REPUBLIC OF KENYA

COMPETENCY BASED MODULAR CURRICULUM

FOR

SOLAR PV SYSTEM INSTALLATION

KNQF LEVEL 5

CYCLE 3

PROGRAMME ISCED CODE: 0713 454 A

TVET CDACC
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FOREWORD

Provision of quality education and training is fundamental to the Government's overall strategy for socio-economic development. Quality education and training contribute to achievement focused on Kenya's development blueprint and sustainable development goals.

Reforms in the education and training sector are necessary for achievement of Kenya Vision 2030 and meeting the provisions the Constitution of Kenya. The education sector had to be aligned to the Constitution and this resulted in formulation of the Policy Framework for Reforming Education and Training (Sessional Paper No. 1 of 2019). A key feature of this policy is the change in the design and delivery of TVET training. This policy document requires that training in TVET be competency based, curriculum development be industry led, certification be based on demonstration of competence and mode of delivery that allows for multiple entry and exit in TVET programs.

These reforms demand that Industry takes a leading role in curriculum development to ensure the curriculum addresses its competence needs. It is against this background that this Curriculum has been developed.

It is my conviction that this curriculum will play a great role towards development of competent human resource for the Electrical Engineering sector's growth and sustainable development.

PRINCIPAL SECRETARY
STATE DEPARTMENT FOR TVET
MINISTRY OF EDUCATION

PREFACE

Kenya Vision 2030 aims to transform Kenya into a newly industrializing middle-income country, providing high-quality life to all its citizens by the year 2030. Kenya intends to create globally competitive and adaptive human resource base to meet the requirements of a rapidly industrializing economy through lifelong education and training. TVET has a responsibility to facilitate the process of inculcating knowledge, skills, and worker behaviour necessary for catapulting the nation to a globally competitive country, hence the paradigm shift to embrace Competency-Based Education and Training (CBET).

TVET Act CAP 210A and Sessional Paper No. 1 of 2019 on Reforming Education and Training in Kenya for Sustainable Development emphasized the need to reform curriculum development, assessment, and certification. This called for a shift to CBET to address the mismatch between skills acquired through training and skills needed by industry, as well as increase the global competitiveness of the Kenyan labour force.

This curriculum has been developed in adherence to the Kenya National Qualifications Framework and CBETA standards and guidelines. The curriculum is designed and organized into Units of Learning with Learning Outcomes, suggested delivery methods, learning resources, and methods of assessing the trainee's achievement. In addition, the units of learning have been grouped in modules to concretize the skills acquisition process and streamline upskilling.

I am grateful to all expert trainers and everyone who played a role in translating the Occupational Standards into this competency-based modular curriculum.

CHAIRMAN
TVET CDACC

ACKNOWLEDGEMENT

This curriculum has been designed for competency-based training and has independent units of learning that allow the trainee flexibility in entry and exit. In developing the curriculum, significant involvement and support was received from industry and various organizations.

I appreciate National Electrical Engineering Sector Skills Committee who enabled the development of this curriculum. I recognize with appreciation the role of the SSC in ensuring that competencies required by the industry are addressed in this curriculum.

I also thank all stakeholders in the Electricity and Energy sector for their valuable input and all those who participated in the process of developing this curriculum.

I am convinced that this curriculum will go a long way in ensuring that workers in construction sector will acquire competencies that will enable them perform their work more efficiently.

COUNCIL SECRETARY/CEO

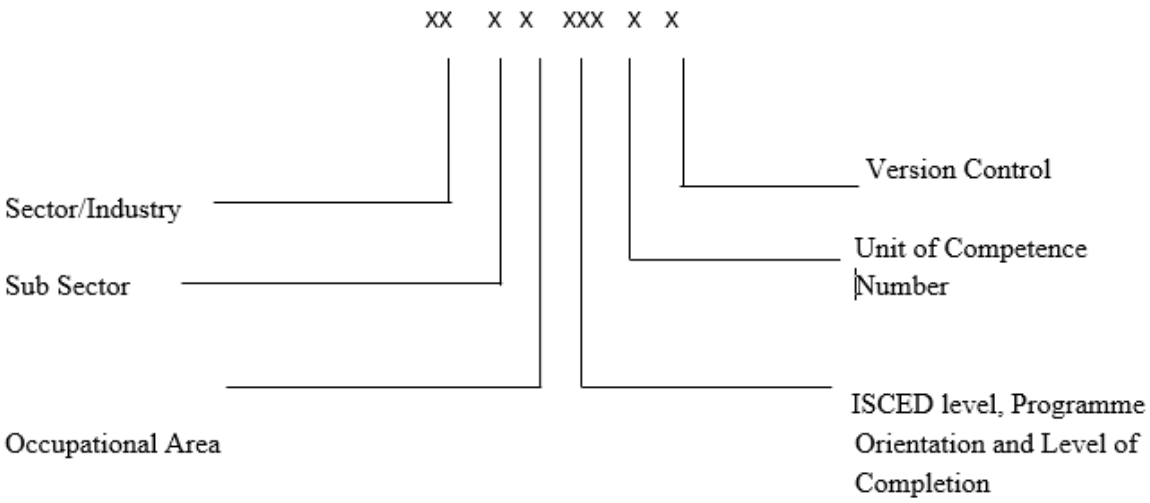
TVET CDACC

TABLE OF CONTENTS

ABBRECIATIONS AND ACRONYMS

CAD	Computer Aided Design
IEEE	Institute of Electrical and electronics Engineers
PPE	Personal Protective Equipment
PV	Photo Voltaic
TVETA	Technical and Vocational Education and Training Authority

KEY TO ISCED UNIT CODE



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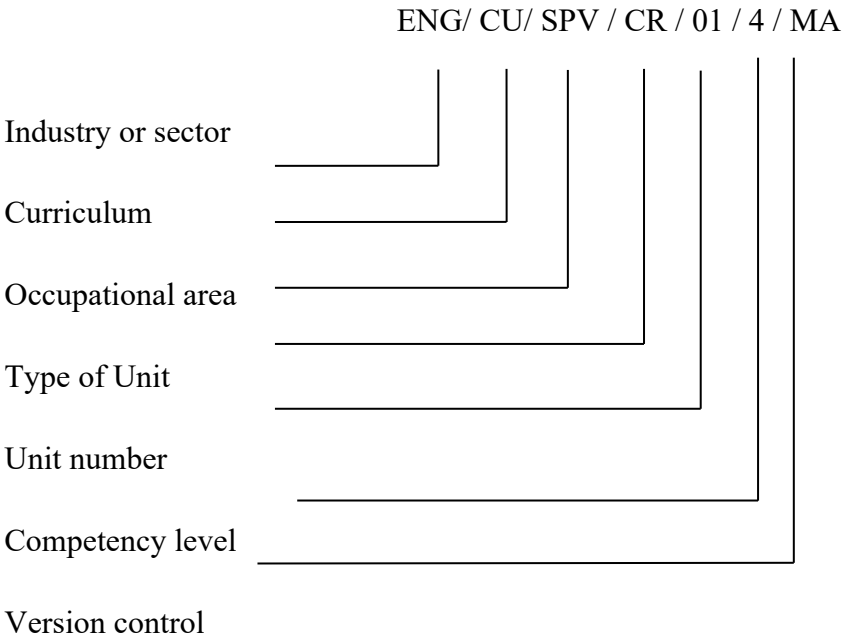

OVERVIEW

Solar PV System Installaer Level 5 qualifications consist of competencies that an individual must achieve to perform solar installation activities. It involves performing Electrical installation, DC Solar PV Systems Installation, Solar Water Pump System Installation, Electrical installation, Solar PV systems, Solar water pump system, Electrical installation I, Solar PV Systems Design, Electrical installation II, Solar PV Pumps System Installation and Security systems installation

Units of Learning

MODULE I				
ISCED Unit Code	**TVETCDACC UNIT CODE**	**Units Title**	**Unit Duration (Hours)**	**Credit Factor**
0713 251 03A	ENG/CU/SPV/CR/01/3/MA	Electrical installation 1	70	7
0713 251 04A	ENG/CU/SPV/CR/02/3/MA	DC Solar PV Systems Installation	70	7
0713 251 05 A	ENG/CU/SPV/CR/03/3/MA	Solar Water Pump System Installation 1	60	6
GRAND TOTAL			**200**	**20**
MODULE II				
0713 351 07A	ENG/CU/SPV/CR/01/4/MA	Electrical installation II	140	14.0
0713 351 08A	ENG/CU/SPV/CR/02/4/MA	Solar PV systems installation.	140	14.0
0713 351 09A	ENG/CU/SPV/CR/03/4/MA	Solar water pump system Installation II	120	12.0
GRAND TOTAL			**400**	**40**

