calibration means just the act of comparison, and does not include any subsequent adjustment.

Competency Unit	Performance Criteria
CU1. Perform level-I calibration(Mastering)	**P1.** Read manual of level one calibration **P2.** Perform zero error calibration of all parts **P3.** Inspect arm according to manual. **P4.** Calibrate arm according to instruction.
CU2. Perform level-II calibration(Kinematics)	**P1.** Read manual of level two calibration **P2.** Perform linear/angular sensors calibration. **P3.** Inspect arm according to manual. **P4.** Calibrate arm according to instruction of kinematics as given.
CU3. Perform level-III calibration(Non-Kinematics)	**P1.** Follow OHS standards. **P2.** Read manual of level three calibration **P3.** Inspect arm according to manual. **P4.** Calibrate arm according to non-kinematics instruction as given.

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:

- Understand the maintenance terminology
- Understand the calibration standards measuring devices
- Understand the operational principle of adjustment hardware components
- Understand and explain the standard operational procedure of maintenance
- Understand and explain the standard operational procedure of calibration
- Understand the functionality of mechanical parts of robots and tolerances
- Understand the understand the robot controller programming
- Understand the kinematics of Robot arm

Critical Evidence(s) Required

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

- Perform Level-I/Level-II/Level-III calibration on various measuring instruments.

Tools and Equipment

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

S. No.	Items
1.	Optical CMM
2.	Scanner.
3.	Slip gauges.
4.	Measuring tools
5.	Coordinate calibration tools

0714E&A93. Inspect Industrial sensors and actuators

Sensors

Overview: This competency standard covers the skills and knowledge required to identify and interface sensors with controller.

Competency Units	Performance Criteria
1. Identify various types of sensors for measuring physical quantities.	P1. Identify various types of pressure sensors. P2. Identify various types of temperature sensors. P3. Identify various types of optical sensors.
2. Interface pressure sensor with controller board.	P1. Identify pressure sensor. P2. Connect jumper wires with controller board and sensor. P3. Design source code for measuring pressure from sensor.

	P4. Display pressure in quantifies form.
3. Interface temperature sensor with controller board.	P1. Identify temperature sensor. P2. Connect jumper wires with controller board and sensor. P3. Design source code for measuring temperature from sensor. P4. Display temperature in quantifies form.
4. Interface optical sensors with controller boards.	P1. Identify various types of optical sensors according to application. P2. Connect jumper wires with controller board and sensors. P3. Design source code for measuring optical based physical quantity. P4. Display optical based physical quantity in numeric form.

Critical Evidence(s) Required

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

- Identify various types sensors.
- Interface various types of sensors with controller board.

Tools and Hardware

SN	Tools
1	Controller board
2	Computer

3	Programming software.
4	Simulation software
5	Communication cable.
6	Power Adaptor
7	Pressure sensor
8	Temperature sensor
9	Optical sensors

Actuator

Overview: This competency standard covers the skills and knowledge required to identify and interface actuators with controller.

Competency Units	Performance Criteria
1. Identify various types of actuators for running task.	P1. Identify various types of motors a/c to their use. P2. Identify various types of solenoids for actuation.
2. Interface actuator with controller board.	P1. Identify actuator according to application need. P2. Connect jumper wires with controller board and actuator's power input circuitry. P3. Design source code for to perform actuating task. P4. Compile and run program to get output.

Critical Evidence(s) Required

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

- Identify various types of actuators according to need.
- Interface various types of actuators with controller board.

Tools and Hardware

SN	Tools
1	Controller board
2	Computer
3	Programming software.
4	Simulation software

5	Communication cable.
6	Power Adaptor
7	Stepper Motors
8	Servo Motors
9	Solenoid Valve

0714E&A94. Test/Calibrate sensors, Stepper motor& Servo Motor

Overview:

This competency standard covers the basic Tests related to sensors, Stepper motor& Servo Motor

Competency Units	Performance Criteria
CU1. Test/Calibrate sensors using Continuity method	**P1.** Check physical status of the optical sensors. **P2.** Disconnect the wires of sensor from the power source **P3.** Make connection as per standard/operational manual **P4.** Check the Continuity **P5.** Measure the resistance of Sensor as per SOP/operation manual **P6.** Verify the Resistance as per SOP/operational manual **P7.** Repeat these steps between the source and sensor to isolate the problem.
CU2. Test/Calibrate sensors using Voltage method	**P1.** Connect the sensors with power source. **P2.** Disconnect the power wires at the sensor **P3.** Make Connection as per SOP/operational manual **P4.** Turn on the power source **P5.** Measure the DC Voltage **P6.** Verify the voltage as per SOP/operational manual
CU2. Test / Calibrate Stepper motor of Actuator using four coil method	**P1.** Measure the resistance of both phases **P2.** Measuring the resistance across one wire from each of the two phases **P3.** Measure the internal resistance of similar wire **P4.** Verify the resistance as per SOP/operational manual **P5.** Perform connection of stepper motor accordingly and Check clockwise and anti clockwise motion of

	stepper motor **P6.** Verify the stepper motor as per SOP/operational manual
CU3. Test/Calibrate Servo Motor of actuator	**P1.** Disconnect power line phases from the Servo motor drive circuit. **P2.** Measure the resistance of the cable independently for each phase. **P3.** Test/measure the resistance for the cross cable phases **P4.** Verify the cable as per SOP/operational manual **P5.** Test or measure the servo motor winding resistance for T1, T2 and T3 separately and record the readings. **P6.** Verify the winding as per SOP/operational manual **P7.** Analyze and interpret the data **P8.** Report the data.

Knowledge & Understanding

- Define voltage, resistance and its unit.
- Describe series and parallel circuit.
- Describe purpose of Multimeter
- Describe how Ohm and voltage meter is connected in the circuit.
- Define the Ohm law
- Define primary and secondary winding
- Define motor winding ratio

SN	Tools
1	Multimeter
2	Voltmeters
3	Ohmmeters

5	Resistors of different values.
6	DC Stepper Motor
7	Sensors (Pressure, Temperature, optical etc)

Critical Evidence(s) Required

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

- Turn on the supply and note the reading of drop voltage against each resistor
- Define different type of sensors
- Define different type of actuators
- Differentiate the stepper and servo motors

0714E&A95. Ensure Product Quality as per standards

Overview: This competency standard covers the skills and knowledge related to product quality means to incorporate features that have a capacity to meet consumer needs (wants) and gives customer satisfaction by improving products (goods) and making them free from any deficiencies or defects.

CU1. Perform periodic maintenance of robot.	**P1. Remove Make schedule for periodic maintenance.** **P2. Perform scheduled maintenance.** **P3. Make report of every maintenance performed.**
CU2. Identify various tool set for maintenance.	**P1.** Identify tools required for specific maintenance. **P2.** Performed maintenance with suitable tools only. **P3.** Keep tools clean, arranged and ready to use.
CU3. Perform quality control on product.	**P1.** Take random samples of manufactured product. **P2.** Conduct inspection of product. **P3.** Make report of inspection **P4.** Take suitable action to improve product quality further.

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 the term quality control
- Understand quality standards
- Understand inspection procedure
- Understanding of instrument for quality control

Critical Evidence(s) Required

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

- Perform Quality test on product

Tools and Equipment

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

S. No.	Items
1.	Maintenance schedule chart
2.	Quality control standards document
3.	Data managing software
4.	Instrument for QC
5.	Tools cleaning agents

0714E&A96. Inspect the hazardous area for installation

Overview: This competency standard covers the skills and knowledge related to hazardous areas are those places where fire or explosion hazards may exist due to flammable gases, flammable liquid–produced vapours, combustible liquid–produced vapours, combustible dusts, or ignitable fibers / flying present in the air in quantities sufficient to produce explosive or ignitable mixtures. Electrical equipment that must be installed in such classified locations should be specially designed and tested to ensure it does not initiate an explosion, due to arcing contacts or high surface temperature of equipment.

Competency Unit	Performance Criteria
CU1. Identify hazardous areas before robot installation	**P1.** Inspect hazards in specific environment. **P2.** Note down every type of hazards. **P3.** Classify hazards types. **P4.** Make suggestions to avoid hazards.
CU2. Perform suitable actions to overcome hazards.	**P1.** Keep floor clean. **P2.** Stop unauthorized access to system. **P3.** Maintain power source with proper voltage and current. **P4.** Stop extra ordinary vibrations. **P5.** Perform proper fixing of joints.
CU3. Emergency actions for unwanted situations	**P1.** Take Identify the brake release switch when a person is caught by robot **P2.** Identify the robot protective functions **P3.** Identify the message of residual risk that is warning and caution. **P4.** Classify the emergency response planning (ERP) for every possible incident or accident. **P5.** Highlight the safety measures for each activity. **P6.** Implementation of safety measures in place.

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 the term safety and hazards
- Define Mechanical hazards
- Define Electrical Hazards
- Define fire hazards
- Define Chemical Hazards
- Define environmental hazards
- Explain emergency plan for unwanted situations
- Memorize important emergency phone number
- Understand safety policy

Critical Evidence(s) Required

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

- Perform the Diagnose Potential Malfunction in Robot.

Tools and Equipment

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

S. No.	Items
1.	Computer system
2.	Software
3.	Complete design of the Robot
4.	Measuring tool kit
5.	Diagnostic tool kit
6.	Robotic fastening tool kit
7.	Trainer
8.	Plant layout
9.	Workplace design and layout
10.	Log book
11.	Recommended Safety instructions
12.	Personal Protective Equipment (PPEs)

Q. *Machine & Mechanisms*

0714E&A97. Demonstrate Simple Mechanisms

Overview: This competency standard covers the skills and knowledge required to basic mechanisms. It includes primary and secondary joints, simple and complex links, four bar and quick return mechanisms. After completing this unit student should be competent to identify different types of simple mechanisms, Draw and interpret kinematic diagrams of simple mechanisms and perform kinematic inversion of simple mechanisms.

Competency Unit	Performance Criteria
CU1. Identify Commonly Used Links and Joints	**P1.** Recognize pin joints. **P2.** Recognize sliding joints. **P3.** Identify cam joints. **P4.** Identify gear joints. **P5.** Differentiate simple and complex links.
CU2. Identify simple mechanisms	**P1.** Identify four bar mechanisms. **P2.** Identify Crank Rocker Mechanism **P3.** Identify Slider Crank Mechanism. **P4.** Identify Quick Return Mechanism.
CU3. Analyze simple mechanisms	**P1.** Differentiate simple and complex mechanism **P2.** Draw kinematic diagram of simple mechanisms. **P3.** Interpret kinematic diagram of simple mechanisms **P4.** Identify degrees of freedom in mechanisms
CU4. Perform kinematic inversion of mechanisms	**P1.** Perform Kinematic Inversion of four bar mechanisms. **P2.** Perform Kinematic Inversion of Crank Rocker Mechanism **P3.** Perform Kinematic Inversion of Slider Crank Mechanism. **P4.** Perform Kinematic Inversion of Quick Return Mechanism.

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 Kinematics
- Describe Constrained Motion
- Describe Machine Elements
- Define Simple mechanisms and their types
- Define Terminology of Mechanisms
- Define Kinematic Inversion
- Define Techniques of Mechanism Analysis
- Define Kinematic Diagrams

Critical Evidence(s) Required

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

- Recognize primary and secondary joints.
- Identify different types of simple mechanism
- Identify degrees of freedom in motion.
- Interpret kinematic diagrams of simple mechanisms.

Tools and Equipment

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

S. No.	Items
1.	Pin Joints, Sliding Joints, Cams, Gears
2.	Four Bar Mechanism Model
3.	Slider Crank Mechanism Model
4.	Crank Rocker Mechanism Model
5.	Quick Return Mechanism Model

0714E&A98. Perform Kinematic Analysis

Overview: This competency standard covers the skills and knowledge required to kinematic analysis of simple mechanisms. It includes model building and simulation of simple mechanisms in working model software and calculation of liner and angular displacements and velocities.

Competency Unit	Performance Criteria
CU1. Develop computer models of simple mechanisms	**P1.** Build Model of Slider Crank Mechanism **P2.** Simulate model of Slider Crank Mechanism **P3.** Build Model of Gear Mechanism **P4.** Simulate Gear Mechanism
CU2. Perform Displacement Analysis	**P1.** Define a position of a point in a mechanism with a position vector. **P2.** Determine Liner Displacement. **P3.** Determine Angular Displacement
CU3. Perform Velocity Analysis	**P1.** Determine Liner Velocity of a point on a link. **P2.** Determine Angular Velocity of a point on a link. **P3.** Relate Linear and Angular velocities of a point on a link.
CU4. Perform kinematic inversion of mechanisms	**P5.** Perform Kinematic Inversion of four bar mechanisms. **P6.** Perform Kinematic Inversion of Crank Rocker Mechanism **P7.** Perform Kinematic Inversion of Slider Crank Mechanism. **P8.** Perform Kinematic Inversion of Quick Return Mechanism.

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:

- Describe CAD Modelling
- Describe Working Model Software
- Define Model Building in Working Model.
- Define Simulation of Mechanisms in Working Model
- Define Kinematic Analysis.
- Describe Gear Terminology
- Define Techniques of Mechanism Analysis

Critical Evidence(s) Required

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

- Perform Model Simple Mechanism in Working Model Software.
- Perform Simulate Simple Mechanism in Working Model Software.
- Perform Calculation liner and angular displacement of a point on a link.