MODULE III				
ISCED Unit Code	**TVETCDACC UNIT CODE**	**Units Title**	**Unit Duration (Hours)**	**Credit Factor**
0611 451 02A	ENG/CU/SPV/BC/01/5/MA	Digital literacy	40	4.0
0031 441 01A	ENG/CU/SPV/BC/02/5/MA	Communication skills	40	4.0
0413 441 03A	ENG/CU/SPV/BC/04/5/MA	Entrepreneurial skills	40	4.0
0541 441 05A	ENG/CU/SPV/CC/01/5/MA	Engineering mathematics I	100	10.0
0713 441 06A	ENG/CU/SPV/CC/02/5/MA	Electrical principles I	50	5.0
0713 451 11A	ENG/CU/SPV/CR/01/5/MA	Solar PV Systems Design	70	7.0
GRAND TOTAL			**340**	**34**
	MODULE IV			
0714 541 13A	ENG/CU/SPV/CC/03/5/MA	Digital Electronics I	60	6.0
0714 541 12A	ENG/CU/SPV/CC/04/5/MA	Analogue Electronics I	50	5.0
0413 441 03A	ENG/CU/SPV/BC/03/5/MA	Work Ethics and Practices	40	4.0
0713 451 10A	ENG/CU/SPV/CR/02/5/MA	Electrical installation III	120	12.0
0732 441 08A	ENG/CU/SPV/CC/07/5/MA	Technical drawings	120	12.0
GRAND TOTAL			**390**	**39**

MODULE V				
ISCED Unit Code	**TVETCDACC UNIT CODE**	**Units Title**	**Unit Duration (Hours)**	**Credit Factor**
0541 441 05A	ENG/CU/SPV/CC/05/5/MA	Engineering mathematics II	80	8.0
0713 441 06A	ENG/CU/SPV/CC/06/5/MA	Electrical principles II	70	7.0

0714 541 13A	ENG/CU/SPV/CC/08/5/MA	Digital Electronics II	70	7.0
0714 541 12A	ENG/CU/SPV/CC/09/5/MA	Analogue Electronics II	50	5.0
0713 451 13A	ENG/CU/SPV/CR/03/5/MA	Solar PV Pumps System Installation	80	8.0
0713 451 14A	ENG/CU/SPV/CR/04/5/MA	Security systems installation	70	7.0
GRAND TOTAL			**420**	**42**
Industry Training			480	48.0
GRAND TOTAL			**2230**	**223.0**

Entry Requirements

An individual entering this course should have any of the following minimum requirements:

a) Kenya Certificate of Secondary Education (K.C.S.E.) with Grade D (plain);

Or

b) Certificate in Solar PV installations or related level 4 course

Or

c) Equivalent qualifications as determined by TVETA.

Trainer Qualification

Qualifications of a trainer for this course include:

a) Possession of at least Solar PV System level 6 or in related trade area;
b) License by TVETA; and
c) License by EBK/KETRB

Industry Training

An individual enrolled in this course will be required to undergo Industry training for a minimum period of 480 hours in solar PV sector. The industrial training may be taken after completion of all units for those pursuing the full qualification or be distributed equally in each

unit for those pursuing part qualification. In the case of dual training model, industrial training shall be as guided by the dual training policy.

Assessment

The course shall be assessed formatively and summatively:

a) During formative assessment all performance criteria shall be assessed based on performance criteria weighting.
b) Number of formative assessments shall minimally be equal to the number of elements in a unit of competency.
c) For qualification packs that commence at levels 3 or 4, assessments of modules 1 and 2 shall be in accordance with assessment guidelines for levels 3 and 4.
d) During summative assessment basic and common units may be integrated in the core units or assessed as discrete units.
e) Theoretical and practical weighting for each unit of learning shall be as follows:
    I. 10 :90 for units in module I and module II
    II. 30:70 for units in module III to module V
f) Formative and summative assessments shall be weighted at 60% and 40% respectively in the overall unit of learning score
g) For a candidate to be declared competent in a unit of competency, the candidate must meet the following conditions:
    i) Obtained at least 40% in theory assessment in formative and summative assessments.
    ii) Obtained at least 60% in practical assessment in formative and summative assessment where applicable.
    iii) Obtained at least 50% in the weighted results between formative assessment and summative assessment where the former constitutes 60% and the latter 40% of the overall score.
h) Assessment performance rating for each unit of competency shall be as follows:

MARKS	COMPETENCE RATING
80 -100	Attained Mastery
65 - 79	Proficient
50 - 64	Competent
49 and below	Not Yet Competent
Y	Assessment Malpractice/irregularities

i) Assessment for Recognition of Prior Learning (RPL) may lead to award of part and/or full qualification.

Certification

A candidate will be issued with a Certificate of Competency upon demonstration of competence in a core Unit of Competency. To attain the Kenya National TVET Certificate in Solar PV System Installation Level 5, the candidate must demonstrate competence in all the Units of Competency as given in the qualification pack. Statement of Attainment certificate may be awarded upon demonstration of competence in certifiable element within a unit.

These certificates will be issued by TVETCDACC

MODULE I

ELECTRICAL INSTALLATION I

UNIT CODE: 0713 251 01A

TVETCDACC UNIT CODE: ENG/CU/SPV/CR/01/3/MA

UNIT DURATION: 70 HOURS

Relationship to Occupational Standards

This unit addresses the Unit of Competency: performing electrical installation 1

Unit Description

This unit specifies competences required for performing electrical installation 1. The competences include identifying electrical installation components, installing electrical system and maintaining electrical installation.

Summary of Learning Outcomes

By the end of this unit of learning the trainee will be able to:

S/NO	Learning Outcome	Duration (Hours)
1.	Identify electrical installation components	20
2.	Install electrical system	40
3.	Maintain electrical installation	10
	TOTAL	**70**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Identify electrical installation components	1.1 Electrical symbols 1.2 Electrical Materials 1.3 Electrical routes	• Project • practical • Portfolio of evidence

		• Third party report • Written assessment • Oral assessment
2 Install electrical system	2.1 Safety measures 2.1.1 PPE 2.1.2 Electrical hazards 2.2 Tools and equipment 2.2.1 Fixing tools 2.2.2 Cutting tools 2.2.3 Measuring tools e.g. Tape measure, Tri-square, Steel rule, Spirit level 2.2.4 Holding tools 2.2.5 Power tools 2.2.6 Multimeter 2.3 Materials 2.3.1 Cables 2.3.2 Lighting Accessories 2.3.3 Power accessories 2.4 Cable management system 2.4.1 Sheath/surface 2.4.2 PVC Conduits 2.4.3 Mini-Trunking 2.5 Protection devices 2.5.1 Circuit breakers 2.5.2 Fuses 2.6 Electrical circuits 2.6.1 Lighting circuit 2.6.2 Ring and radial circuits 2.7 Testing	• Project • practical • Portfolio of evidence • Third party report • Written assessment • Oral assessment

	2.7.1 Continuity 2.7.2 Polarity 2.8 Housekeeping practice 2.8.1 Waste disposal 2.8.2 Recycle 2.8.3 Reuse 2.8.4 Reduce	
3. Maintain electrical installation	3.1 Electrical equipment and system Inspection 3.2 Materials and tools assembly 3.3 Maintenance 3.4 Maintenance reports	• Project • practical • Portfolio of evidence • Third party report • Written assessment • Oral assessment

Suggested Methods of Instruction

Practical

Projects

Demonstrations

Group discussion

Direct instructions

Field trips

On-job-training

Recommended Resources for 25 trainees

S/No.	Category/Item	Description/ Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			

1.	Textbooks	• B. Scaddan Electrical installation work • J. Hyde Electrical installation Principles and Practices	5 pcs	1:5
2.	Installation manuals	• IEEE regulation • BS3939 • NEMA regulations • OSHA • Occupational Safety and Health Act (OSHA) • National Environmental Management Authority (NEMA) regulations • IEEE regulations • EPRA regulation	5 pcs	1:5
3.	Charts	• Single line diagram • Circuit diagrams • Colour codes	1 pcs for each	1:25
4.	Power point presentations	For trainer's use	1	1:25
B	**Learning Facilities & infrastructure**			
5.	Lecture/theory room	$50m^2$	1	1:25
6.	Workshop	$150m^2$	1	1:25
7.	Site			

C	**Consumable materials**			
8.	Electrical cables	1.5mm^2(red, black green)	5 rolls	1:5
		2.5mm^2(red, black green)	5 rolls	1:5
		4.0 mm^2(red, black green)	3 rolls	1:10
		6.0 mm^2(red, black green)	2 rolls	1:12
		10 mm^2(red, black green)	2 rolls	1:12
9.	Insulation tapes		25 pcs	1:1
10.	Accessories	Switches, sockets, Junction boxes, Consumer units, Lamp holders, Patrice boxes, Circuit breakers	25 pcs	1:1
11.	Conduits and trunkings	PVC conduits, Steel conduits, Mini trunking	25 pcs	1:1
D	**Tools and Equipment**			
12.	Hacksaws		25 pcs	1:1
13.	Striping knives		25 pcs	1:1