Tools and Equipment

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

S. No.	Items
1.	Computers
2.	CAD software
3.	Working Model Software

0714E&A99. Demonstrate Mechanical Power Transmission Elements

Overview: This competency standard covers the skills and knowledge covers the various methods of mechanical power transmission methods. Covering the knowledge related to belts, gears and chain drives, this unit will enable students to select appropriate power transmission method.

Competency Unit	Performance Criteria
CU1. Belts Drives	**P1.** Identify Belt Types. **P2.** Identify Pulley Types **P3.** Understand Belt Drive Geometry.
CU2. Gears	**P1.** Identify gear types **P2.** Understand Spur Gear Terminology. **P3.** Understand Spur Gear Geometry.
CU3. Chain Drives	**P1.** Select chain types. **P2.** Understand Chain Derive Geometry

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:

- Describe Mechanical power transmission fundamentals.
- Describe Types of belt drives and pulleys
- Define Belt Drives Geometry
- Describe Types of Gears
- Define Gear Geometry
- Describe Types of chain Drives
- Define Chain Drive Geometry.

Critical Evidence(s) Required

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

- Identify various types of gears, belts and chains.
- Explain the various terms of gear geometry.

Tools and Equipment

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

S. No.	Items
1.	Belts and Pulleys of Various Sizes
2.	Various types of Gears.
3.	Various types of Chain Drives

0714E&A100. Perform Kinematic Analysis of Mechanical power Transmission Elements

Overview: This competency standard covers the skills and knowledge required for kinematic analysis of mechanical power transmission elements. Covering the knowledge related to belts, gears and chain drives, this unit will enable students to perform the kinematic analysis of selected power transmission method

Competency Unit	Performance Criteria
CU1. Belts Drives	**P1.** Select belts size **P2.** Determine diameter of driver and driven pulleys. **P3.** Calculate velocity ratio for belts **P4.** Calculate belt speed.

CU2. Gears	**P1.** Determine rotational velocities of driver and driven gears. **P2.** Calculate Velocity Ratios Gears.
CU3. Chain Drives	**P1.** Determine Velocity Ratio for Chains. **P2.** Calculate Chain Speed

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:

- Describe Mechanical power transmission fundamentals.
- Define Belt Drives Geometry
- Define Belt Drives Kinematics
- Define Gear Geometry
- Define Gear Kinematics
- Define Chain Drive Geometry
- Define Chain Drive Kinematics

Critical Evidence(s) Required

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

- Perform calculate the Velocity Ratios for Gears, Belt and Chain Drives

Tools and Equipment

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

S. No.	Items
1.	Belts and Pulleys of Various Sizes
2.	Various types of Gears.
3.	Various types of Chain Drives
4.	Computers
5.	Working Model Software

R. *Robotic Programing*

0714E&A101. Advanced Programming-I

Overview: This competency standard covers the skills and knowledge required to develop how to write a computer program. It will create the knowledge to write lists of instructions for a computer to follow and to develop the software programs, the scripts, or other sets of instructions for the computers to execute. This unit will cover the knowledge of programming language C which has variety of data types and powerful operators. Due to this, students will be able to write computer programs efficiently and easily.

Competency Unit	Performance Criteria
CU1. Python Setup on Windows	**P1.** Download the Python 3 Installer **P2.** Run the installer **P3.** Download the python IDE **P4.** Identify Interpreter vs Script Mode
CU2. Remote Connection to RPi with VNC	**P5.** Enabling VNC Server **P6.** Enabling VNC Server graphically **P7.** Enabling VNC Server at the command line **P8.** Connecting to your Raspberry Pi with VNC Viewer **P9.** Establishing a direct connection **P10.** Establishing a cloud connection **P11.** Authenticating to VNC Server **P12.** Creating a virtual desktop
CU3. Raspberry Pi Raspbian OS Setup	**P13.** Download and Install raspbian and image writer **P14.** Setup the SD card formatter on windows **P15.** Write the image **P16.** Write the OS on the SD card **P17.** Setting up the pi **P18.** Run the Setup **P19.** Reboot the Raspberry pi **P20.** Update the firmware **P21.** Identify the RPi Models and GPIO **P22.** Python package installation using pip
CU4. Introduction to LINUX commands	**P23.** Opening Linux Terminal **P24.** Perform Basics of Linux Terminal **P25.** Use Commands to display directory

	P26. Create file on the directory **P27.** Use Commands to run the file on LINUX
CU5. Develop a program based on control structures	**P28.** Identify Basic Data Types **P29.** Use Assignment Operators **P30.** Use print() function **P31.** Use Comments in Python **P32.** Use input() functions **P33.** Identify Code Blocks and Indentation **P34.** Identify Reserved words in Python **P35.** Use Assignment Operators and Expressions **P36.** Use Arithmetic Operations **P37.** Identify Precedence and Associativity **P38.** Identify Docstring

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:

- Understand Installation of python
- Understand Raspbian environment
- Define VNC connection
- Understand the LINUX commands
- Define File handling of python
- Define Tuples and its methods
- Define Operators and sets
- Define Dictionary and methods
- Define Strings and its methods
- Define Relational operators
- Define Logical operators.
- Define conditional operator.
- Define Arrays.
- Explain one dimension array declaration.
- Explain the initialization of array.
- Explain the accessing of array elements.
- Define the declaration of two dimension array.

- Define Functions.
- Explain types of functions
- Explain function prototype
- Explain function definition.
- Explain the use of function call.
- Explain the passing parameters to Function.
- Define the pointer

Critical Evidence(s) Required

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

- Develop a computer system based on Raspbian board.
- Install and run python based simple code.

Tools and Equipment

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

S. No.	Items
1.	Computer system
2.	Integrated Development Environment (IDE)
3.	Python
4.	Raspberry pi
5.	Linux operating system (Raspbian)
6.	Memory card
7.	RJ-45 cable
8.	Adaptor

0714E&A102. Advanced Programming-II

Overview: This competency standard covers the skills and knowledge required to develop how to write a computer program. It will create the knowledge to write lists of instructions for a computer to follow and to develop the software programs, the scripts, or other sets of instructions for the computers to execute. This unit will cover the knowledge of programming language C which has variety of data types and powerful operators. Due to this, students will be able to write computer programs efficiently and easily.

Competency Unit	Performance Criteria
CU1. Develop program Using Conditional Structures and Operators	**P39.** Use Boolean Expressions **P40.** Use If Statement **P41.** Use If-Else **P42.** Use Nested-If **P43.** Use If-Elif-Else **P44.** Identify Membership Operators **P45.** Identify Logical Operators **P46.** Use Bitwise Operators **P47.** Identify Simple Recursion **P48.** Use Factorial with Recursion **P49.** Program to display Fibonacci sequence using recursion **P50.** Use Indirect Recursion
CU2. Develop program using loop	**P51.** Use While Loop **P52.** Use While-break **P53.** Use While-Continue **P54.** Use for-list **P55.** Use for-range **P56.** Use for-continue-break **P57.** Program to display prime numbers in an interval **P58.** Calculate factorial **P59.** Compute Fibonacci Series
CU3. Develop a program using Functions	**P60.** Use simple FUNCTIONS. **P61.** Use Function Declaration. **P62.** Use Function Prototype. **P63.** Use Function Arguments **P64.** Use Call Functions. **P65.** Pass parameters to Function.

	P66. Use Function Arbitrary Arguments
CU4. Python file handling	**P67.** Create a Text File **P68.** Append Data to a File **P69.** Read a File **P70.** Read a File line by line **P71.** Identify File Modes in Python **P72.** Handling of CSV file **P73.** Handling of Excel File
CU5. Develop a program using Python Data Structure	**P74.** Declare Strings **P75.** Create Lists in python **P76.** Apply Lists methods **P77.** Constructing Tuples in python **P78.** Apply Tuples methods **P79.** Create Sets **P80.** Use Operators on Sets **P81.** Create Dictionary **P82.** Methods to query information from dictionaries **P83.** Create Strings **P84.** Formatters and Operator on String **P85.** Methods on String

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:

- Understand Installation of python
- Understand Raspbian environment
- Define VNC connection
- Understand the LINUX commands
- Define File handling of python
- Define Tuples and its methods
- Define Operators and sets
- Define Dictionary and methods
- Define Strings and its methods
- Define Relational operators
- Define Logical operators.

- Define conditional operator.
- Define Arrays.
- Explain one dimension array declaration.
- Explain the initialization of array.
- Explain the accessing of array elements.
- Define the declaration of two dimension array.
- Define Functions.
- Explain types of functions
- Explain function prototype
- Explain function definition.
- Explain the use of function call.
- Explain the passing parameters to Function.
- Define the pointer

Critical Evidence(s) Required

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

- Develop a python program using various libraries.

Tools and Equipment

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

S. No.	Items
9.	Computer system
10.	Integrated Development Environment (IDE)
11.	Python
12.	Raspberry pi

S. *Robotic System Evaluation*

0714E&A103. Perform Robot Installation

Overview: This competency standard covers the skills and knowledge related to installation of robotic arm, method of hardware installation at workplace and installation of robot operating software and its configuration. Set them to do. Like in factories all they have to do with making their products is make the robot.

Competency Unit	Performance Criteria
CU1. Perform Hardware installation of robotic arm.	**P1.** Remove protective plastic from robot **P2.** Inspect for damages and missing parts **P3.** Move the robot to designated installation area **P4.** Bolt the robot in place **P5.** Connect cables and peripherals **P6.** Connect end effector.
CU2. Perform Software installation of robotic arm.	**P1.** Install software suite for robotic arm. **P2.** Check connectivity cable **P3.** Configure settings with hardware specification. **P4.** Check interlocking.

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:

Learn and understand how to analyze industrial environment.

- Learn and understand types and working of bolts.
- Learn and understand what are firmware
- Learn and understand types of software use for operation of robotic arm.
- Learn how to read datasheet.
- Learn interlock.
- Learn the mobility of robots.
- Understand how to inspect damages and missing parts.
- Learn troubleshooting of software.
- Understanding about payload.
- Understanding about various types of cables.
- Understanding about various types of connectors.
- Understanding about interlocking features
- Understand to read installation manual

Critical Evidence(s) Required

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

- Develop and maintain hardware structure of robot.
- Perform Install and configure software of robot.

Tools and Equipment

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

S. No.	Items
1.	Computer System
2.	Connectors
3.	Cables
4.	Tools for installation
5.	Bolts and nuts
6.	End effectors
7.	Robot operating software
8.	Cleaning and lubricating chemicals

0714E&A104. Diagnose precise robot movement

Overview: This competency standard covers the skills and knowledge related to robot faults the detection of faults and detail knowledge of fault causes, how robot can be used in precision working jobs and tolerances and Limitation, speed of robot movement and precision control.

Competency Unit	Performance Criteria
CU1. Perform fault detection	**P1.** Remove check behaviour of joints as per manual. **P2.** Check behaviour of end effector as per manual. **P3.** Check power wiring. **P4.** Check the behaviour of all sensors & switches.
CU2. Perform repeatability.	**P1.** Give coordinate to perform task. **P2.** Check if the given task is completed successfully, again give the same task. **P3.** Check both outputs.
CU3. Detect error.	**P1.** Give coordinate to perform task. **P2.** Measure the error between given coordinate and actual result **P3.** Calculate the error in percentage.

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:

- Learn Understanding of repeatability procedure.
- Understanding of analyzing precision of specific instrument.
- Understanding of analyzing accuracy of specific instrument.
- Understanding of robot functionality.
- Understanding of motion range of robot.
- Understand and learn different task to check the precision of robotic movement.
- Understanding of cable routing.

Critical Evidence(s) Required

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

- Perform fault detection.
- Perform repeatability test.
- Perform Accuracy and precision test.

Tools and Equipment

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

S. No.	Items
1.	Multimeter
2.	Computer system
3.	Data analyzing Software
4.	Precision toolkit
5.	Reference measuring instrument

0714E&A105. Diagnose Coupling Parameters

Overview: This competency standard covers the skills and knowledge related to choosing a specific robot, a lot of different configurations can be made regarding the end effector's fixation method. In fact, most of the time when buying a specific gripper and robotic arm, they won't match with each other. This is why most companies use mechanical couplings or adapters to be able to fix the gripper to the robot arm.

Competency Unit	Performance Criteria
CU1. Verify physical structure	**P1.** Check the broken parts **P2.** Ensure the accurate connectivity of all parts according to manual. **P3.** Tight parts (if required). **P4.** Verify smooth and normal operation of all parts.
CU2. Diagnose Coupling Parameters	**P5.** Install Identify the method of determining aspects of movement quality. **P6.** Identify the kinematic couplings for precision fixtures and assembly. **P7.** Identify the precision robot calibration using kinematic placed inclinometers. **P8.** Identify the checking of stability and mechanical interchangeability.
CU3. Apply diagnose strategy	**P1.** Give Diagnose coupling of end effector **P2.** Diagnose coupling of joints **P3.** Diagnose coupling with base

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:

- Understand and learn the method of determining aspects of movement quality.
- Understand and learn the kinematic couplings for precision fixtures and assembly.
- Understand and learn the precision robot calibration using kinematic placed inclinometers
- Understand and learn the checking of stability and mechanical interchangeability.
- Understand and learn the tools for diagnosing the kinematic coupling.

Critical Evidence(s) Required

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

- Perform diagnostic procedures on Robot.

Tools and Equipment

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

S. No.	Items
1.	Position measuring tool
2.	Fixtures and assembly.
3.	Inclinometer
4.	Mechanical strength measuring tools
5.	Coordinate calibration tools
6.	Tool Box

0714E&A106. Implement the performance characteristics identified in ISO9283 standards

Overview: This competency standard covers the skills and knowledge related to ISO9283 intended to facilitate understanding between users and manufacturers of robots and robot systems. It defines the important performance characteristics, describes how they shall be specified and recommends how they should be tested.

Competency Unit	Performance Criteria

Competency Unit	Performance Criteria
CU1. Identify performance characteristics of ISO9283	**P1.** Identify the proper tool according to standard. **P2.** Determine the error according to ISO Standard. **P3.** Identify the Coordinate calibration error. **P4.** Identify the measurement error. **P5.** Identify the robot initialization error **P6.** Identify the vibration and others error. **P7.** Identify the data selection error.
CU2. Apply performance characteristics of ISO9283	**P1.** Install Apply ISO9283 on robot manufacturing. **P2.** Apply ISO9283 on robot system

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:

- Understand and learn to read and solve error messages according to ISO9283 Standard.
- Understand to resolve the Coordinate calibration error.
- Understand to resolve the measurement error
- Understand to resolve the robot initialization error

Critical Evidence(s) Required

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

- Perform the Test of precision, accuracy and repeatability of robot.
- Perform Fault detection of robot.

Tools and Equipment

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

S. No.	Items

1.	Vibration sensors
2.	Jumpers
3.	Measuring tools
4.	Error measuring tools
5.	Coordinate calibration tools

T. *Robotic Application*

0714E&A107. Develop Line Following Robot

Overview: This competency standard covers the skills and knowledge required to develop one of the advanced mobile robots is the Line Follower Robot. It is basically a robot which follows a particular path or trajectory and decides its own course of action which interacts with obstacle. The path can be a black line on the white floor (visible) or a magnetic field (invisible). Its applications start from basic domestic uses to industrial uses, etc. The present condition in industry is they are carrying the parcels or materials one place to another place using the crane system. Sometimes lifting of big weights at that time may cause the breakage of lifting materials and will be cause damage to the parcels also. The line following robots is commonly used for carry children through shopping malls, homes, entertainment places, industries. The use of line following robotic vehicle is transport the materials from one place to another place in the industries. This robot movement completely depends on the track. The robot can do anything you set them to do. Like in factories all they have to do with making their products is make the robot.

Competency Unit	Performance Criteria

Competency Unit	Performance Criteria
CU1. Identify parts of Line following robot	**P1.** Open basic trainer kit of Line following robot. **P2.** Identify actuators **P3.** Identify sensors to detect path. **P4.** Arrange parts according to their utilization.
CU2. Assembly of Line following robot	**P1.** Assembly of the parts of line following robot **P2.** Select the Controller **P3.** Draw the circuit diagram **P4.** Electric wiring of sensors, actuator and controller **P5.** Design the algorithm flowchart to implement on controller. **P6.** Recognize the power supply distribution for controller and actuator. **P7.** Recognize the program algorithm for the line following robot
CU3. Programming of controller	**P1.** Open programming software IDE on computer **P2.** Develop code for line following robot **P3.** Compile and upload code in controller.
CU4. Perform robot movement test	**P1.** Preform the robot movement detection test **P2.** Check the line following robot feasibility and manipulability. **P3.** Check of line following robot operating conditions **P4.** Check the condition of each component and overall assembly of the line following robot. **P5.** Check all the connections of the components.

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:

- Understanding of numerous types of Line following robot
- Understanding of sensors used in line following robot.
- Understanding of numerous types of actuators
- Understanding and learn connection controller, sensors and actuators.
- Understanding of controller programming software
- Understanding and learn to develop code for line following robot
- Understanding and learn troubleshooting of code.

Critical Evidence(s) Required

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

- Perform integration of line following robot.
- Perform Uploading the code in controller of line following robot.

Tools and Equipment

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

S. No.	Items
1.	Computer system
2.	Integrated Development Environment (IDE)
3.	Turbo C, C++, Code block
4.	Line following trainer kit
5.	Screw driver
6.	Jumper wires
7.	Chassis for line following robot.

0714E&A108. Develop Smart phone control robot using Bluetooth

Overview: This competency standard covers the skills and knowledge required to design and control the motion of robot using Bluetooth device of an Android phone. Many android apps available today which are helpful to achieve this task.

Competency Unit	Performance Criteria

Competency Unit	Performance Criteria
CU1. Identify parts of robot	**P1.** Open basic trainer kit of ground vehicle robot. **P2.** Identify mobile base. **P3.** Identify actuators **P4.** Identify Bluetooth modem to for communication. **P5.** Arrange parts according to their utilization.
CU2. Assembly of robot	**P1.** Assemble the parts **P2.** Select the Controller **P3.** Draw the circuit diagram **P4.** Electric wiring of sensors, actuator and controller. **P5.** Design the algorithm flowchart to implement on controller. **P6.** Recognize the power supply distribution for controller and actuator. **P7.** Recognize the program algorithm for the Smart Phone Control Robot Using Bluetooth.
CU3. Programming of controller	**P1.** Program the controller to change direction of robot according to the receive signal from smart phone android application via Bluetooth. **P2.** Download and Install the android application on smartphone. **P3.** Connect the Bluetooth with Bluetooth module on controller.
CU4. Perform robot movement test	**P1.** Identification of movement of the Smart Phone Control Robot Using Bluetooth. **P2.** Preform the robot movement detection test **P3.** Check the robot feasibility and manipulability. **P4.** Check the robot all possible operating conditions. **P5.** Check the Bluetooth range and its connectivity. **P6.** Check the condition of each component and overall assembly of the robot. **P7.** Check all the connections of the components.

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:

- Understanding of numerous types of controlled robot
- Understanding of Bluetooth transmitter.
- Understanding of numerous types of actuators
- Understanding and learn connection controller, transmitter, receiver and actuators.
- Understanding of controller programming software

- Understanding and learn to develop Bluetooth controlled robot
- Understanding and learn troubleshooting of code.
- Understanding about android operating system
- Understanding about android application.
- Understanding the configuration of android application used in project.

Critical Evidence(s) Required

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

- Perform integration of Bluetooth controlled robot.
- Perform Uploading of code in controller of robot.
- Perform download and installation of smart phone application.

Tools and Equipment

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

S. No.	Items
1.	Computer system
2.	Integrated Development Environment (IDE)
3.	Turbo C, C++, Code block
4.	Robot trainer kit
5.	Screw driver
6.	Jumper wires
7.	Bluetooth transceiver.
8.	Controller board.
9.	Smart phone

0714E&A109. Develop IoT based home automation

Overview: This competency standard covers the skills and knowledge required to Home automation system uses the portable devices as a user interface. They can communicate with home automation network through an Internet gateway, by means of low power communication protocols like Zigbee, Wi-Fi etc. This project aims at controlling home appliances via Smartphone using Wi-Fi as communication protocol.

Competency Unit	Performance Criteria
CU1. Identify basic components of home automation	**P1.** Identify basic components of home automation **P2.** Identify the specification of home appliances and things to automate. **P3.** Select the components for each part of the automation system. **P4.** Identify the sensors to detect light, movement, temperature and other.
CU2. Perform integration of parts	**P1.** Perform the WiFi/Ethernet module connection with controller. **P2.** Connect the LCD display with controller. **P3.** Design the model and overall assembly on single control unit. **P4.** Select the Controller **P5.** Draw the circuit diagram **P6.** Electric wiring of sensors, actuator and controller.
CU3. Configure system	**P1.** Recognize the power supply distribution for sensors, controller and actuator. **P2.** Recognize the program algorithm for each sensor. **P3.** Setup the cloud for getting the sensors data on cloud. **P4.** Program the controller to automate the door, turn light on/off from smart phone, control the Fan from smart phone and display the temperature and humidity on screen.
CU4. Perform testing	**P1.** Download and Install the android application on smartphone. **P2.** Connect the Internet with Internet module on controller. **P3.** Control light, fans and home appliances with mobile using IoT.

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:

- Understanding of numerous types of controller
- Understanding of WIFI transceiver.
- Understanding of numerous types of actuators
- Understanding and learn connection controller, transmitter, receiver and actuators.
- Understanding of controller programming software
- Understanding and learn to develop WIFI connection.
- Understanding and learn troubleshooting of code.
- Understanding about android operating system
- Understanding about android application.
- Understanding the configuration of android application used in project.
- Understanding and learning of IoT protocol
- Understanding and learning of relay based module.

Critical Evidence(s) Required

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

- Perform integration of WIFI module with internet.
- Perform Uploading of code in controller.
- Perform download and installation of smart phone application.
- Perform automation of home appliances.

Tools and Equipment

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

S. No.	Items
1.	Computer system
2.	Integrated Development Environment (IDE)
3.	Turbo C, C++, Code block
4.	Home automation kit
5.	Screw driver
6.	Jumper wires

7.	WIFI transceiver.
8.	Controller board.
9.	Smart phone
10.	Internet availability

0714E&A110. Develop Smart Phone Control Door Lock System

Overview: This competency standard covers the skills and knowledge required for Android mobile controlled door security locking system has its main application in security systems. It can be used in house, shop, offices, industry.

Competency Unit	Performance Criteria
CU1. Identify the components of remote control door locks	**P1.** Specify the types Of Smart Phone Control Door Lock System. **P2.** Identify the specification of door lock. **P3.** Select the components. **P4.** Identify the actuators. **P5.** Identify the module to detect the Bluetooth signals
CU2. Assemble door locks with bluetooth	**P1.** Perform the Bluetooth module connection with controller. **P2.** Connect the LCD display with controller. **P3.** Design the model and overall assembly on single control unit. **P4.** Select the Controller **P5.** Draw the circuit diagram.
CU3. Configure and Perform testing	**P1.** Download and Install the android application on smartphone. **P2.** Connect the Bluetooth with Bluetooth module on controller. **P3.** Identification of door activity according to pin code provide to unlock the door. **P4.** Preform the Door Lock System error detection test. **P5.** Check the robot feasibility and manipulability. **P6.** Check the Door Lock System all possible operating conditions. **P7.** Check the Bluetooth range and its connectivity. **P8.** Check the condition of each component. **P9.** Check all the connections and wiring of the components.

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:

- Understanding of numerous types of controller
- Understanding of Bluetooth transceiver.
- Understanding of numerous types of actuators
- Understanding and learn connection controller, transmitter, receiver and actuators.
- Understanding of controller programming software
- Understanding and learn to connect Bluetooth transceiver.
- Understanding and learn troubleshooting of code.
- Understanding about android operating system
- Understanding about android application.
- Understanding the configuration of android application used in project.
- Understanding and learning various types of motors
- Understanding and learning of relay based module.

Critical Evidence(s) Required

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

- Perform integration of WIFI module with internet.
- Perform Uploading of code in controller.
- Perform download and installation of smart phone application.
- Perform controlling of door lock.

Tools and Equipment

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

S. No.	Items
1.	Computer system
2.	Integrated Development Environment (IDE)
3.	Turbo C, C++, Code block
4.	Home automation kit
5.	Screw driver
6.	Jumper wires

7.	WIFI transceiver.
8.	Controller board.
9.	Smart phone
10.	Internet availability
11.	Door lock

0714E&A111. Develop Security System Using Motion Detector

Overview: This competency standard covers the skills and knowledge required for motion sensor is device that detects when someone is in your home when they shouldn't be. A motion sensor uses one or multiple technologies to detect movement in an area. If a sensor is tripped, a signal is sent to your security system's control panel, which connects to your monitoring center, alerting you and the monitoring center to a potential threat in your home.

Competency Unit	Performance Criteria

Competency Unit	Performance Criteria
CU1. Identify parts of security system	**P1.** Specify the types Of Security System Using Motion Detector. **P2.** Identify the specification of Security System. **P3.** Select the components. **P4.** Identify the actuators. **P5.** Identify the sensor to detect the Motion.
CU2. Perform Assembly and integrate	**P1.** Select the Controller. **P2.** Design the model and overall assembly on single control unit. **P3.** Draw the circuit diagram. **P4.** Electric wiring of sensors, actuator and controller. **P5.** Design the algorithm flowchart to implement on controller. **P6.** Recognize the power supply distribution for sensors, controller and actuator.
CU3. Perform Programming and configuration	**P1.** Write code for security system according to provided sensor and actuator. **P2.** Upload code into controller **P3.** Perform the Security System movement detection test. **P4.** Check the Security System in all possible operating conditions. **P5.** Check the buzzer range. **P6.** Check the condition of each component. **P7.** Check all the connections and wiring of the components.

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:

- Understanding of numerous types of motion sensor
- Understanding of numerous types of actuators
- Understanding and learn connection controller, motion sensor and actuators.
- Understanding of controller programming software
- Understanding and learn troubleshooting of code.
- Understanding and learning various types of alarm system
- Understanding and learning of relay based module.

Critical Evidence(s) Required

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

- Perform integration of motion sensor with controller.
- Perform Uploading of code in controller.
- Perform Installation of alarm.

Tools and Equipment

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

S. No.	Items
1.	Computer system
2.	Integrated Development Environment (IDE)
3.	Turbo C, C++, Code block
4.	Alarm
5.	Screw driver
6.	Jumper wires
7.	Motion sensor
8.	Controller board.
9.	Loud speaker

0714E&A112. Develop Water-level Detection in Tank

Overview: This competency standard covers the skills and knowledge required for motion sensor is device that detects when someone is in your home when they shouldn't be. A motion sensor uses one or multiple technologies to detect movement in an area. If a sensor is tripped, a signal is sent to your security system's control panel, which connects to your monitoring center, alerting you and the monitoring center to a potential threat in your home.