14.	Side cutters		25 pcs	1:1
15.	Pliers		25 pcs	1:1
16.	Tape measure		25 pcs	1:1
17.	Try Square		25 pcs	1:1
18.	Spirit level		25 pcs	1:1
19.	Assorted Screw driver		25 pcs	1:1
20.	Assorted hammers		25 pcs	1:1
21.	Crimping tools		5 pcs	1:5
22.	PPEs		25 pcs	1:1
23.	Multimeters		5 pcs	1:5
24.	Earth resistance meter		5 pcs	1:5
25.	Steel conduit bending machine		2 pcs	1:13
26.	Stocks & Dies		5 pcs	1:5
27.	Vices		5 pcs	1:5
28.	Bending spring		5 pcs	1:5
29.	Drilling machines		5 pcs	1:5
30.	Crocodile clips		50 pcs	2:1

31.	Mc4 clips		50 pcs	2:1
32.	Clamp clips		50 pcs	2:1
33.	Cable ties		1250 pcs	50:1
34.	Bolt and nuts		150 pcs	6:1
35.	Wall plug		150 pcs	6:1
36.	Work stations		25	1:1
37.	Installation boards	1.2 by 1m	13 pcs	1:2

DC SOLAR PV SYSTEMS INSTALLATION

UNIT CODE: 0713 251 04A

TVETCDACC UNIT CODE: ENG/CU/SPV/CR/02/3/MA

UNIT DURATION: 70 HOURS

Relationship to Occupational Standards

This unit addresses the Unit of Competency: install DC solar PV systems

Unit Description

This unit covers competences required in installing solar PV systems. The competences include constructing DC solar PV support structures, installing DC solar PV system components and maintaining DC solar PV system

Summary of Learning Outcomes

By the end of this unit of learning the trainee will be able to:

S/NO	Learning Outcome	Duration (Hours)
1.	Construct DC Solar PV support structures	10
2.	Install DC Solar PV system components	40
3.	Maintain DC Solar PV System	10
	TOTAL	**70**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Construct DC Solar PV support structures	1.1 Safety procedures 1.2 Types of mounting structures 1.2.1 Solar roof system 1.2.2 Steel ground racks 1.2.3 Pole mounting 1.3 Solar PV batteries structures	• Project • practical • Portfolio of evidence • Third party report • Written assessment • Oral assessment
2. Install DC Solar PV system components	2.1 Solar PV module 2.1.1 Mono crystalline 2.1.2 Poly crystalline 2.1.3 Amorphous 2.1.4 Single module up to 300 Wp. 2.2 Components of solar system mounting and installation 2.2.1 Charger controller 2.2.2 Solar batteries 2.2.3 Cables 2.3 Solar PV batteries 2.3.1 Maintenance free 2.3.2 Flooded type 2.3.3 Single battery 12V 2.4 Lay Electrical cables 2.5 Lightening arrestors installation 2.5.1 Earth Rod 2.5.2 Surge arrestor (SPD) 2.6 Housekeeping practice 2.6.1 Waste disposal 2.6.2 Recycle 2.6.3 Reuse 2.6.4 Reduce	• Project • practical • Portfolio of evidence • Third party report • Written assessment • Oral assessment

3. Maintain solar PV system	3.1 Maintenance materials preparation 3.2 Maintenance 3.2.1 Cleaning the modules 3.2.2 Cleaning battery terminals 3.2.3 Applying jelly/grease on battery terminals 3.2.4 Checking states of electrolytes 3.3 Maintenance reports	• Project • practical • Portfolio of evidence • Third party report • Written assessment • Oral assessment

Suggested Methods of Instruction

Practical

Projects

Demonstrations

Group discussion

Direct instructions

Field trips

On-job-training

Recommended Resources for 25 trainees

S/No.	Category/Item	Description/ Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
1.	Textbooks	• B. Scaddan Electrical installation work • J. Hyde Electrical installation Principles and Practices	5 pcs	1:5

2.	Installation manuals	• IEEE regulation • BS3939 • NEMA regulations • OSHA • Occupational Safety and Health Act (OSHA) • National Environmental Management Authority (NEMA) regulations • IEEE regulations • EPRA regulation	5 pcs	1:5
3.	Charts	• Single line diagram • Circuit diagrams • Colour codes	1 pcs for each	1:25
4.	Power point presentations	For trainer's use	1	1:25
B	**Learning Facilities & infrastructure**			
5.	Lecture/theory room	$50m^2$	1	1:25
6.	Workshop	$150m^2$	1	1:25
7.	Site			
C	**Consumable materials**			
8.	Electrical cables	$1.5mm^2$(red, black green)	5 rolls	1:5

		2.5mm^2(red, black green)	5 rolls	1:5
		4.0 mm^2(red, black green)	3 rolls	1:10
		6.0 mm^2(red, black green)	2 rolls	1:12
		10 mm^2(red, black green)	2 rolls	1:12
9.	Insulation tapes		25 pcs	1:1
10.	Accessories	Switches, sockets, Junction boxes, Consumer units, Lamp holders, Patrice boxes, Circuit breakers	25 pcs	1:1
11.	Conduits and trunkings	PVC conduits, Steel conduits, Mini trunking	25 pcs	1:1
D	**Tools and Equipment**			
12.	Hacksaws		25 pcs	1:1
13.	Striping knives		25 pcs	1:1
14.	Side cutters		25 pcs	1:1
15.	Pliers		25 pcs	1:1
16.	Tape measure		25 pcs	1:1
17.	Try Square		25 pcs	1:1

18.	Spirit level		25 pcs	1:1
19.	Assorted Screw driver		25 pcs	1:1
20.	Assorted hammers		25 pcs	1:1
21.	Crimping tools		5 pcs	1:5
22.	PPEs		25 pcs	1:1
23.	Multimeters		5 pcs	1:5
24.	Earth resistance meter		5 pcs	1:5
25.	Steel conduit bending machine		2 pcs	1:13
26.	Stocks & Dies		5 pcs	1:5
27.	Vices		5 pcs	1:5
28.	Bending spring		5 pcs	1:5
29.	Drilling machines		5 pcs	1:5
30.	Crocodile clips		50 pcs	2:1
31.	Mc4 clips		50 pcs	2:1
32.	Clamp clips		50 pcs	2:1
33.	Cable ties		1250 pcs	50:1
34.	Bolt and nuts		150 pcs	6:1
35.	Wall plug		150 pcs	6:1

36.	Work stations		25	1:1
37.	Installation boards	1.2 by 1m	13 pcs	1:2

SOLAR WATER PUMP SYSTEM INSTALLATION 1

UNIT CODE: 0713 251 05A

TVETCDACC UNIT CODE: ENG/CU/SPV/CR/03/3/MA

UNIT DURATION: 60 HOURS

Relationship to Occupational Standards

This unit addresses the Unit of Competency: install solar PV water pump systems 1

Unit Description

This unit covers competences required in install solar water pump system. The competences include constructing solar PV module system support structures, installing solar water pump system components and maintaining solar water pump system.

Summary of Learning Outcomes

By the end of this unit of learning the trainee will be able to:

S/NO	Learning Outcome	Duration (Hours)
1.	Construct Solar PV module system support structures	10
2.	Install Solar PV water pump system components	40
3.	Maintain solar PV water pump system	10
	TOTAL	**60**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Construct Solar PV water pump system	1.1 Safety procedures 1.2 Types of solar PV mounting structures 1.2.1 Solar roof system	• Project • practical

support structures	1.2.2 Steel ground racks 1.2.3 Pole mounting 1.3 Solar PV water pump mounting structures design interpretation.	• Portfolio of evidence • Third party report • Written assessment • Oral assessment
2. Install Solar water pump system component	2.1 Solar PV module mounting 2.1.1 Mono crystalline 2.1.2 Poly crystalline 2.1.3 Amorphous 2.2 Single panel up to 300 Wp 2.3 Solar PV water pump installation 2.3.1 Surface/submersible DC water pump 2.4 Cables joints 2.5 Lightening arrestor 2.6 Housekeeping practice 2.6.1 Waste disposal 2.6.2 Recycle 2.6.3 Reuse 2.6.4 Reduce	• Project • practical • Portfolio of evidence • Third party report • Written assessment • Oral assessment
3. Maintain solar water pump system	3.1 Solar water pump Materials preparation 3.1.1 Cables 3.1.2 Cable ties 3.1.3 Accessories 3.1.4 Grease 3.2 Solar PV water pump system testing 3.3 Maintenance activities 3.3.1 Cleaning module 3.3.2 Removal of silt 3.4 Maintenance report preparation	• Project • practical • Portfolio of evidence • Third party report • Written assessment • Oral assessment