Competency Unit	Performance Criteria
CU1. Identify parts for water level detection	**P1.** Specify the types of Water-level Detection in Tank. **P2.** Identify the specification of Water-level Detection Tank. **P3.** Select the components. **P4.** Identify the actuators. **P5.** Identify the sensor to detect the Water-level.
CU2. Perform assembly and integration of parts	**P1.** Select the Controller. **P2.** Design the model and overall assembly on single control unit. **P3.** Draw the circuit diagram. **P4.** Electric wiring of sensors, actuator and controller. **P5.** Design the algorithm flowchart to implement on controller. **P6.** Recognize the power supply distribution for sensors, controller and actuator.
CU3. Perform Programming and configuration	**P1.** Program using Algorithm to detect the Water-level in tank and display reading on the LCD. **P2.** Preform the Water-level Detection test on different ranges of sensor with varying the level of water. **P3.** Check the Water-level Detection System feasibility and manipulability.
CU4. Perform Running and testing	**P1.** Check the Water-level Detection System all possible operating conditions. **P2.** Check the sensor range. **P3.** Check the condition of each component. **P4.** Check all the connections and wiring of the components.

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:

- Understanding of numerous types of water level sensing technique
- Understanding of numerous types of indicators
- Understanding and learn connection controller, level sensor and indicator.
- Understanding of controller programming software
- Understanding and learn troubleshooting of code.
- Understanding and learning various types of alarm system
- Understanding and learning of motor control system.

Critical Evidence(s) Required

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

- Perform integration of level sensor with controller
- Perform Uploading of code in controller.
- Perform Installation of alarm system
- Performing motor controlling
-

Tools and Equipment

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

S. No.	Items
1.	Computer system
2.	Integrated Development Environment (IDE)
3.	Turbo C, C++, Code block
4.	Alarm
5.	Screw driver
6.	Jumper wires
7.	Level sensor
8.	Controller board.
9.	Motor
10.	Computer system

0714E&A113. Develop Mini CNC 2D Plotter

Overview: This competency standard covers the skills and knowledge required for use of system to draw computerize 2D plotting on paper. It is use t draw map and design.

Competency Unit	Performance Criteria

Competency Unit	Performance Criteria
CU1. Identify parts of CNC machine	**P1.** Specify the types 2D CNC Plotter. **P2.** Identify static base of 2D CNC Plotter. **P3.** Identify the actuators. **P4.** Select the components. **P5.** Identify the sensors.
CU2. Perform Assembly of CNC parts	**P1.** Design the model and overall assembly of the CNC machine. **P2.** Assembly of the parts **P3.** Select the Controller **P4.** Draw the circuit diagram **P5.** Electric wiring of sensors, actuator and controller **P6.** Design the algorithm flowchart to implement on controller. **P7.** Recognize the power supply distribution for controller and actuator. **P8.** Recognize the program algorithm for the 2D CNC
CU3. Perform Programming of CNC system	**P1.** Program the controller to trace the input image on the page. **P2.** Apply translator to convert image into G&M Code **P3.** Upload code. **P4.** Identification of movement of the 2D CNC Plotter.
CU4. Perform Running and testing	**P1.** Preform the robot movement detection test **P2.** Check the 2D CNC Plotter feasibility and manipulability. **P3.** Check of 2D CNC Plotter operating conditions. **P4.** Check the condition of each component and overall assembly of the 2D CNC Plotter. **P5.** Check all the connections of the components. **P6.** Perform debugging (If required)

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:

- Understanding of numerous types of 2D imaging technique
- Understanding of numerous types of coordinates system

- Understanding and learn connection controller, stepper motor and indicator.
- Understanding of controller programming software
- Understanding and learn troubleshooting of code.
- Understanding and learning paper installation technique
- Understanding and learning of 2D motor control system.

Critical Evidence(s) Required

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

- Perform integration of parts of CNC machine
- Perform Uploading of code in controller.
- Perform Print 2D plot

Tools and Equipment

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

S. No.	Items
1.	Computer system
2.	Integrated Development Environment (IDE)
3.	Turbo C, C++, Code block
4.	Alarm
5.	Screw driver
6.	Jumper wires
7.	Controller board.
8.	Motors
9.	Old CD ROMs

0714E&A114. Develop Voice Controlled Robot

Overview: This competency standard covers the skills and knowledge required for Voice Controlled Robotic Vehicle helps to control robot through voice commands received via android application. The integration of control unit with Bluetooth device is done to capture and read the voice commands. The robotic vehicle then operates as per the command received via android application.

Competency Unit	Performance Criteria

Competency Unit	Performance Criteria
CU1. Identify parts of voice controlled robot	**P1.** Specify the types of Voice Controlled Robot. **P2.** Identify mobile base of robot. **P3.** Identify the actuators for of robot. **P4.** Select the components for robot. **P5.** Identify the sensors to recognize the voice instructions.
CU2. Perform Assembly of Robot	**P1.** Design the model and overall assembly of the robot. **P2.** Assembly of the parts of line following robot **P3.** Select the Controller **P4.** Draw the circuit diagram **P5.** Electric wiring of sensors, actuator and controller **P6.** Design the algorithm flowchart to implement on controller. **P7.** Recognize the power supply distribution for controller and actuator. **P8.** Recognize the program algorithm for the Voice Controlled Robot.
CU3. Perform Programming and configuration	**P1.** Program the controller to change direction of robot according to the voice command. **P2.** Upload the code into the controller. **P3.** Identification of movement of the Voice Controlled Robot.
CU4. Perform Running and testing	**P1.** Preform the robot movement detection test. **P2.** Check the robot feasibility and manipulability. **P3.** Check of line robot operating conditions. **P4.** Check the condition of each component and overall assembly of the robot. **P5.** Check all the connections of the components.

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:

- Understanding of numerous types of voice controlled mechanism
- Understanding of numerous voice command sensor
- Understanding and learn connection controller, sensor and indicator.
- Understanding of controller programming software

- Understanding and learn troubleshooting of code.
- Understanding and learning Bluetooth connection and pairing
- Understanding and learning of UART based communication.

Critical Evidence(s) Required

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

- Perform integration of parts of voice controlled robot
- Perform Uploading of code in controller.
- Perform robot movement by using voice commands

Tools and Equipment

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

S. No.	Items
1.	Computer system
2.	Integrated Development Environment (IDE)
3.	Turbo C, C++, Code block
4.	Smart phone
5.	Screw driver
6.	Jumper wires
7.	Controller board.
8.	Motors

U. *Industrial Electronics*

0714E&A115. Implement diode and Thyristor in power control application.

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

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

	record the output wave shape
CU5. Build full wave converter and observe natural commutation.	**P1.** Draw circuit diagram of full wave converter. **P2.** Make connection as per diagram. **P3.** Switch on the power supply and apply triggering pulse at the gate of SCR. **P4.** Connect oscilloscope across the load resistor and record the output wave shape the output wave shape

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

Critical Evidence(s) Required

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

- Build forward bias circuit of diode and observe its behavior
- Build reverse bias circuit of diode and observe its behavior
- Use SCR to build Phase control rectifier
- Build force commutated circuit for SCR

- Build full wave converter

Tools and Equipment

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

S. No.	Items
1.	Power diode
2.	Resistor of 1 K ohms
3.	Volt meter
4.	Ampere meter
5.	DC supply
6.	Connecting leads
7.	Power supply
8.	Centre tapped transformer
9.	Bread Board
10.	Oscilloscope
11.	Resistor of 10 K ohms
12.	Capacitor 10uF
13.	SCR
14.	Oscilloscope Dual
15.	Potentiometer 500 o
16.	Resistor of 10 K & 100 K ohms
17.	Inductor 2mH
18.	Diode

0714E&A116. Construct single phase and three phase Inverter

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

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

	record the output wave shape

Knowledge & Understanding

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

Critical Evidence(s) Required

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

- Construct single phase half bridge inverter and observe its output
- Construct single phase full bridge inverter and observe its output
- Construct three phase bridge inverter and observe its output

Tools and Equipment

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

S. No.	Items
1.	Power MOSFET IRF 840
2.	Power Diode 1N4007
3.	DC Source 12V
4.	Resistor 10K
5.	Function Generator
6.	IC 7404
7.	Controller IC
8.	Oscilloscope
9.	Connecting leads

0714E&A117. Control speed of DC/AC Motor

Overview: This competency standard covers the skills and knowledge required to control speed of DC/AC motor.

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

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

Knowledge & Understanding

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 DC motor
- Describe parts of DC motor
- Enlist the methods to control the speed of DC motor.
- Describe armature control method.
- Describe field control method.
- Describe the range of firing angle of SCR's

- Define use of controller IC.
- Define AC to AC conversion
- Define cycle-converter.
- Describe types of cycle-converter
- Define single phase cycle-converter.
- Define three phase cycle-converter.
- Define synchs.
- Define synchrony generator or TX
- Define synchrony receiver or Rx

Critical Evidence(s) Required

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

- Implement armature control method to control the speed of DC motor with 3 phase control bridge rectifier and Bridge rectifier
- Implement Field control method & armature control method to control the speed of DC motor with 3 phase bridge rectifier
- Implement AC to AC converter to control the speed of 3 phase AC motor

Tools and Equipment

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

S. No.	Items
1.	Multimeter
2.	Connecting leads
3.	Synchrony Transmitter & Receiver
4.	Supply
5.	Power supply
6.	Connecting leads
7.	CRO
8.	Firing Circuit
9.	SCR’s
10.	Power Electronics Trainer Kit
11.	Power Diode 1N4007
12.	Controller IC
13.	DC Motor
14.	AC motor
15.	Connecting leads
16.	Three phase supply

V. ***Hydraulic & Pneumatic Machinery***

0714E&A118. Operate Hydraulic Bench and Its Functions

Overview: This competency standard covers the skills and knowledge required to provide knowledge for observing Hydraulic Bench, identify various standard parts of Hydraulic Bench and its main functions.

Competency Unit	Performance Criteria

CU1. Identify parts of hydraulic bench	**P1.** Enlist all parts of a Hydraulic Bench **P2.** Identify Control valve, Drain valve and Dump valve. **P3.** Identify Sump Tank and Volumetric Tank. **P4.** Identify Open Channel and Vertical Pipe. **P5.** Identify Centrifugal Pump **P6.** Identify Actuators
CU2. Identify/perform Various Functions of/on Hydraulic Bench	**P1.** Ensure that pump is switched off. **P2.** Set up the device to be tested. **P3.** Attach a water supply for open channel flow or a close conduct device to the water inlet. **P4.** Ensure that all connections are secure. **P5.** Ensure that supply valve is closed, and dump valve is open. **P6.** Turn the pump on. **P7.** Open slowly the supply valve to allow water to circulate the bench. **P8.** Make appropriate measurement in the device being tested for a given setting of supply valve e.g. pressure reading, water depths etc. **P9.** Closedown the supply valve upon the completion of test. **P10.** Turn off the valve. **P11.** Disconnect the device used for testing.

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:

- Describe the purpose of a Hydraulic Bench
- Explain the working of a hydraulic bench with help of circuit diagram.
- Describe the importance of Centrifugal pump in a Hydraulic Bench.
- Describe the function of Main Tank and of Sump Tank.
- Explain the purpose and working of Control valve, Drain Valve and Dump Valve.
- Describe centrifugal pump
- Define Difference between sump tank and volumetric tank
- Define Difference control valve, drain valve and dump valve
- Define Difference main channel and side channels
- Describe water level indicator
- Describe stilling baffle
- Define Difference between overflow and starter
- Describe a Schematic Diagram of Hydraulic Bench

Critical Evidence(s) Required

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

- Identify parts of hydraulic bench
- Identify Functions of/on Hydraulic Bench
- Perform Various Functions of/on Hydraulic Bench

Tools and Equipment

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

S. No.	Items
1.	Hydraulic bench
2.	Control Valve
3.	Centrifugal pump
4.	Sump tank
5.	Vertical pipe
6.	Channel
7.	Drain valve
8.	Volumetric tank
9.	Water Level Indicator
10.	Dump valve
11.	Actuators
12.	Side Channel

0714E&A119. Analyse the performance of Pumps

Overview: This competency standard covers the skills and knowledge required to observe and analyse centrifugal pump as well as reciprocating pump.

Competency Unit	Performance Criteria
CU1. Analyze the performance of Centrifugal Pump	**P1.** Prime the pump **P2.** Open the gate valve 1 or 2 rotations **P3.** Start the motor and set the vacuum gauge reading to the required head **P4.** Note down the following readings • Pressure gauge reading G • Vacuum Gauge Reading V • Time taken for 10 revolutions in the energy meter T • Time taken to fill up 200 cm rise in the collecting tank, t • The difference in the levels of the pressure and vacuum gauges, x **P5.** Set the vacuum gauge reading to the other heads **P6.** Note down the above readings G, V, T, and t **P7.** Take at least 5 sets of readings by varying the head through delivery valve and note down the readings
CU2. Analyse the performance of Reciprocating Pump	**P1.** Prime the pump **P2.** Open the gate valve 1 or 2 rotations **P3.** Start the motor and set the vacuum gauge reading to the required head **P4.** Note down the following readings • Pressure gauge reading G • Vacuum Gauge Reading V • Time taken for 10 revolutions in the energy meter T • Time taken to fill up 200 cm rise in the collecting tank, t • The difference in the levels of the pressure and vacuum gauges, x **P5.** Set the vacuum gauge reading to the other heads **P6.** Note down the above readings G, V, T, and t **P7.** Take at least 5 sets of readings by varying the head through delivery valve and note down the readings

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:

- Describe centrifugal pump working principle
- Describe pump casing
- Describe impeller
- Describe suction pipe and delivery pipe
- Describe reciprocating pump
- Describe suction valve and delivery valve
- Describe crank and connecting rod mechanism
- Describe suction and delivery pipe
- Describe function of Piston
- Define difference between centrifugal and reciprocating pump.

Critical Evidence(s) Required

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

- Identify the centrifugal pump gauges
- Operate the centrifugal pump
- Analyze the performance of centrifugal pump
- Identify the reciprocating pump gauges
- Operate the reciprocating pump
- Analyze the performance of reciprocating pump
- Identify difference between centrifugal and reciprocating pump.

Tools and Equipment

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

S. No.	Items
1.	Apparatus
2.	Centrifugal Pump
3.	Test Bench
4.	Pipe Hoses
5.	Voltmeter
6.	Ammeter
7.	Reciprocating Pump
8.	Tachometer
9.	Stop watch
10.	Pressure gauge

11.	Energy meter

0714E&A120. Working/operation directional control valves

Overview: This competency standard covers the skills and knowledge required to operate gate valve, operate globe valve, operate check valve, operate plug valve, operate ball valve, operate butterfly valve, operate needle valve, operate pinch valve, Operate relief valve, pressure gauges, temperature gauges, Flow gauges and Different types of sensor.

Competency Unit	Performance Criteria
CU1. Operate gate valve	**P1.** Choose the type of valve **P2.** Create pressure according to the requirement **P3.** Calculate the pressure and mass flow rate of the water w.r.t. time **P4.** Calculate efficiency of the valve **P5.** Perform the same procedure for remaining types of the valves
CU2. Operate globe valve	**P1.** Choose the type of valve **P2.** Create pressure according to the requirement **P3.** Calculate the pressure and mass flow rate of the water w.r.t. time **P4.** Calculate efficiency of the valve
CU3. Operate check valve	**P1.** Choose the type of valve **P2.** Create pressure according to the requirement **P3.** Calculate the pressure and mass flow rate of the water w.r.t. time **P4.** Calculate efficiency of the valve
CU4. Operate plug valve	**P1.** Choose the type of valve **P2.** Create pressure according to the requirement **P3.** Calculate the pressure and mass flow rate of the water w.r.t. time

	P4. Calculate efficiency of the valve
CU5. Operate ball valve	**P1.** Choose the type of valve **P2.** Create pressure according to the requirement **P3.** Calculate the pressure and mass flow rate of the water w.r.t. time **P4.** Calculate efficiency of the valve
CU6. Operate butterfly valve	**P1.** Choose the type of valve **P2.** Create pressure according to the requirement **P3.** Calculate the pressure and mass flow rate of the water w.r.t. time **P4.** Calculate efficiency of the valve
CU7. Operate needle valve	**P1.** Choose the type of valve **P2.** Create pressure according to the requirement **P3.** Calculate the pressure and mass flow rate of the water w.r.t. time **P4.** Calculate efficiency of the valve
CU8. Operate pinch valve	**P1.** Choose the type of valve **P2.** Create pressure according to the requirement **P3.** Calculate the pressure and mass flow rate of the water w.r.t. time **P4.** Calculate efficiency of the valve
CU9. Operate relief valve	**P1.** Choose the type of valve **P2.** Create pressure according to the requirement **P3.** Calculate the pressure and mass flow rate of the water w.r.t. time **P4.** Calculate efficiency of the valve
CU10. Demonstrate Pressure gauges, temperature gauges, Flow gauges and Different types of sensor.	**P1.** Choose the type of valve **P2.** Create pressure according to the requirement **P3.** Calculate the pressure and mass flow rate of the water w.r.t. time **P4.** Calculate efficiency of the valve

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:

- Describe the motion of the valves
- Describe the measurements of pressure
- Define Calculate mass flow rate in both cases either fully opened or fully closed
- Describe to control air, fuel gas, feed water, steam, lube oil hydrocarbon and other services
- Define the efficiency calculation of the valves
- Define the efficiency calculation of the gauges w.r.t. sensor values

Critical Evidence(s) Required

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

- Perform to operate gate valve, operate globe valve, operate check valve, operate plug valve, operate ball valve, operate butterfly valve, operate needle valve, operate pinch valve, operate relief valve, pressure gauges, temperature gauges, Flow gauges and Different types of sensor.
- Perform to control air, fuel gas, feed water, steam, lube oil hydrocarbon and other services

Tools and Equipment

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

S. No.	Items
1.	Various types of valves
2.	Water resources
3.	Pipe lines
4.	Valve test bench
5.	Pressure gauges
6.	Various types of pressures, temperatures And flow gauges
7.	Heat resources
8.	Sensors

0714E&A121. Setup a Pressure Device and Hold Specific Load on a Double Acting Cylinder

Overview: This competency standard covers the skills and knowledge required to use pressure reducing valve on double acting cylinder and holding load on double acting cylinder.

Competency Unit	Performance Criteria
CU1. Set-up pressure device on a double acting cylinder using pressure reducing valve	**P1.** Complete the hydraulic circuit as drawing given **P2.** Turn on the circuit supply and check if all devices are working properly **P3.** Ensure Fluid starts flowing and the initially adjusted pressure is passed on to the circuit while passing through the relief valve. **P4.** Observe and note the pressure reading at various pressure gauges. **P5.** Change direction with the help of DCV and ensure control of double acting cylinder according to this direction. **P6.** Re-observe and re-note the readings on all the pressure gauges.

CU2. Hold specific load using double acting cylinder	**P1.** Complete the hydraulic circuit as per drawings. **P2.** Turn on the circuit supply and check if all devices are working properly **P3.** Adjust pressure according to desired/required load. **P4.** Ensure fluid flow from port A. This would uplift the load. **P5.** Now change the position of DCV and ensure fluid entrance from port B. **P6.** Observe the downward motion of loaded ram. **P7.** Take the pressure reading and observe the cylinder return.

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:

- Describe pressure reducing valve
- Describe purpose of double acting cylinder as a pressure device
- Describe applications of double acting cylinder with the pressure pipe
- Describe function of pilot operated check valve
- Describe DCV
- Describe the role of RAM

Critical Evidence(s) Required

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

- Perform pressure adjustment according to the required load.
- Identify the graphic symbols for various types of hydraulic components.
- Explain methods use in holding load on double acting cylinder.
- Describe purpose of double acting cylinder as a pressure device
- Describe applications of double acting cylinder with the pressure pipe

Tools and Equipment

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

S. No.	Items
1.	Apparatus
2.	Hydraulic Bench

3.	Double ACTING Cylinder
4.	Pressure reading valve
5.	DCV pipe hoses
6.	Hydraulic bench
7.	Double acting cylinder
8.	Pilot operated check valve
9.	Direction control valve
10.	Various loads
11.	Pipe hoses
12.	Pressure gauges

0714E&A122. Actuate Double Acting Hydraulic Cylinder

Overview: This competency standard covers the skills and knowledge required to actuate a double acting hydraulic cylinder by a switch, speed regulation through throttle valve and flow control valves. It also explains actuation of double acting hydraulic cylinder by one-way throttle valve.

Competency Unit	Performance Criteria
CU1. Actuate double acting hydraulic cylinder by	**P1.** Complete all connections of hydraulic circuit as per drawing

switch and draw a circuit diagram	**P2.** Turn on the push button switch to start the supply of fluid with which double acting cylinder will start moving **P3.** Move the piston to initiate the supply from forward stroke **P4.** Turn on the second push button switch after the piston reaches top dead centre. This will start supply in the opposite direction **P5.** Observe the functions from control valve by varying its speed after the completion of supply in the circuit **P6.** Note all observations.
CU2. Actuate double acting hydraulic cylinder by oneway throttle valve	**P1.** Prepare the hydraulic circuit as per drawing **P2.** Turn on the circuit power supply and ensure that all accessories are working properly **P3.** Ensure throttle valve on return line of the circuit works properly. **P4.** Open the valve and ensure extra supply of oil to observe quick return of cylinder. **P5.** Observe cylinder speed at various positions of the valve. **P6.** Note all the observations

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:

- Describe types of hydraulic cylinder
- Describe Double acting hydraulic circuit
- Describe direction control valve
- Describe function of push button
- Describe throttle valve function
- Describe one-way throttle valve
- Explain role of cylinder speed

Critical Evidence(s) Required

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

- Working of Actuate double acting hydraulic cylinder by switch
- Working of Actuate double acting hydraulic cylinder by one-way throttle valve

Tools and Equipment

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

S. No.	Items
1.	Apparatus
2.	Hydraulic bench
3.	Double acting cylinder
4.	Pipe hoses and fittings
5.	Pressure gauges
6.	Flow control valve
7.	Direction control valve
8.	Push button
9.	Hydraulic bench
10.	Double acting cylinder
11.	Pipe hoses And fittings
12.	Pressure gauges
13.	One-way Throttle valve
14.	Direction control valve

0714E&A123. Construct Circuit of Double Acting Hydraulic Cylinder for Mechanical Interlocking

Overview: This competency standard covers the skills and knowledge required to construct a hydraulic cylinder for mechanical interlocking and use of push buttons, limit switch and stored energy in double acting hydraulic cylinder

Competency Unit	Performance Criteria
CU1. Construct a hydraulic circuit for double acting hydraulic cyclinder for mechanical interlocking with switch	**P1.** Complete the hydraulic circuit as per drawings. **P2.** Turn on the circuit supply and check if all devices are working properly **P3.** Operate hydraulic circuit **P4.** Try lift some weight **P5.** Drop the pressure using pressure gauge before the piston starts moving **P6.** Construct Hydraulic Circuit Diagram **P7.** Construct electric circuit diagram
CU2. Construct circuit to control double acting Hydraulic Cylinder using 2 push buttons and canceling with limit switch	**P1.** Prepare simulation circuit of double acting cylinder as per drawing **P2.** Fix the push button and limit switch at their designated place as per drawing **P3.** Turn on the circuit power supply and ensure proper working of all equipment. **P4.** Press the push button to start fluid supply and will enable the cylinder for forward stroke supply. **P5.** Observe that as the push rod touches limit switch the supply of coil would disconnect and the piston would stop. **P6.** Press the second push button to complete backward stroke of piston, this will enable the supply of side coil and the backward stroke of piston would be completed and as it enters the surroundings of limit switches the supply would be disconnected. **P7.** Change 5/2 DCV and complete the opposite circuit. **P8.** Observe this changed circuit and note down all the observations.
CU3. Construct hydraulic circuit using Accumulator stored Energy by DAC	**P1.** Turn on the motor power supply and ensure proper working of all devises and equipment. **P2.** Use flow control valve to ensure fluid flow. **P3.** Observe the movement of piston rod. **P4.** When the circuit is burnt/completed the turn off the power supply. **P5.** Observe that due to accumulator the double acting

	cylinder completes its stroke and doesn't stop immediately after the burning of circuit.
CU4. Measure pressure at various connections in hydraulic circuits	**P1.** prepare the hydraulic circuit as per drawing **P2.** Install pressure gauges on the points where pressure is to be noted **P3.** Turn on the hydraulic circuit **P4.** Ensure fluid flow through the whole circuit **P5.** Complete the circuit and note the readings of all gauges **P6.** Enter all readings in observation table

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:

- Describe mechanical interlocking function
- Describe the function of hydraulic circuit
- Describe double acting hydraulic cylinder
- Describe 3/2 push buttons
- Describe 5/2 double acting side pilot operated DCV
- Describe function of connecting tubes
- Describe function of limit switches
- Describe the role of accumulator
- Describe mechanism of energy storage in accumulator
- Describe working of hydraulic accumulator
- Describe fluid port
- Describe construction of hydraulic actuator
- Describe function of actuators
- Describe coupling
- Describe functioning of chillers
- Describe proximity switch or limit switch
- Describe purpose of hydraulic circuit
- Draw analogy between hydraulic and electrical circuit
- Describe function of pressure control valve
- Describe flow control valve

Critical Evidence(s) Required

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

- Working of Actuate double acting hydraulic cylinder by switch

- Describe mechanical interlocking function
- Describe double acting hydraulic cylinder
- Describe function of connecting tubes
- Describe mechanism of energy storage in accumulator
- Describe working of hydraulic accumulator
- Describe construction of hydraulic actuator
- Describe function of actuators
- Describe purpose of hydraulic circuit
- Describe function of pressure control valve
- Describe flow control valve

Tools and Equipment

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

S. No.	Items
1.	Apparatus
2.	Hydraulic bench
3.	Mechanical interlocking
4.	Double acting cylinder
5.	Fluid control valve
6.	DC pressure Gauges
7.	Double acting cylinder
8.	3/2 push button
9.	5/2 double acting side pilot operated DCV
10.	Contacting tubes
11.	Hydraulic bench
12.	Push button
13.	Limit switch
14.	Pressure gauges
15.	Hydraulic Bench
16.	Double Acting Cylinder
17.	Accumulator Flow Control
18.	Valve
19.	DCV
20.	Pipe Hoses
21.	Pressure Gauges
22.	Hydraulic bench
23.	Pressure control valve
24.	Flow control valve
25.	Hydraulic pump hoses

0714E&A124. Set Speed and Direction of a Hydraulic Actuator

Overview: This competency standard covers the skills and knowledge required to set-up a hydraulic motor using flow control valve and setting-up direction using direction control valve.