Suggested Methods of Instruction

Practical

Projects

Demonstrations

Group discussion

Direct instructions

Field trips

On-job-training

Recommended Resources for 25 Trainees

S/No.	Category/Item	Description/ Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
1.	Textbooks	• B. Scaddan Electrical installation work • J. Hyde Electrical installation Principles and Practices	5 pcs	1:5
2.	Installation manuals	• IEEE regulations • BS3939 • NEMA regulations • Occupational Safety and Health Act (OSHA)	5 pcs	1:5

		• National Environmental Management Authority (NEMA) regulations • EPRA regulation • PV system requirement refer KEBS Standards of 1673-1:2004		
3.	Charts	• Single line diagram • Circuit diagrams • Colour codes	1 pcs for each	1:25
4.	Power point presentations	For trainer's use	1	1:25
B	**Learning Facilities & infrastructure**			
5.	Lecture/theory room	$50m^2$	1	1:25
6.	Workshop	$150m^2$	1	1:25
7.	Site			
C	**Consumable materials**			
8.	Electrical wires	$1.5mm^2$(red, black green)	5 rolls	1:5
		$2.5mm^2$(red, black green)	5 rolls	1:5
		4.0 mm^2(red, black green)	3 rolls	1:10

		6.0 mm^2(red, black green)	2 rolls	1:12
		10 mm^2(red, black green)	2 rolls	1:12
9.	Insulation tapes		25 pcs	1:1
10.	Accessories	Switches, sockets, Junction boxes, Consumer units, Lamp holders, Patrice boxes, Circuit breakers	25 pcs	1:1
11.	Conduits and trunkings	PVC conduits, Steel conduits, Mini trunking	25 pcs	1:1
D	**Tools and Equipment**			
12.	Hacksaws		25 pcs	1:1
13.	Striping knives		25 pcs	1:1
14.	Side cutters		25 pcs	1:1
15.	Pliers		25 pcs	1:1
16.	Tape measure		25 pcs	1:1
17.	Try Square		25 pcs	1:1
18.	Spirit level		25 pcs	1:1
19.	Assorted Screw driver		25 pcs	1:1
20.	Assorted hammers		25 pcs	1:1
21.	Crimping tools		5 pcs	1:5

22.	PPEs		25 pcs	1:1
23.	Multimeters		5 pcs	1:5
24.	Inclinometer		5 pcs	1:5
25.	Spanner		5 pcs	1:5
26.	cable lugs		150 pcs	6:1
27.	racks		13	1:2
28.	solar spacer		25	1:1
29.	mounting spacer		25	1:1
30.	ground mount pipe caps		50 pcs	2:1
31.	solar panel cleaning kit		13	1:2
32.	Locking tool clip		13	1:2
33.	Permanent roof anchor		13	1:2
34.	Mounting brackets		13	1:2
35.	Crocodile clips		50 pcs	2:1
36.	Mc4 clips		50 pcs	2:1
37.	MC4 Climping tool		5 pcs	1:5
38.	Clamp clips		50 pcs	2:1
39.	Cable ties		1250 pcs	50:1
40.	Bolt and nuts		150 pcs	6:1
41.	Wall plug		150 pcs	6:1

42.	Ladder		5	1:5
43.	Module mover		5	1:5
44.	ballast block carrier		5	1:5
45.	Thermal camera		5	1:5
46.	Irradiance meter		5	1:5
47.	Insulation resistance tester		5	1:5
48.	Vent pipe cutter		5	1:5
49.	Work stations		25	1:1
50.	Installation boards	1.2 by 1m	13 pcs	1:2

MODULE II

ELECTRICAL INSTALLATION II

UNIT CODE: 0713 351 04A

TVETCDACC UNIT CODE: ENG/CU/SPV/CR/01/4/MA

UNIT DURATION: 140 HOURS

Relationship to Occupational Standards

This unit addresses the Unit of Competency: Perform electrical installation II

Unit Description

This unit specifies competences required for performing electrical installation II. The competences include producing electrical drawings, interpreting electrical installation drawing, installing electrical system, testing electrical installation and maintaining electrical installation.

Summary of Learning Outcomes

By the end of this unit of learning the trainee will be able to:

S/NO	Learning Outcome	Duration (Hours)
1.	Produce electrical drawings	10
2.	Interpret electrical installation drawing	30
3.	Install electrical system	60
4.	Test electrical installation	20
5.	Maintain electrical installation	20
	TOTAL	**140**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Produce electrical drawings	1.1 Electrical symbols and abbreviations 1.2 Meaning of electrical drawings 1.3 Drawing of electrical diagrams e.g. block, schematic, circuit, line and wiring	• Practical demonstration • Projects • Written tests • Oral test
2. Interpret electrical installation drawing	2.1 Wiring diagrams 2.1.1 Single line diagram 2.1.1.1 Intake point 2.1.1.2 Lighting plan 2.1.1.3 Power circuit 2.1.1.4 Change over switching 2.1.2 Schematic diagram 2.1.3 Wiring diagram 2.2 Bill of quantities;	• Written assessment • Practical assessment • Projects • Oral Questioning • Third party report • Portfolio of evidence
3 Install electrical system	3.1 Safety; PPE, handling of equipment 3.2 Tools, equipment and materials 3.2.1 Cutting tools e.g. Hacksaws, Stripping knives, Side cutters, Pliers 3.2.2 Fixing tools e.g. Assorted hammers, Assorted Screw drivers	• Written assessment • Practical assessment • Projects

	3.2.3 Fastening tools e.g Assorted spanners and wrenches 3.2.4 Lifting and tensioning tools 3.2.5 Holding tools 3.2.6 Power tools 3.2.7 Multimeter 3.2.8 Cables 3.2.9 Accessories 3.3 Cable management systems 3.3.1 Cable duct 3.3.2 Steel Conduits 3.3.3 Trunking 3.4 Cable Termination techniques 3.4.2 Cable lugs 3.4.3 Cable glands 3.4.4 Cable joints i.e Tee joint, married joint, end twist, Britannia joint. 3.5 Earthing and protection systems 3.5.2 IT 3.5.3 TNC 3.5.4 TNS 3.5.5 TT 3.5.6 TNCS/PME/PEN/CNE 3.5.7 Circuit breakers 3.5.8 Fuses 3.5.9 ELCBs/RCD 3.6 Installation of final circuits 3.6.2 ***Special*** Lighting circuits 3.6.3 Power circuits	• Oral Questioning • Third party report • Portfolio of evidence

	3.7 Housekeeping practices 3.7.1 Disposal of waste 3.7.2 Reusing 3.7.3 Recycling 3.7.4 Cleaning and storage of tools and equipment	
4 Test electrical installation	4.1 Definition of terms: inspection 4.1.1 Visual inspection: 4.1.1.1 Colour codes 4.1.1.2 Labelling 4.1.1.3 Damages 4.1.1.4 Termination 4.2 Electrical tests 4.2.1 Continuity test 4.2.2 Insulation resistance test 4.2.3 Polarity test 4.3 IEE Regulations	• Practical • Demonstration • Projects • Written tests • Oral Questioning
5 Maintain electrical installation	5.1 Definition; maintenance; servicing; repair; fault, diagnosis/troubleshooting 5.2 Visual inspection: 5.2.1 Colour codes 5.2.2 Labelling 5.2.3 Damages 5.2.4 Termination 5.3 Importance of maintenance 5.4 Maintenance materials and tools 5.4.1 Hacksaws 5.4.2 Stripping knives 5.4.3 Side cutters 5.4.4 Pliers	• Practical • Demonstration • Projects • Written tests • Oral Questioning

	5.4.5 Tape measure 5.4.6 Assorted hammers 5.4.7 Assorted Screw drivers 5.4.8 Assorted spanners and wrenches 5.4.9 Digital Multimeter 5.4.10 Phase tester 5.5 Cause of equipment failure 5.6 Maintenance activities 5.6.1 Faulty lamps 5.6.2 Faulty accessories 5.6.3 Types of Maintenance 5.6.3.1 Preventive Maintenance 5.6.3.2 Corrective Maintenance 5.6.3.3 Predictive Maintenance 5.6.3.4 Condition-Based Maintenance 5.7 Types of faults 5.7.1 Short circuits 5.7.2 Loose connections 5.7.3 Bad connections 5.7.4 Open circuits 5.8 Electrical tests 5.8.1 Continuity test 5.8.2 Insulation resistance test 5.8.3 Polarity test 5.9 Maintenance report	

	5.9.1 Repairs 5.9.2 Inspection 5.9.3 Maintenance task e.g preventive maintenance task 5.9.4 Test and maintenance report form	

Suggested Methods of Instruction

1. Practical
2. Projects
3. Demonstrations
4. Group discussion
5. Direct instructions
6. Field trips
7. On-job-training

Recommended Resources for 25 Trainees

S/No.	Category/Item	Description/ Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
38.	Textbooks	B. Scaddan Electrical installation work	5 pcs	1:5

		J. Hyde Electrical installation Principles and Practices		
39.	Installation manuals	IEEE regulation BS3939 NEMA regulations OSHA	5 pcs	1:5
40.	Charts	Single line diagram Circuit diagrams Colour codes	1 pcs for each	1:25
41.	Power point presentations	For trainer's use	1	1:25
B	**Learning Facilities & infrastructure**			
1.	Lecture/theory room	$50m^2$	1	1:25
2.	Workshop	$150m^2$	1	1:25
3.	Laboratory	$100m^2$	1	1:25
4.	Site			
C	**Consumable materials**			
1.	Electrical wires	$1.5mm^2$(red, black green)	5 rolls	1:5

		2.5mm^2(red, black green)	5 rolls	1:5
		4.0 mm^2(red, black green)	3 rolls	1:10
		6.0 mm^2(red, black green)	2 rolls	1:12
		10 mm^2(red, black green)	2 rolls	1:12
2.	Insulation tapes		25 pcs	1:1
3.	Accessories	Switches, sockets, Junction boxes, Consumer units, Lamp holders, Patrice boxes, Circuit breakers	25 pcs	1:1
4.	Pipes and trunkings	PVC conduits, Steel conduits, Mini trunking	25 pcs	1:1
D	**Tools and Equipment**			
1.	Hacksaws		25 pcs	1:1
2.	Striping knives		25 pcs	1:1
3.	Side cutters		25 pcs	1:1
4.	Pliers		25 pcs	1:1

5.	Tape measure		25 pcs	1:1
6.	Try Square		25 pcs	1:1
7.	Spirit level		25 pcs	1:1
8.	Assorted Screw driver		25 pcs	1:1
9.	Assorted hammers		25 pcs	1:1
10.	Crimping tools		5 pcs	1:5
11.	PPEs		25 pcs	1:1
12.	Multimeters		5 pcs	1:5
13.	Clamp meters		5 pcs	1:5
14.	Insulation resistance meter		5 pcs	1:5
15.	Earth resistance meter		5 pcs	1:5
16.	Stocks & Dies		5 pcs	1:5
17.	Vices		5 pcs	1:5
18.	Oscilloscope		5 pcs	1:5
19.	Pipe bending Machine		5 pcs	1:5
20.	Bending spring		5 pcs	1:5
21.	Drilling machines		5 pcs	1:5
22.	Work stations		25	1:1
23.	Installation boards	1.2 by 1m	13 pcs	1:2

SOLAR PV SYSTEMS INSTALLATION

UNIT CODE: 0713 351 08A

TVETCDACC UNIT CODE: ENG/CU/SPV/CR/02/4/MA

UNIT DURATION: 140 HOURS

Relationship to Occupational Standards

This unit addresses the Unit of Competency: install solar PV systems

Unit Description

This unit covers the competences required in Install Solar PV Systems. Competences include; applying electrical concepts, constructing Solar PV support structures, installing Solar PV system components and maintaining solar PV system.

Summary of Learning Outcomes

By the end of this unit of learning the trainee will be able to:

S/NO	Learning Outcome	Duration (Hours)
1.	Apply basic electrical concepts	20
2.	Construct Solar PV support structures	40
3.	Install Solar PV system component	60
4.	Maintain solar PV system	20
	TOTAL	**140**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Apply basic electrical concepts	1.1 The meaning of SI unit 1.2 SI unit of various types of Electrical parameters 1.2.1 Power – Watts (W) 1.2.2 Current – Amperes (A) 1.2.3 Resistance – Ohms(Ω) 1.2.4 Voltage – Volts (V) 1.3 Identification of Quantities of Charge, force, work and power 1.4 Ohm's law 1.5 Calculations involving parallel and series circuits 1.6 Calculations involving various Electrical parameters e.g. Power, Current, Voltage, Resistance	• Practical demonstration • Projects • Written tests Oral test
2. Construct Solar PV support structures	2.1 Safety Procedures 2.2 Tools and equipment 2.2.1 Hydrometer 2.2.2 Inclinometer 2.2.3 Compass 2.3 Types of mounting structures 2.3.1 Rooftop 2.3.2 Ground 2.3.3 Solar roof system 2.3.4 Steel ground racks 2.3.5 Pole mounting	• Practical • demonstration • Projects • Written tests • Oral Questioning

	2.4 Solar PV Battery structures	
3. Install Solar PV system components	3.1 Planning to install 3.2 Pre-installation checks 3.3 Solar Panel Mounting positioning 3.4 security of the panels 3.5 Methods of solar panel connection 3.5.1 Parallel and series 3.6 Components of solar system mounting and installation 3.6.1 Charger controller 3.6.2 Inverters 3.6.3 Solar batteries e.g Maintenance free, Flooded type, Series connection up to 24v/1000wp, Parallel connection up to 24v/1000wp, Series-parallel connection up to 24v/1000wp 3.7 Cables 3.8 Lay Electrical cables 3.8.1 Cable laying tools 3.8.2 Cable segregation 3.8.3 Cable labelling 3.9 Mount Solar panel 3.9.1 Installation of Solar panel 3.9.1.1 Slanting angle/tilt angle 3.9.1.2 Panel Ratings	• Practical • demonstration • Projects • Written tests • Oral Questioning

	3.10 Terminate solar Electrical cables 3.10.1 Meaning of terms 3.10.2 Cable lugging 3.10.3 Solar Cable connectors 3.11 Lightening arrestors base installation 3.11.1 Rod gap arrester 3.11.2 Earth Rod 3.11.3 Surge arrestor (SPD) 3.12 Housekeeping 3.12.1 Waste disposal 3.12.2 Recycle 3.12.3 Reuse 3.12.4 Reduce	
4. Maintain solar PV system	4.1 Materials e.g pure water, soft bristle brushes, microfiber cloths or sponges, calcium, grease 4.2 Tests 4.2.1 Continuity test 4.2.2 Insulation resistance test 4.2.3 Polarity test 4.2.4 Short circuit systems (Isc) 4.2.5 Open circuit voltage (Voc) 4.2.6 Battery voltage and current 4.3 Maintenance of; 4.3.1 Solar modules 4.3.2 Solar batteries maintenance	• Practical • demonstration • Projects • Written tests • Oral Questioning

	4.3.3 Inverter maintenance 4.3.4 Charge controller maintenance 4.4 Maintenance records 4.4.1 Maintenance checklist 4.4.2 Maintenance reports	

Suggested Methods of Instruction

1. Practical
2. Projects
3. Demonstrations
4. Group discussion
5. Direct instructions
6. Field trips
7. On-job-training

Recommended Resources for 25 Trainees

S/No.	Category/Item	Description/ Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
1.	Textbooks	Solar Electric Handbook by Solar energy International	5 pcs	1:5

		B. Scaddan Electrical installation work J. Hyde Electrical installation Principles and Practices		
2.	Installation manuals	Solar PV manuals	5 pcs	1:5
3.	Charts	Single line diagram Solar PV layout Circuit diagrams Colour codes	1 pc for each	1:25
4.	Power point presentations	For trainer's use	1	1:25
B	**Learning Facilities & infrastructure**			
5.	Lecture/theory room	$50m^2$	1	1:25
6.	Workshop	$150m^2$	1	1:25
7.	Laboratory	$100m^2$	1	1:25
8.	Site			
C	**Consumable materials**			
9.	Electrical wires	$1.5mm^2$(red, black green)	5 rolls	1:5
		$2.5mm^2$(red, black green)	5 rolls	1:5

		4.0 mm^2(red, black green)	3 rolls	1:10
		6.0 mm^2(red, black green)	2 rolls	1:12
		10 mm^2(red, black green)	2 rolls	1:12
10.	Insulation tapes		25 pcs	1:1
11.	Accessories	Switches, sockets, Junction boxes, Consumer units, Lamp holders, Patrice boxes, Circuit breakers	25 pcs	1:1
12.	Solar Panels		10	1:3
13.	Charge controller		10	1:3
14.	Batteries		10	1:3
15.	Inverter		10	1:3
16.	Mounting racks		10	1:3
17.	Pipes and trunkings	PVC conduits, Steel conduits, Mini trunking	25 pcs	1:1
18.	Materials and supplies	Clamp clips,Cable ties, Conduits, Bolt and nuts, Wall plug, Mounting	10	1:3

		brackets, cable lugs, racks, solar spacer, mounting spacer, ground mount pipe caps, cleaning kit, Locking tool clip, Permanent roof anchor		
D	**Tools and Equipment**			
19.	Hacksaws		25 pcs	1:1
20.	Striping knives		25 pcs	1:1
21.	Side cutters		25 pcs	1:1
22.	Pliers		25 pcs	1:1
23.	Tape measure		25 pcs	1:1
24.	Try Square		25 pcs	1:1
25.	Spirit level		25 pcs	1:1
26.	Assorted Screw driver		25 pcs	1:1
27.	Assorted hammers		25 pcs	1:1
28.	MC4 Crimping tools		5 pcs	1:5
29.	PPEs		25 pcs	1:1
30.	Multimeters		5 pcs	1:5
31.	Irradiance meter		5 pcs	1:5
32.	Insulation resistance tester		5 pcs	1:5
33.	Polarity tester		5 pcs	1:5