Competency Unit	Performance Criteria
CU1. Set hydraulic Actuator(Motor) R.P.M using flow control valve	**P1.** Complete the hydraulic circuit as per drawing. **P2.** Turn on the motor power supply and ensure proper working of all devises and equipment. **P3.** Fix the tachometer with the rotor to note motor RPM **P4.** Use flow control valve to control the flow, this would also control the motor RPM. **P5.** Observe the speed during this process. **P6.** Note RPM at different flow rates and analyze them.
CU2. Set hydraulic Actuator (Motor) direction by using direction control valve	**P1.** Complete the hydraulic circuit as per drawing. **P2.** Turn on the motor power supply and ensure proper working of all devises and equipment. **P3.** Use DCV to rotor the motor Clockwise and Anti Clockwise. **P4.** Observe the direction during this process. **P5.** Repeat the process.

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:

- Describe hydraulic motor

- Describe operating principle of hydraulic motor
- Describe tachometer
- Describe flow control valve
- Describe DCV

Critical Evidence(s) Required

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

- Describe operating principle of hydraulic motor
- Describe tachometer
- Describe operating principle of hydraulic motor
- Describe tachometer
- Describe flow control valve

Tools and Equipment

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

S. No.	Items
1.	Apparatus
2.	Hydraulic bench
3.	Hydraulic motors
4.	Tachometer
5.	Flow control valve
6.	Direction control valve
7.	Pipe hoses
8.	Pressure gauges
9.	Hydraulic bench
10.	Hydraulic motors
11.	Tachometer
12.	Flow control valve
13.	Direction control valve
14.	Pipe hoses
15.	Pressure gauges

0714E&A125. Perform Pressure measuring instruments operations

Overview: This competency standard covers the skills and knowledge required to identify, and explain the construction and working of various pressure measuring devices.

Competency Unit	Performance Criteria
CU1. U Tube Manometer	**P1.** Set up the equipment. Connect one leg of manometer to the inlet port and the other leg to the outlet port. Initiate the flow of fluid through the test pipe. **P2.** Observe the difference in head between the two legs of the manometer and record. **P3.** Compute the pressure difference between the pipe inlet and outlet. **P4.** Repeat the experiment for various flow rates of fluid through the test pipe.
CU2. Inclined manometer	**P1.** Set up the equipment. Connect one leg of inclined manometer to the inlet port and the other leg to the outlet port. Initiate the flow of fluid through the test pipe. **P2.** Observe the difference in head between the two legs of the manometer and record. **P3.** Compute the pressure difference between the pipe inlet and outlet. **P4.** Repeat the experiment for various flow rates of fluid through the test pipe.

CU3. Micro Manometer	**P1.** Observe the enlarged ends of both tubes of the manometer **P2.** Adjust the instrument initially as p1 = p2. **P3.** Note the reading of the micrometer **P4.** Apply the unknown pressure difference **P5.** Observe the meniscus to move off the hairline, which can be restored to the initial position by raising or lowering the well (mercury sump). **P6.** Note the difference in the initial and final micrometer readings **P7.** Note the height of the mercury column and hence the pressure.
CU4. Pressure measurement in The Mercury Barometer	**P1.** Take a reservoir and fill with any fluid **P2.** Put a glass tube in the reservoir in inverted state **P3.** Make the top portion of glass tube as air tight while the internal surface as complete vacuum **P4.** When the glass tube is dipped in the tank, an improper balanced pressure is created **P5.** Observe water from the tank rises in the tube **P6.** Note that the water would rise to particular height/ limit **P7.** Note that point where the water would stop lifting up **P8.** This pressure noted directly from the scale of the tube would give us the exact atmospheric/ air pressure
CU5. Borden Tube	**P1.** Observe the device consisting of a metallic tube of elliptical section closed at one end A **P2.** Note the other end B being fitted to the gauge point where the pressure is to be measured. **P3.** Enter the fluid in the tube **P4.** Observe the tube tending to straighten. **P5.** Observe a pinion-sector arrangement pivoted with the pointer needle and already calibrated markings **P6.** Note the small elastic deformation of the tube is communicated to a pointer over a graduated dial. **P7.** Calibrate the device by subjecting it to various known pressures.
CU6. Piezo Metric Tube	**P1.** Close all the valves of the tubes manifold. **P2.** Fill the tank until the lower part of the piezo metric tube is in contact with water. **P3.** Connect the pump to the upper plug of the tank with the non-return valve in the correct direction and pressurize the tank. **P4.** Observe if the water head in the piezo metric tube rises.

	P5. Observe the level is kept constant when we stop to pressurize with the pump.
CU7. Elastic Diaphragms	**P1.** Observe the diaphragm fixed in a tubular member. **P2.** Observe the initial pressure on a diaphragm **P3.** Apply the unknown pressure from one side. **P4.** Observe a direct connection between diaphragm and pinion-sector **P5.** Observe a pinion-sector arrangement pivoted with the pointer needle and already graduated markings on the dial **P6.** Note the small elastic deformation of the diaphragm is communicated to a pointer over the graduated dial.

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 Difference between absolute pressure and gauge pressure
- Define Difference between u tube inclined and differential manometer
- Define Pressures as low as 0.025mm water column can be measured.
- Define What is a barometer
- Define What is the basic function of a barometer
- Explain the selection process of a pressure gauge
- Describe the types of Bourdon tubes
- Explain the purpose of different Bourdon tubes
- Explain the formula for calculating a static head
- Define Conversion of pressure gauge into a level gauge
- Define the units of Pressure
- Explain the necessity of putting the plug in the tank
- Explain natural frequency

Critical Evidence(s) Required

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

- Differentiate between absolute pressure and gauge pressure
- Differentiate between u tube inclined and differential manometer
- Explain the selection process of a pressure gauge
- Explain the purpose of different Bourdon tubes
- Explain the formula for calculating a static head

- Explain the necessity of putting the plug in the tank
- Explain natural frequency

Tools and Equipment

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

S. No.	Items
1.	U Tube Manometer
2.	Hydraulic Bench (if working fluid is water)
3.	Air Compressor (if working fluid is air), Scale
4.	Inclined Manometer
5.	Hydraulic Bench (if working fluid is water)
6.	Air Compressor (if working fluid is air), Scale

0714E&A126. Operate Flow Regulating Devices (Valves)

Overview: This competency standard covers the skills and knowledge required to identify, evaluate and explain different types of valves.

Competency Unit	Performance Criteria
CU1. Ball Valve	**P1.** Identify various parts of the ball valve including Handle, shaft, Ball, Seats and valve body **P2.** Observe a ball with a hole drilled through the centre swivel mounted within the valve body **P3.** Ensure the hole in the ball is orientated in the same direction as the pipe to allow flow **P4.** Observe the hole in the ball is oriented away from the direction of the pipe, the flowrate will be restricted and

	finally cut off completely when the hole is oriented at 90 degrees to the pipe direction **Note**: that the hole in the ball is a lesser diameter than the nominal bore of the pipe
CU2. Butterfly Valve	**P1.** Identify the gear box, handle, butterfly and the body of the butterfly valve **P2.** Observe a circular disc in the middle of fluid pipe. **P3.** Ensure the butterfly is oriented in the same direction as the pipe to allow full flow. **P4.** Oriented the butterfly away from the direction of the pipe, the flowrate will be restricted by the increased area of obstruction to the fluid **P5.** Keep the butterfly orienting away from the fluid until 90 degrees to completely restrict the flow
CU3. Gate valve	**P1.** Identify gate and body of the gate valve **P2.** Identify the gate in the valve **P3.** Identify the shape of the gate with respect to the pipe diameter **P4.** Identify the direction of movement of the gate **P5.** Ensure the complete upward motion of the gate for full flow of the fluid **P6.** Ensure compete downward motion of the gate until the opposite end for complete restriction to the fluid flow.
CU4. Diaphragm Valve	**P1.** Identify bonnet, diaphragm/ flexible sheet, seat and main body of the valve **P2.** Identify whether the valve is manual or pneumatic actuated **P3.** Observe the fluid flow rates from the pipe as the diaphragm is pushed towards the seat for complete obstruction to the flow
CU5. Non Return Valve	**P1.** Identify the following parts in a non-return/ check valve: body, cover plate, disc, seats, hinge, hinge pin, nut, cotter pin, stud bolt, gasket, washer **P2.** Observe the fluid flow as the disk is released **P3.** Observe the disk being fixed as the flow direction is reversed
CU6. Pressure Relief Valve	**P1.** Identify the following parts in pressure relief valve: set pressure adjusting screw, spring, disk holder, seat disk, nozzle, bonnet, bonnet plug and body

	P2. Identify various types of pressure relief valve **P3.** Observe system pressure and spring pressure **P4.** Observe the valve opening as the system pressure increases then spring pressure

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 a valve
- Identify applications of Ball Valve
- Explain the safety precautions of ball valve
- Explain the terminology of 'butterfly valve'
- Identify its industrial applications
- Explain the safety precautions of Butterfly Valve
- Describe Gate/ Knife gate valve
- Explain the isolation valves
- Explain the precaution for knife gate valve
- Identify its Industrial Applications
- Explain the safety precautions of Gate valve
- Compare diaphragm and gate valve
- Explain the industrial applications of diaphragm valve
- Explain the safety precautions of Diaphragm Valve
- Mention and explain various types of non-return valve
- Explain unidirectional valve working mechanism
- Identify various industrial applications of Non-return valve
- Explain the safety precautions of Non Return Valve
- Explain the safety aspects of pressure relief valve
- Describe industrial applications of Pressure relief valve
- Explain the safety precautions of Pressure Relief Valve

Critical Evidence(s) Required

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

- Identify a different types of valves
- Explain the safety precautions of ball valve
- Explain the terminology of 'butterfly valve'
- Explain the safety precautions of Gate valve
- Explain the industrial applications of diaphragm valve

- Explain the safety precautions of Diaphragm Valve
- Mention and explain various types of non-return valve
- Explain various industrial applications of Non-return valve
- Describe industrial applications of Pressure relief valve

Tools and Equipment

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

S. No.	Items
1.	Apparatus
2.	Ball Valve
3.	Section view drawing of Ball Valve
4.	Butterfly Valve
5.	Section view drawing of Butterfly Valve
6.	Gate Valve
7.	Section view drawing of Gate Valve
8.	Diaphragm Valve
9.	Section view drawing of
10.	Non Return Valve
11.	Section view drawing of Non Return Valve
12.	Pressure Relief Valve
13.	Section view drawing of Pressure Relief Valve

0714E&A127. Maintain Pneumatic System

Overview: This competency standard covers the skills and knowledge required to Pneumatic system maintenance in process industry. It also deals with basic

Pneumatic concepts, Test performed and verification of system. Maintenance of temperature & Perform repairing in pneumatic system.

Competency Unit	Performance Criteria
CU1. Perform pneumatic system tests	**P1.** Apply desired pneumatic pressure as per system requirement **P2.** Verify pneumatic cylinder performance for normal operation **P3.** Test filters performance for clogging **P4.** Verify performance of gauges performance for normal operation **P5.** Verify performance of pneumatic Pumps performance for normal operation
CU2. Verify Pneumatic system parameter and temperature	**P1.** Verify performance of pneumatic system performance for normal operation **P2.** Verify physical condition of pneumatic system performance for normal operation **P3.** Test compressing equipment parameter implementing recommended testing methods **P4.** Adjust equipment controls for desired parameters
CU3. Diagnose fault in Pneumatic system	**P1.** Determine air leakage in pneumatic system implementing leakage testing methods. **P2.** Verify Pneumatic equipment performance for normal operation
CU4. Replace equipment	**P1.** Remove desired equipment from Pneumatic system **P2.** Mount equipment in Pneumatic system
CU5. Repair pneumatic system	**P1.** Diagnose causes of leakage in the system **P2.** Replace faulty equipment in pneumatic system implementing recommended testing methods

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:

- Interpret Pneumatic drawing / manual
- Define physical properties of air
- Describe Volume and pressure in pneumatic system

- Relate Pressure, Volume and temperature in Gases
- Describe working of air compressor
- Enlist equipment of a typical pneumatic system
- Describe working of pneumatic equipment
- Describe the method of compress air Preparation
- Describe the production method and application of compressed air and vacuum
- Describe the method of pneumatic system performance test
- Describe the method of parameter testing in pneumatic system

Critical Evidence(s) Required

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

- Define basic Pneumatic concepts, Test performed and verification of system.
- Perform to Maintain temperature
- Perform repairing in pneumatic system.

Tools and Equipment

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

S. No.	Items
1.	Measuring tapes
2.	Mechatronics simulator station
3.	Number punch and alphabet punch
4.	Oil separator
5.	Old and damaged instruments for better inspiration
6.	Pinching Pliers
7.	Pipe wrench
8.	Piping and Tubing Training System
9.	Pliers set (combination, side cutter and nose)
10.	Pneumatic filters
11.	Pneumatic valves
12.	Pressure calibrator

W. *Develop Entrepreneur Skills*

0714E&A128. Investigate Micro Business Opportunities

Overview :

This competency describes the performance outcomes, skills and knowledge required to develop business ideas, and to investigate market needs and factors affecting potential markets.