34.	Clamp meter		5 pcs	1:5
35.	Thermal camera		5 pcs	1:5
36.	Inclinometer		5 pcs	1:5
37.	Ladder		5 pcs	1:5
38.	ballast block carrier		5 pcs	1:5
39.	Module mover		5 pcs	1:5
40.	Vent pipe cutter		5 pcs	1:5
41.	Flat pry bar		5 pcs	1:5
42.	Battery operated drill		5 pcs	1:5
43.	Safety harness		25 pcs	1:1

SOLAR WATER PUMP SYSTEM INSTALLATION II

UNIT CODE: 0713 351 09A

TVETCDACC UNIT CODE: ENG/CU/SPV/CR/03/4/MA

UNIT DURATION: 120 HOURS

Relationship to Occupational Standards

This unit addresses the Unit of Competency: install solar water pump systems II

Unit Description

This unit covers the competences required in Install Solar Water Pump System II. Competences include; managing electrical workshop, constructing Solar PV module system support structures, installing Solar water pump system components, maintaining solar water pump system.

Summary of Learning Outcomes

By the end of this unit of learning the trainee will be able to:

S/NO	Learning Outcome	Duration (Hours)
1.	Manage electrical workshop	10
2.	Construct Solar PV module system support structures	40
3.	Install Solar water pump system components	60
4.	Maintain solar water pump system	10
	TOTAL	**120**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Manage electrical workshop	1.1. Health and safety procedures 1.1.1. Safety measures. 1.1.2. Relevant clauses in appropriate Acts e.g. 1.1.3. Occupational safety and health act (OSHA) 1.1.4. Work injury benefits act (WIBA) 1.1.5. Safety Regulations and procedures 1.1.6. PPEs 1.1.7. First Aid 1.1.8. Relevant regulations e.g. IEE regulations 1.1.9. Common hazards and sources of danger e.g. burns, cuts, electric shock, falling from heights, falling objects, noise, dust, chemicals 1.2.Electrical workshop records e.g. 1.2.1. Inventory 1.2.2. Duty schedule 1.2.3. Maintenance schedule, etc. 1.3.Storage of Tools, equipment and materials	• Practical demonstration • Projects • Written tests • Oral test
2. Construct Solar PV module system support structures	2.1 Solar PV modules e.g Mono crystalline, Poly crystalline, Amorphous 2.1.1 Solar PV connections e.g Series connection up to 1000 wp 2.1.2 Parallel connection up to 1000 wp 2.1.3 Series-parallel connection up to 1000 wp 2.2 Types of mounting structures 2.2.1 Rooftop 2.2.2 Ground 2.2.3 Solar roof system	• Practical • demonstration • Projects • Written tests • Oral Questioning

	2.2.4 Steel ground racks 2.2.5 Pole mounting 2.3 Solar PV water pump mounting structures e.g ground mount systems, top of pull mount, scalable ground mount	
3. Install Solar PV pump system components	3.1.Solar PV module mounting 3.1.1 Flat roof mounting 3.1.2 roof hook 3.1.3 Water proof carport 3.1.4 Packing canopy 3.1.5 Ground mounting 3.2.Solar pumping system 3.2.1 Module 3.2.2 PV pump inverter 3.2.3 Pumps and motors; ac and dc 3.3.Types of single-phase pump systems 3.3.1 Submersible pump 3.3.2 Floating pumps 3.3.3 Surface pumps 3.4.Lightening arrestor; components of lightening arrestors, importance of lightening arrestors 3.5.Housekeeping 3.5.1 Waste disposal 3.5.2 Recycle 3.5.3 Reuse 3.5.4 Reduce	• Practical • demonstration • Projects • Written tests • Oral Questioning
4. Maintain solar water pump system	4.1.Tests i. Continuity test ii. Insulation resistance test iii. Polarity test	• Practical demonstration • Projects • Written tests

	iv. Short circuit systems (Isc) v. Open circuit voltage (Voc) vi. Irradiance meter 4.2.Maintenance is carried out as per IET regulations 4.3.Maintenance records 4.1.1. Maintenance checklist 4.1.2. Maintenance reports	• Oral Questioning

Suggested Methods of Instruction

1. Practical
2. Projects
3. Demonstrations
4. Group discussion
5. Direct instructions
6. Field trips
7. On-job-training

Recommended Resources for 25 Trainees

S/No.	Category/Item	Description/ Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
5.	Textbooks	Solar Electric Handbook by Solar energy International	5 pcs	1:5

		B. Scaddan Electrical installation work J. Hyde Electrical installation Principles and Practices		
6.	Installation manuals	Solar PV manuals	5 pcs	1:5
7.	Charts	Single line diagram Solar PV layout Circuit diagrams Colour codes	1 pc for each	1:25
8.	Power point presentations	For trainer's use	1	1:25
B	**Learning Facilities & infrastructure**			
44.	Lecture/theory room	$50m^2$	1	1:25
45.	Workshop	$150m^2$	1	1:25
46.	Laboratory	$100m^2$	1	1:25
47.	Site			
C	**Consumable materials**			
48.	Electrical wires	$1.5mm^2$(red, black green)	5 rolls	1:5
		$2.5mm^2$(red, black green)	5 rolls	1:5

		4.0 mm^2(red, black green)	3 rolls	1:10
		6.0 mm^2(red, black green)	2 rolls	1:12
		10 mm^2(red, black green)	2 rolls	1:12
49.	Insulation tapes		25 pcs	1:1
50.	Accessories	Switches, sockets, Junction boxes, Consumer units, Lamp holders, Patrice boxes, Circuit breakers	25 pcs	1:1
51.	Solar Panels		10	1:3
52.	Charge controller		10	1:3
53.	Batteries		10	1:3
54.	Inverter		10	1:3
55.	Mounting racks		10	1:3
56.	Pipes and trunkings	PVC conduits, Steel conduits, Mini trunking	25 pcs	1:1
57.	Materials and supplies	Clamp clips,Cable ties, Conduits, Bolt and nuts, Wall plug, Mounting	10	1:3

		brackets, cable lugs, racks, solar spacer, mounting spacer, ground mount pipe caps, cleaning kit, Locking tool clip, Permanent roof anchor		
D	**Tools and Equipment**			
58.	Hacksaws		25 pcs	1:1
59.	Striping knives		25 pcs	1:1
60.	Side cutters		25 pcs	1:1
61.	Pliers		25 pcs	1:1
62.	Tape measure		25 pcs	1:1
63.	Try Square		25 pcs	1:1
64.	Spirit level		25 pcs	1:1
65.	Assorted Screw driver		25 pcs	1:1
66.	Assorted hammers		25 pcs	1:1
67.	MC4 Crimping tools		5 pcs	1:5
68.	PPEs		25 pcs	1:1
69.	Multimeters		5 pcs	1:5
70.	Irradiance meter		5 pcs	1:5
71.	Insulation resistance tester		5 pcs	1:5
72.	Polarity tester		5 pcs	1:5

73.	Clamp meter		5 pcs	1:5
74.	Thermal camera		5 pcs	1:5
75.	Inclinometer		5 pcs	1:5
76.	Ladder		5 pcs	1:5
77.	ballast block carrier		5 pcs	1:5
78.	Module mover		5 pcs	1:5
79.	Vent pipe cutter		5 pcs	1:5
80.	Flat pry bar		5 pcs	1:5
81.	Battery operated drill		5 pcs	1:5
82.	Safety harness		25 pcs	1:1

MODULE III

DIGITAL LITERACY

UNIT CODE: 0611 451 02B

TVETCDACC UNIT CODE: ENG/CU/SPV/BC/01/5/MA

Relationship to Occupational Standards

This unit addresses the Unit of Competency: Apply Digital Literacy

Duration of Unit: 40 Hours

Unit Description

This unit covers the competencies required to demonstrate digital literacy. It involves operating computer devices, solving tasks using the Office suite, managing data and information, performing online communication and collaboration, applying cybersecurity skills, and performing jobs online.

Summary of Learning Outcomes

By the end of this unit of learning the trainee will be able to:

S/NO	Learning Outcome	Duration (Hours)
1.	Operate Computer Devices	10
2.	Solve Tasks Using Office Suite	5
3.	Manage Data and Information	10
4.	Perform Online Communication and Collaboration	5
5.	Apply Cyber security Skills	5
6.	Perform Online Jobs	5
TOTAL		**40**

Learning Outcomes, Content, and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Operate computer devices	1.1 Meaning and importance of digital literacy 1.2 Functions and Uses of Computers 1.3 Classification of computers 1.4 Components of a computer system 1.5 Computer Hardware 1.6 The System Unit E.g. Motherboard, CPU, casing 1.7 Input Devices e.g. Pointing, keying, scanning, voice/speech recognition, direct data capture devices. 1.8 Output Devices e.g. hardcopy output and softcopy output 1.9 Storage Devices e.g. main memory e.g. RAM, secondary storage (Solid state devices, Hard Drives, CDs & DVDs, Memory cards, Flash drives 1.10 Computer Ports e.g. HDMI, DVI, VGA, USB type C etc. 1.11 Classification of computer software 1.12 Operating system functions 1.13 Procedure for turning/off a computer 1.14 Mouse use techniques 1.15 Keyboard Parts and Use Techniques 1.16 Desktop Customization	1 Observation 2 Portfolio of Evidence 3 Project 4 Written assessment 5 Practical assessment 6 Oral assessment

Learning Outcome	Content	Suggested Assessment Methods
	1.17 File and Files Management using an operating system 1.18 Computer Internet Connection Options 1.18.1 Mobile Networks/Data Plans 1.18.2 Wireless Hotspots 1.18.3 Cabled (Ethernet/Fiber) 1.18.4 Dial-Up 1.18.5 Satellite 1.18.6 Computer external devices management 1.19 Device connections 1.20 Device controls (volume controls and display properties)	
2. Solve tasks using Office suite	2.1 Meaning and Importance of Word Processing 2.2 Examples of Word Processors 2.3 Working with word documents 2.3.1 Open and close word processor 2.3.2 Create a new document 2.3.3 Save a document 2.3.4 Switch between open documents 2.4 Enhancing productivity 2.4.1 Set basic options/preferences 2.4.2 Help resources	1 Observation 2 Portfolio of Evidence 3 Project 4 Written assessment 5 Practical assessment 6 Oral assessment

Learning Outcome	Content	Suggested Assessment Methods
	2.4.3 Use magnification/zoom tools 2.4.4 Display, hide built-in tool bar 2.4.5 Using navigation tools 2.5 Typing Text 2.6 Document editing (copy, cut, paste commands, spelling and Grammar check) 2.7 Document formatting 2.7.1 Formatting text 2.7.2 Formatting paragraph 2.7.3 Formatting styles 2.7.4 Alignment 2.7.5 Creating tables 2.7.6 Formatting tables 2.8 Graphical objects 2.8.1 Insert object (picture, drawn object) 2.8.2 Select an object 2.8.3 Edit an object 2.8.4 Format an object 2.9 Document Print setup 2.9.1 Page layout, 2.9.2 Margins set up 2.9.3 Orientation. 2.10 Word Document Printing 2.11 Meaning & Importance of electronic spreadsheets	

Learning Outcome	Content	Suggested Assessment Methods
	2.12 Components of Spreadsheets 2.13 Application areas of spreadsheets 2.14 Using spreadsheet application 2.14.1 Parts of Excel screen: ribbon, formula bar, active cell, name box, column letter,row number, Quick Access Toolbar. 2.14.2 Cell Data Types 2.14.3 Block operations 2.14.4 Arithmetic operators (formula bar (-, +, *, /). 2.14.5 Cell Referencing 2.15 Data Manipulation 2.15.1 Using Functions (Sum, Average, SumIF, Count, Max, Max, IF, Rank, Product, mode etc) 2.15.2 Using Formulae 2.15.3 Sorting data 2.15.4 Filtering data 2.15.5 Visual representation using charts 2.16 Worksheet printing 2.17 Electronic Presentations 2.18 Meaning and Importance of electronic presentations 2.19 Examples of Presentation Software	

Learning Outcome	Content	Suggested Assessment Methods
	2.20 Using the electronic presentation application 2.20.1 Parts of the PowerPoint screen (slide navigation pane, slide pane, notes, the ribbon, quick access toolbar, and scroll bars). 2.20.2 Open and close presentations 2.20.3 Creating Slides (Insert new slides, duplicate, or reuse slides.) 2.20.4 Text Management (insert, delete, copy, cut and paste, drag and drop, format, and use spell check). 2.20.5 Use magnification/zoom tools 2.20.6 Apply or change a theme. 2.20.7 Save a presentation 2.20.8 Switch between open presentations 2.21 Developing a presentation 2.21.1 Presentation views 2.21.2 Slides 2.21.3 Master slide 2.22 Text 2.22.1 Editing text 2.22.2 Formatting 2.22.3 Tables	

Learning Outcome	Content	Suggested Assessment Methods
	2.23 Charts 2.23.1 Using charts 2.23.2 Organization charts 2.24 Graphical objects 2.24.1 Insert, manipulate 2.24.2 Drawings 2.25 Prepare outputs 2.25.1 Applying slide effects and transitions 2.25.2 Check and deliver • Spell check a presentation • Slide orientation • Slide shows, navigation 2.26 Print presentations (slides and handouts)	
3. Manage Data and Information	3.1 Meaning of Data and information 3.2 Importance and Uses of data and information 3.3 Types of internet services 3.3.1 Communication Services 3.3.2 Information Retrieval Services 3.3.3 File Transfer 3.3.4 World Wide Web Services 3.3.5 Web Services 3.3.6 Automatic Network Address Configuration 3.3.7 News Group	1 Observation 2 Portfolio of Evidence 3 Project 4 Written assessment 5 Practical assessment 6 Oral assessment

Learning Outcome	Content	Suggested Assessment Methods
	3.3.8 Ecommerce 3.4 Types of Internet Access Applications 3.5 Web browsing concepts 3.5.1 Key concepts 3.5.2 Security and safety 3.6 Web browsing 3.6.1 Using the web browser 3.6.2 Tools and settings 3.6.3 Clearing Cache and cookies 3.6.4 URIs 3.6.5 Bookmarks 3.6.6 Web outputs 3.7 Web based information 3.7.1 Search 3.7.2 Critical evaluation of information 3.7.3 Copyright, data protection 3.8 Downloads Management 3.9 Performing Digital Data Backup (Online and Offline) 3.10 Emerging issues in internet	
4. Perform online communication and collaboration	4.1 Netiquette principles 4.2 Communication concepts 4.2.1 Online communities 4.2.2 Communication tools 4.2.3 Email concepts 4.3 Using email 4.3.1 Sending email	1 Observation 2 Portfolio of Evidence 3 Project 4 Written assessment 5 Practical

Learning Outcome	Content	Suggested Assessment Methods
	4.3.2 Receiving email 4.3.3 Tools and settings 4.3.4 Organizing email 4.4 Digital content copyright and licenses 4.5 Online collaboration tools 4.5.1 Online Storage (Google Drive) 4.5.2 Online productivity applications (Google Docs & Forms) 4.5.3 Online meetings (Google Meet/Zoom) 4.5.4 Online learning environments 4.5.5 Online calendars (Google Calendars) 4.5.6 Social networks (Facebook/Twitter - Settings & Privacy) 4.6 Preparation for online collaboration 4.6.1 Common setup features 4.6.2 Setup 4.7 Mobile collaboration 4.7.1 Key concepts 4.7.2 Using mobile devices 4.7.3 Applications 4.7.4 Synchronization	assessment 6 Oral assessment
5. Apply cyber security skills.	5.1 Data protection and privacy 5.1.1 Confidentiality of data/information 5.1.2 Integrity of data/information 5.1.3 Availability of data/information	1 Observation 2 Portfolio of Evidence 3 Project

Learning Outcome	Content	Suggested Assessment Methods
	5.2 Internet security threats 5.2.1 Malware attacks 5.2.2 Social engineering attacks 5.2.3 Distributed denial of service (DDoS) 5.2.4 Man-in-the-middle attack (MitM) 5.2.5 Password attacks 5.2.6 IoT Attacks 5.2.7 Phishing Attacks 5.2.8 Ransomware 5.3 Computer threats and crimes 5.4 Cybersecurity control measures 5.4.1 Physical Controls 5.4.2 Technical/Logical Controls (Passwords, Pins, Biometrics) 5.4.3 Operational Controls 5.5 Laws governing protection of ICT in Kenya 5.5.1 The Computer Misuse and Cybercrimes Act No. 5 of 2018 5.5.2 The Data Protection Act No. 24 Of 2019	4 Written assessment 5 Practical assessment 6 Oral assessment
6. Perform Online Jobs	6.1 Introduction to online working 6.2 Types of online Jobs 6.3 Online job platforms 6.3.1 Remotask 6.3.2 Data annotation tech	1 Observation 2 Portfolio of Evidence 3 Project 4 Written