Competency Unit	Performance Criteria
CU-1. Describe business ideas	P1. Gather information for business ideas from appropriate sources P2. List details of business ideas and opportunities P3. Research alternative business ideas in light of the resources available P4. Specify and list products and services to match business ideas P5. .Identify and research potential customer information for business ideas P6. Identify and take into account financial, business and technical skills available when researching business opportunities

CU-2. Identify market needs	P1. Collect information regarding market size and potential from appropriate sources P2. Investigate market trends and developments to identify market needs relative to business ideas P3. Gather market information from primary and secondary sources to identify possible market needs in relation to business ideas P4. Identify ethical and cultural requirements of the market and their impact on business ideas P5. Identify new and emerging markets and document their features P6. Identify and organise information on expected market growth or decline and associated risk factors
CU-3. Investigate factors affecting the market	P1. Identify projected changes in population, economic activity and the labour force that may affect business ideas P2. Identify movements in prices and projected changes in availability of resources P3. Review trends and developments and identify their potential impact on business ideas

Knowledge and understanding

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

- Define entrepreneurship.
- Explain the concept of entrepreneurship
- Explain the various types of enterprise that exist in the community
- Identify and interpret the terms and elements involved in the concept of enterprise

- Appreciate that the advancement of individual and society in general when entrepreneurship is adopted
- Explain various motivational factors that entrepreneurs possess and utilize.
- Exhibit the skills needed to assess and evaluate a risk
- Describe the outline of small enterprise
- Describe the creativity and innovation
- Apply the techniques for developing creative abilities
- Explain the resources of business idea
- Explain the collective and creative thinking
- Explain how to generate a business idea
- Appreciate the importance of, and possess techniques for identifying and assessing business opportunities.
- Identify the various entrepreneurial characteristics
- Access personal potential for becoming future entrepreneurs.
- Identify leadership qualities which are essential to the success of entrepreneurs
- Identify self- management skills and how they are important to be enterprising
- Apply a rational approach to make personal and business decisions
- Explain the steps for decision making and rating of decision making skills
- Apply the rules of negotiation for resolving business issues

Tools and Equipment

S No.	Tools
1	Calculator
2	Ruler
3	Papers and Pencil

Critical Evidence(s) Required

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

Evidence of the following is essential**:**

- Thorough investigation of business opportunities and ideas
- Clearly identified products/services and customer information for each business idea
- Thorough collection and analysis of market information and associated factors relating to business ideas
- Knowledge of ethical and cultural requirements.

0714E&A129. Develop a Micro Business Proposal

Overview :

This competency describes the performance outcomes, skills and knowledge required to develop an identified business idea, to research the feasibility of the business opportunity and to present a business idea in formats that suit a range of stakeholders

Competency Unit	**Performance Criteria**
CU1.Evaluate business opportunities	P1. Identify and research key factors that influence viability of business ideas P2. Analyse business ideas in terms of personal or family needs and commitments P3. Evaluate impacts of emerging or changing technology, including e-commerce, on the business P4. Determine viability of business opportunity in line with perceived risks, resources available, financial returns and other outcomes sought P5. Assess and match personal skills/attributes against those perceived as necessary for a particular business opportunity P6. Identify and assess business risks according to resources available and personal preferences

CU2.Detail the business idea	P1. .Develop an accurate description of the business idea for key stakeholders P2. Develop an accurate summary of the major products and/or services required to suit personal needs and requirement
CU3.Prepare the business **Overview** to suit different stakeholders	P1. Present an accurate list of key stakeholders and their information requirements P2. Determine an acceptable method of presentation of information for each stakeholder P3. Provide accurate customised information to target audiences

Knowledge and understanding

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

- State and local government legislative requirements relating to business operation, especially in regard to occupational health and safety (OHS) and environmental issues,
- Income and expenditure costing •
- Principles of risk assessment relevant to the business opportunity

Tools and Equipment

S No.	Tools
1	Calculator
2	Ruler

3	Papers and Pencil

Critical Evidence(s) Required

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

Evidence of the following is essential**:**

- accurate and complete outline of the business idea that considers the major elements of**:**
  - products/services
  - customers
  - operations and processes
  - income and expenditure
  - resources
  - marketing
  - location

0714E&A130. Develop a Marketing Plan

Overview :

This competency describes the performance outcomes, skills and knowledge required to research, develop and present a marketing plan for an entrepreneurship business

Competency Unit	**Performance Criteria**

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

	tactics P3. Present marketing plan for approval in the required format and timeframe P4. Adjust marketing plan in response to feedback from key stakeholders and disseminate for implementation within the required timeframe

Knowledge and understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of**:** Culturally appropriate communication skills to relate to people from diverse backgrounds and people with diverse abilities

- Describe the market & marketing
- Differentiate between sellers and buyers' market
- Describe the five 'w' of market
- Explain the procedure for assessing the market size and demand
- Explain the major factors to be considered when selecting a location for a business
- Describe the basic types of business ownership and the limitation of each
- Explain the computation of initial and working capital needed to start an enterprise
- Identify the advantages and disadvantages of using various sources of capital to start an enterprise
- Explain the component of cost of product
- Explain the breakeven analysis for a new business
- Calculate the breakeven point for various new business

Tools and Equipment

S No.	Tools
1	Calculator

2	Ruler
3	Papers and Pencil

Critical Evidence(s) Required

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

- Devising, documenting and presenting a marketing plan
- Detailing approaches and
- The marketing mix to achieve organisational marketing objectives.

0714E&A131. Develop and Review a Business Plan.

Overview :

This competency standard covers the process of developing and reviewing business for a small business enterprise. It requires the application of knowledge and skills to determine the scope of the business plan, prepare a business plan, determine goals, trial systems, and document, monitor and review the business plan.

Competency Unit	Performance Criteria
CU-1. Determine scope of business	**P1.** Determine scope of the business plan and associated systems is determined in consultation with specialist personnel. **P2.** Access accurate information for inform business plan development **P3.** Account for and incorporate trends and seasonal variations into the business plan. **P4.** Account for strategic goals, targets and directions of the enterprise in the development of the business plan **P5.** Comply Legal obligations in developing the business plan.
CU-2. Prepare business plan	**P1.** Develop operational goals and targets to meet the enterprise strategic plan. **P2.** Identify and incorporate supply chains into the business plan. **P3.** Identify risk management needs are within the business plan. **P4.** Incorporate trial systems in order to test budgetary impact and operational potential prior to full implementation of the business plan.

	P5. Set clear and measureable indicators of operational performance to allow for realistic analysis of performance.
CU-3. Document and review business plan	**P1.** Include fiscal and operational systems that enhance performance management and suit enterprise requirements. **P2.** Incorporate resource considerations the business plan. **P3.** Document accurately and clearly communicate business Plan to all relevant parties. **P4.** Monitor to identify strengths, weaknesses and areas for improvement performance against the business plan **P5.** Make recommendations to improve the business plan and associated systems as required.

Knowledge and understanding

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

- Appreciate the importance of business plan
- Explain the process of writing a business plan
- Develop feasibility for a business idea
- Realize the problem that may be encountered when starting a small business/Enterprise
- Develop a business plan for a small business on the standard format
- Evaluate the business plan in a real market satiation

- The knowledge requirements for this competency standard are listed below**:**
- budgeting
- forecasting
- operational systems
- relevant industrial awards and agreements
- communication techniques
- logical and analytic methods
- profit and loss and cash flow systems
- working knowledge of environmental, OHS, industrial relations, taxation, corporate and industry legislation as they relate to the enterprise

Tools and Equipment

S No.	Tools
1	Construction Lab Tools
2	Rule,tape, square, hammer, hand saw, hand plane, chisel, shovel, wheelbarrow, sledge hammer, pick, mattock 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.

0714E&A132. 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
CU-1. Ascertain own financial position and the ability to provide capital/equity for the business	P1. Realistically detail personal, family or community financial situation in terms of funds available and commitments already incurred P2. Determine equity finance and assets available for micro business from personal, family or community sources
CU-2. Determine projected cash flow for the business	P1. Determine the level of forecast business activity over a year and the business mix P2. Estimate establishment costs for the business and repayment schedule for borrowings P3. Calculate the monthly variable and fixed costs needed to conduct business activity over a year P4. Estimate personal drawings needed to be taken from the business P5.Estimate the monthly income generated by the business for a year based on price per unit item or hourly charge rate for labor P6. Develop a cash flow budget for the first year of business operation P7. Seek professional advice to estimate goods and services tax and operating finance required for the

	business
CU-3. Source the required funds to establish the business	P1. Estimate required funding to establish and run the business based on expected sales and activity levels, available finances and commitments P2. Investigate methods of accessing alternative sources of finance P3. Identify strategies for meeting financial obligations P4. Implement plans to access available funds as required
CU-4. Monitor profitability of the business	P1. Maintain and review monthly expenditure and income records P2. Compare equity at beginning and end of a year to estimate business performance P3. Assess the financial viability of the business after a year of operation P4. Seek professional advice on depreciation, insurance and tax implications of the business

Knowledge and understanding

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

- Basic budgeting
- basic costing for the business
- financial commitments and requirements
- financial reports and terminology
- methods and relative costs of obtaining finance
- own financial position
- Sources of advice and assistance.

Critical Evidence(s) Required

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

- investigation of projected cash flow for the business
- estimation of the funding needed to establish and operate the business
- assessment of the financial viability of the business
- Knowledge of basic budgeting.

0714E&A133. Manage Human Resources

Overview :

This competency standard covers the skills and knowledge required to manage human resources and to manage and develop human resources to achieve organization's operational objectives

Competency Unit	Performance Criteria
CU-1. Lead and motivate people	P1.Establish goals for people and teams to optimise achievement in work tasks. P2.Take into account the capabilities of people and teams. P3. Provide advice and support sensitive to the individual's needs to people in the performance of their duties. P4. Undertake activities to achieve commitment to common goals. P5. Recognise and encourage initiative and innovation P6. Recognise and communicate achievements within the organisation.
CU-2. Undertake human resource planning	*P1.Determine human resource needs* within the anticipated operational needs and allocated budget. P2. Analyse alternatives to staffing levels which clearly demonstrate returns to the organisation. P3. Develop contingency plans for staffing which meet key provisions of the human resources plan. P4. Compare existing competencies of staff with the needs of the work group. P5. Plan staffing levels and negotiate with

	stakeholders within the organisational framework to achieve maximum efficiency of operations.
CU-3. Develop and facilitate performance	P1.Negotiate Performance Criteria individuals, teams and work groups. P2. Review Performance Criteria as circumstances change. P3. Conduct p*erformance appraisal* based on clearly established and agreed Performance Criteria. P4.Identify and propose the total performance development system strategies to rectify performance shortfalls and recognise success. P5. Address performance problems confidentially and in a constructive and timely manner, in line with relevant organisational procedures. P6. Make s*elections, transfers and promotions* in accordance with organisation policies and supported with documented information. P7. Develop and implement mechanisms for the identification of human resource development needs within the work group taking account of the strategic plan for the organisation.
CU-4. Facilitate training, education and development opportunities	P1.Make information on planned training events widely available throughout the organisation. P2. Include training, education and development plans as part of individual/team performance plans. P3. Facilitate individual/team access to, and participation in, training, education and development opportunities.

	P4.Contribute coaching and mentoring effectively to the training, education and development of personnel in an environment of change. P5.***Enhance training, education and development opportunities*** of individual, team and organisational performance. P6. Create workplace environment is which facilitates training, education and development

Knowledge and understanding

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

- Describe the hiring method/Procedures
- Describe the term & conditions of services and job description for various employments
- Describe the characteristics of successful sales personals
- communication principles
- conflict resolution principles and practice
- Equal Employment Opportunity
- grievance procedures
- interpersonal relations
- leadership theory and principles
- management principles and practice
- Occupational Health and Safety
- training and education principles
- training need analysis

Critical Evidence(s) Required

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

It is essential that competence be demonstrated in the application of human resource management in a wide range of contexts in achieving the organisation's objectives.

- Evidence should be gathered over a period of time in a range of actual or simulated workplace environments.
- Evidence of competent performance should be obtained by observing an individual in a management role within the workplace or exercise or operational environment. Knowledge may be assessed through written assignments, project reports, debriefings and action learning projects.

0714E&A134. Market Products and Services

Overview :

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

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

	role in your marketing strategies P4. Ensure the data used is reliable and the market environment and trends are substantiated P5. Evaluate the role of marketing professionals in providing advice
CU-3. Develop a marketing plan for your products and services	P1. Establish marketing objectives based on current and potential product specifications P2.Select appropriate production processes to ensure product specifications are met P3. Select selling strategies to ensure required prices are achieved P4. Select appropriate distribution channel options to ensure access to target markets is achieved efficiently and appropriately P5.Establish time-frames for production, distribution and selling activities P6.Develop a gross margin budget to demonstrate the cost effectiveness of the marketing plan P7.Develop partial gross margin budgets to account for market variability
CU-4. Determine promotional strategies	P1. Prepare and record detailed plans for promotional activities P2. Outline objectives, level of exposure and available markets P3. Ensure strategies take account of time management and scheduling issues, and resource constraints P4. Create promotional materials that enhance the product and commercial presentation P5.Record and communicate priorities, responsibilities, timelines and budgets for promotional activities.

CU-5. Implement marketing activities	P1. Schedule planned marketing activities within appropriate timeframes P2. Develop measurable performance targets that meet business plan objectives P3. Organise distribution channels and ensure product and service information is accurate and readily available to clients P4. Implement marketing activities within budgetary constraints to meet legal, ethical and enterprise requirements
CU-6. Evaluate marketing performance .	P1. Review the established marketing objectives to ensure they remain viable P2. Make an objective assessment of the marketing plan and its implementation by a comparison of valid and reliable data against the established objectives P3.Assess product, pricing and distribution policies in relation to market changes, marketing objectives and enterprise requirements P4. Identify areas of positive marketing performance and take corrective action to remedy poor marketing performance areas P5. Document and distribute information for continual analysis and effective planning management

Knowledge and understanding

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

- Describe the life cycle of product

- Identify the various ways of selecting suppliers,
- Explain the inventory management of stock, raw material and finished goods etc.
- Appreciate the importance of financial record keeping in a small business
- Explain techniques to keep cost as low as possible
- Develop balance sheet for a small enterprise
- Explain the operating cycle concept
- Explain the income tax computation procedure for a small business
- Explain the basic scheme of sales tax
- Explain the assessment procedure for returns and filling of returns.

Critical Evidence(s) Required

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

- Handle and set Lightening for Current affair program
- identify the marketable features of the product and potential markets
- develop a range of marketing alternatives
- collect and analyses data to assess alternatives in a marketing plan
- evaluate performance targets and recommend modifications or improvements
- implement and evaluate a marketing plan
- Plan to manage promotional activities.

0714E&A135. Monitor and Review Business Performance

Overview :

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

Competency Unit	Performance Criteria
CU-1. Evaluate commercial performance	P1. Gather and analyse data relating to enterprise performance to identify historical and current performance. P2. Review and analyse operational structures to determine the suitability of organisational processes to enterprise objectives. P3. Evaluate enterprise strengths and weaknesses against market conditions to determine current and future capacities. P4. Evaluate enterprise objectives are to identify variations and scope for future development.
CU-2. Allocate and co-ordinate business resources	P1. Identify and communicate roles and responsibilities of personnel. P2. Identify resource requirements for enterprise and cost them using standard financial analysis techniques. P3. Calculate costs of ensuring sustainability of enterprise operations and factor into business planning for the enterprise.
CU-3. Identify performance requirements	**P1.** Develop realistic performance indicators within available timeframes and resources **P2.** Identify and minimize factors inhibiting performance against objectives.

	P3. Monitor and assess market conditions based on relevant data. **P4.** Prepare and incorporate strategies and programs to promote the sustainability of operations into enterprise procedures.
CU-4. Review business performance	**P1.** Review regularly enterprise operations to identify opportunities for improvements in performance. **P2.** Monitor and anticipate impact of natural conditions on enterprise to assess sustainability of resource use. **P3.** Compare costs and estimates with resource allocation. **P4.** Determine operational plans to determine schedule of activities

Knowledge and understanding

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

- rates of return for products and/or services
- financial analysis techniques
- structure and operation of small businesses relevant State/Territory Occupational Health and Safety (OHS)
- legislative requirements
- environmental conditions, positive environmental practices and negative impact minimisation measures
- human resource requirements for the enterprise
- transport requirements for the enterprise
- Enterprise/property improvement requirements.
- market performance in commodities
- statutory marketing requirements

Critical Evidence(s) Required

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

- review operational structures to determine effectiveness
- identify available resources to assess capacity
- develop realistic performance indicators
- review enterprise operations against performance indicators
- Plan to improve business performance by addressing results of review.

0714E&A136. Negotiate for Resolving Business Issues

Overview :

This competency standard covers the skills and knowledge required to negotiate for resolving business issues

Competency Unit	Performance Criteria
CU-1. Develop and implement issue resolution and grievance procedures	P1. Establish problem solving/issue resolution procedures within legislative requirements and organisation's guidelines. P2. Manage grievances and complaints are in a timely and caring way to optimise likelihood of a favourable outcome for all parties and in line with organisational objectives and procedures. P3. Document and communicate individual's rights and obligations under industrial awards/agreements and legislation are in a clear and concise manner and in appropriate language. P4. Conduct hearings, interviews and meetings within the principles of industrial democracy and participative, consultative processes. P5. Identify and invite all relevant industrial parties to participate in the resolution process.
CU-2. Manage disciplinary matters	P1. Implement disciplinary matters in accordance with organisation's procedures. P2. Conduct investigations in a caring and confidential manner to maintain performance and morale. P3. Provide feedback promptly. P4. Institute appeals processes in accordance with organisational procedures. P5. Recognize and recommend deficiencies in procedures for changes made

Knowledge and understanding

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

- Communication Skills
- Interpersonal skills
- Business letter writing
- Forecasting techniques

0714E&A137. Manage Personal Finances

Overview :

This unit of competency describes the outcomes required to develop, implement and monitor a personal budget in order to plan regular savings and manage debt effectively.

Unit of Competency	Performance Criteria
CU1 Develop a personal budget	**P1** Calculate current living expenses using available information to prepare a personal budget. **P2** Keep a record of all income and expenses for a short period of time to help estimate ongoing expenses. **P3** Subtract total expenses from total income to determine a surplus or deficit budget for the specified period. **P4** Find reasons for a deficit budget and ways to reduce expenditure identified.

	P5 Identify ways to increase income, if possible
CU2 Develop longer term personal budget	**P1** Analyze income and expenditure and set longer term personal, work and financial goals. **P2** Develop a longer-term budget based on the outcomes of short-term budgeting, and adjust to meet living, work and future career requirements. **P3** Identify obstacles that might affect finances such as job loss, sickness or unexpected expenses contingency savings **P4** Formulate a regular savings plan based on budget, using secure savings products and services. **P5** Monitor expenditure against budget and identify areas of possible expenditure saving
CU3 Identify ways to maximize future finances	**P1** Determine sources and ways to maximize personal income, including from work, investments or available government payments/allowances. **P2** Get further education or training to maintain or improve future income. **P3** Identify the need for debt to finance living and other expenses, and determine the appropriate levels of debt and repayment. **P4** Consolidate existing debt, where possible, to minimize interest costs and fees.

	P5 Seek professional money management services, where available, to ensure financial plans are effective and achievable.

Knowledge and understanding

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

- .Explain the abilities to plan and organize to keep records and monitor a personal budget
- .Describe abilities to set and review goals
- Explain basic financial management and record keeping to enable development and management of a personal budget
- Describe benefits of financial goal setting and personal budgeting to enable effective management of personal finances
- Outline numeracy skills to compare income and expenditure

Critical Evidence(s) Required

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

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

Performance requirements

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

- develop a personal budget based on analysis of expenditure and income;
- formulate goals and identify financial contingency plans; and
- Monitor expenditure for a period of up to 2 weeks

0714E&A138. Coordinate a Work Team

Overview :

This unit is concerned with the competencies required to achieve operational outcomes and effective working relationships through managing and developing individuals and teams.

Unit of Competency	Performance Criteria
CU1 Develop and maintain a cooperative work group	**P1** Work contributions and suggestions from staff are **P2** continually sought and encouraged **P3** Contributions to work group operations are acknowledged and suggestions are dealt with constructively **P4** Develop staff skills according to work requirements **P5** Implement new work practices **P6** Address conflict between staff members in accordance with current personnel practices.
CU2 Communicate objectives and required standards	**P1** Inform the staff of the objectives and standards **P2** required **P3** Commit to objectives and standards **P4** Practices of safe, fair and participative work principals are and promote to staff
Provide feedback on performance	**P1** Give constructive feedback on all aspects of work performance provided to individuals and team **P2** Access and address performance in a

	fair and timely manner in accordance with relevant guidelines, procedures and natural justice
CU3 Support and participate in development activities	**P1** Assess training needs of all staff, implemented and promoted **P2** Devise an action plan to meet individual and group training **P3** and development needs is collaboratively developed, **P4** agreed to and implemented **P5** Identify specific training needs of individuals **P6** Encourage staff in applying skills and knowledge in the workplace **P7** Provide training to the required standard on the job **P8** Support and encourage staff to attend training courses and to take up other development opportunities.
CU4 Provide leadership. direction and guidance to the work group	**P1** Link between the function of the group and the **P2** goals of the organization **P3** Participate in decision making routinely to develop, implement and review work of the group and to allocate responsibilities where appropriate **P4** Give opportunities and encouragement to others to develop new and innovative work practices and strategies **P5** Identify conflict and resolve with

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

Knowledge and understanding

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

- Explain the principles of effective team operation
- Explain the principles of human resource management
- Describe the training delivery processes in the workplace
- Outline the industry assessment guidelines

Critical Evidence(s) Required

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

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

Performance requirements

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

- assessing and evaluating skills
- working effectively in a team environment
- achievement of work outcomes

0714E&A139. Lead Small Teams

Overview :

This unit describes the outcomes required to lead small teams including setting and maintaining team and individual performance standards

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Unit of Competency	Performance Criteria
CU1 Facilitate team Development	**P1** Identify work requirements, standards and purpose to team members. **P2** Assist team to develop objectives, targets and key performance indicators relevant its purpose and workplace goals. **P3** Allocate duties regard to the skills required to properly **P4** undertake the assigned task and according to company policy **P5** Identify roles, responsibilities and expectations of each team member **P6** Disseminate and discuss performance expectations to individual team members.
CU2 Motivate and build the Team	**P1** Develop positive and constructive relationships with and between team members **P2** Facilitate team communication processes **P3** Involve team members in the process of examining risks and options and making decisions, to ensure acceptance and support. **P4** Encourage individual and team efforts and contributions **P5** Strengths and weaknesses of team

	members are determined and sharing of work tasks is promoted to up skill team members. **P6** Recognize team members' queries and discuss and deal with it.
CU3 Facilitate and monitor team effectiveness	**P7** Monitor the implementation of work plan and team and individual performance 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 the person concerned.

Knowledge and understanding

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

- Explain conflict resolution techniques
- Explain management styles
- Describe methods of monitoring performance
- Outline the relevant legal requirements
- Outline strategies for dealing effectively with team member complaints or grievances and
- Explain team dynamics and facilitation processes
- Describe communication skills
- State workplace policies and procedures

Critical Evidence(s) Required

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

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

Performance requirements

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

- demonstrate the ability to build positive team spirit and effectively manage overall team
- performance within a workplace context;
- demonstrate the ability to coordinate a work team in a range of contexts or occasions; and
- Show knowledge of leadership, motivation and teamwork principles.

Islamabad 3rd September, 2019

NOTIFICATION

No. F. 5(13)/2018-DD (TE): In pursuance of sub-section (d) of section-6" Functions of the Commission" National Vocational & Technical Training Commission (NAVTTC) Act-2011, NAVTTC is pleased to approve and notify following qualifications in seven (07) trades for Level 1-5 under National Vocational Qualification Framework (NVQF), which have been developed in compatibility with latest global trends in the fields and fulfilling requirements of competency based training and assessment (CBT&A) system. The qualifications have been developed and validated in collaboration with TEVTAs, QABs, industry and other relevant stakeholders: -

S#	National Vocational Qualifications
1.	National Qualification Level-5 diploma in **Artificial Intelligence**
2.	National Qualification Level-5 diploma in **Robotics Technology**
3.	National Qualification Level-5 diploma in **Automation & Process Control**
4.	National Qualification Level-5 diploma in **Mechatronics Technology**
5.	National Qualification Level-5 diploma in **Water Quality & Resource Management**
6.	National Qualification Level-5 diploma in **Retail and Merchandize Management**
7.	National Qualification Level-5 diploma in **Printing & Publishing Technology**

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

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

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

Distribution:

1. Federal Secretary, Ministry of Federal Education & Professional Training, Govt of Pakistan
2. Federal Secretary, Ministry of Overseas Pakistanis and Human Resource Development, Govt of Pakistan, Islamabad
3. Federal Secretary, Ministry of Industry and Production, Govt of Pakistan, Islamabad
4. Federal Secretary, Ministry of Textile Industry, Govt of Pakistan, Islamabad
5. Federal Secretary, Ministry of Commerce, Govt of Pakistan, Islamabad
6. Federal Secretary, Ministry of Railway, Govt of Pakistan, Islamabad
7. Federal Secretary, Ministry of Climate Change, Govt of Pakistan, Islamabad
8. Federal Secretary, Ministry of Religious Affairs, Govt of Pakistan, Islamabad
9. Federal Secretary, Ministry of Communication, Govt of Pakistan, Islamabad
10. Federal Secretary, Ministry of Aviation Division, Govt of Pakistan, Islamabad
11. Federal Secretary, Ministry of Science & Technology, Govt of Pakistan, Islamabad
12. Chairperson, Punjab Technical Education and Vocational Training Authority (P-TEVTA), Lahore
13. Managing Director, Khyber Pakhtunkhwa Technical Education and Vocational Training Authority (KP-TEVTA),
14. Managing Director, Sindh Technical Education and Vocational Training Authority (S-TEVTA), Karachi
15. Chairman, Azad Jammu & Kashmir, Technical Education and Vocational Training Authority (AJ&K TEVTA), Muzafarabad
16. Director TVET Cell, Gilgit Baltistan, Gilgit
17. Director General, Punjab Vocational Training Council (PVTC), Punjab
18. Managing Director, Technology Upgradation and Skill Development Company (TUSDEC) Lahore
19. Project Director, Punjab Skill Development Program (PS DP) 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. Director General, Federal Directorate of Education Islamabad
38. Secretary, IBCC, Islamabad: *with the request that National qualifications of Level 5 diploma in the aforementioned trades may be considered equivalent to Diploma of Associate Engineer/HSSC after inclusion of compulsory courses in the light of IBCC general requirement.*

Copy for information to: -

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