Learning Outcome	Content	Suggested Assessment Methods
	6.3.3 Cloud worker 6.3.4 Upwork 6.3.5 Oneforma 6.3.6 Appen 6.4 Online account and profile management 6.5 Identifying online jobs/job bidding 6.6 Online digital identity 6.7 Executing online tasks 6.8 Management of online payment accounts.	assessment 5 Practical assessment 6 Oral assessment
7. Apply job entry techniques	7.1 Types of job opportunities 7.1.1 Self-employment 7.1.2 Service provision 7.1.3 product development 7.1.4 salaried employment 7.2 Sources of job opportunities 7.3 Resume/ curriculum vitae 7.3.1 What is a CV 7.3.2 How long should a CV be 7.3.3 What to include in a AC 7.3.4 Format of CV 7.3.5 How to write a good CV 7.3.6 Don'ts of writing a CV 7.4 Job application letter 7.4.1 What to include 7.4.2 Addressing a cover letter	1 Observation 2 Portfolio of Evidence 3 Project 4 Written assessment 5 Practical assessment 6 Oral assessment

Learning Outcome	Content	Suggested Assessment Methods
	7.4.3 Signing off a cover letter 7.5 Portfolio of Evidence 7.5.1 Academic credentials 7.5.2 Letters of commendations 7.5.3 Certification of participations 7.5.4 Awards and decorations 7.6 Interview skills 7.6.1 Listening skills 7.6.2 Grooming 7.6.3 Language command 7.6.4 Articulation of issues 7.6.5 Body language 7.6.6 Time management 7.6.7 Honesty 7.7 Generally knowledgeable in current affairs and technical area	

Suggested Methods Instruction

- Instructor-led facilitation using active learning strategies
- Demonstration by trainer
- Practical work by trainees
- Viewing of related videos
- Group discussions
- Project
- Role play
- Case study

Recommended Resources for 25 Trainees

S/N0	RESOURCES	QUANTITY
1.	computers with the following software: • Windows/Linux/Macintosh Operating System • Microsoft Office Software • Google Workspace Account • Antivirus Software	25
2.	Printers	2
3.	Printing Papers	enough
4.	External storage media	25
5.	Projector	1
6.	Whiteboard	1
7.	Smartboard/Smart TV (Where applicable)	1
8.	Assorted whiteboard markers	enough
9.	Internet connection	enough
10.	5 samples of CVs	5
11.	Assorted whiteboard markers	enough
12.	5 samples of job applications	5

COMMUNICATION SKILLS

UNIT CODE:0031 441 01B

TVETCDACC UNIT CODE: ENG/CU/SPV/BC/02/5/MA

Relationship to Occupational Standards

This unit addresses the Unit of Competency: Apply Communication Skills

Duration of Unit: 40 hours

Unit Description

This unit covers the competencies required to apply communication skills. It involves applying communication channels, written communication skills, non-verbal skills, oral communication skills, and group communication skills.

Summary of Learning Outcomes

By the end of this unit of learning the trainee will be able to:

S/NO	Learning Outcome	Duration (Hours)
1.	Apply communication channels.	10
2.	Apply written communication skills.	10
3.	Apply non-verbal skills.	10
4.	Apply oral communication skills.	5
5.	Apply group communication skills.	5
TOTAL		**40**

Learning Outcomes, Content, and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Apply communication channels	1.1 Communication process 1.2 Principles of effective communication 1.3 Channels/medium/modes of communication 1.4 Factors to consider when selecting a channel of communication 1.5 Barriers to effective communication 1.6 Flow/patterns of communication 1.7 Sources of information 1.8 Organizational policies	1 Oral questions 2 Written assessment 3 Observation 4 Portfolio of Evidence 5 Practical assessment 6 Third party report
2. Apply written communication skills	2.1 Types of written communication 2.2 Elements of communication 2.3 Organization requirements for written communication	1 Oral assessment 2 Written assessment 3 Observation 4 Portfolio of Evidence 5 Practical assessment 6 Third party report
3. Apply non-verbal communication skills	3.1 Utilize body language and gesture 3.2 Apply body posture 3.3 Apply workplace dressing code	1 Oral assessment 2 Written assessment 3 Observation 4 Portfolio of Evidence 5 Practical assessment

Learning Outcome	Content	Suggested Assessment Methods
		6 Third party report
4. Apply oral communication skills	4.1 Types of oral communication pathways 4.2 Effective questioning techniques 4.3 Workplace etiquette 4.4 Active listening	1 Oral assessment 2 Written assessment 3 Observation 4 Portfolio of Evidence 5 Practical assessment 6 Third party report
5. Apply group discussion skills	5.1 Establishing rapport 5.2 Facilitating resolution of issues 5.3 Developing action plans 5.4 Group organization techniques 5.5 Turn-taking techniques 5.6 Conflict resolution techniques 5.7 Team-work	1 Oral assessment 2 Written assessment 3 Observation 4 Portfolio of Evidence 5 Practical assessment

Suggested Methods of Instruction

1. Discussion
2. Roleplaying
3. Simulation
4. Direct instruction
5. Demonstration
6. Field trips

Recommended Resources for 25 trainees

General Resources	Tools and Equipment	Materials and Supplies
7. 25 Desktop computers/laptops	Mobile phones	Flashcards
8. Internet connection		Flip charts
9. 1 Projector 10. 1 Printer		2 packets of assorted colors of whiteboard marker pens
11. 1 Whiteboard		Printing papers
12. Report writing templates		

ENTREPRENEURIAL SKILLS

UNIT CODE: 0413441 04B

TVETCDACC UNIT CODE: ENG/CU/SPV/BC/04/5/MA

UNIT DURATION: 40 hours

Relationship to occupational standards

This unit addresses the unit of competency: Apply entrepreneurial skills.

Unit Description:

This unit covers the competencies required to apply entrepreneurial skills. It involves applying financial literacy, applying entrepreneurial concepts, identifying entrepreneurship opportunities, applying business legal aspects, and developing business innovative strategies and developing business plans.

Summary of Learning Outcomes

S/No	Learning Outcome	Duration in hours.
1.	To apply financial literacy	6
2.	To apply the entrepreneurial concept	4
3.	To identify entrepreneurship opportunities	6
4.	To apply business legal aspects	6
5.	To innovate business strategies	6
6.	To develop a business plan	12
	TOTAL	**40**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
• Apply Financial Literacy	1.1.Sources of personal and business funds 1.2.Personal finance management 1.3.Balancing between needs and wants 1.4. Budget Preparation 1.5.Saving management 1.6. Factors to consider when deciding where to save 1.7.Debt management 1.8.Factors to consider before taking a loan 1.9.Investment decisions 1.10. Types of investments 1.11. Factors to consider when investing money 1.12. Insurance services 1.13. insurance products available in the market 1.14. Insurable risks	• Practical Assessment • Project • Third Party Report • Portfolio of Evidence • Written Assessment • Oral Questioning
• Apply Entrepreneurial Concept	2.1.Difference between Entrepreneurs and Business persons 2.2.Types of entrepreneurs 2.3.Ways of becoming an entrepreneur	• Practical Assessment • Project • Third Party Report • Portfolio of Evidence • Written Assessment • Oral Questioning

Learning Outcome	Content	Suggested Assessment Methods
	2.4. Characteristics of Entrepreneurs 2.5. salaried employment and self-employment 2.6. Requirements for entry into self-employment 2.7. Roles of an Entrepreneur in an enterprise 2.8. Contributions of Entrepreneurship	
• Identify Entrepreneurship Opportunities	3.1. Sources of business ideas 3.2. Factors to consider when evaluating business opportunity 3.3. Business life cycle	• Practical Assessment • Project • Third Party Report • Portfolio of Evidence • Written Assessment • Oral Questioning
• Apply Business Legal Aspects	4.1. Forms of business ownership 4.2. Business registration and licensing processing 4.3. Types of contracts and agreements 4.4. Employment laws 4.5. Taxation laws	• Practical Assessment • Project • Third Party Report • Portfolio of Evidence • Written Assessment • Oral Questioning
• Innovate Business Strategies	5.1. Creativity in business 5.2. Innovative business strategies 5.3. Entrepreneurial Linkages 5.4. ICT in business growth and development	• Practical Assessment • Project • Third Party Report • Portfolio of Evidence • Written Assessment

Learning Outcome	Content	Suggested Assessment Methods
		• Oral Questioning
• Develop Business Plan	6.1.Business description 6.2.Marketing plan 6.3.Organizational Management plan 6.4.Production/operation plan 6.5.Financial plan 6.6.Executive summary 6.7.Business plan presentation 6.8.Business idea incubation	• Practical Assessment • Project • Third Party Report • Portfolio of Evidence • Written Assessment • Oral Questioning

Suggested Methods of Instruction

- Direct instruction with active learning strategies
- Project (Business plan)
- Case studies
- Field trips
- Group Discussions
- Demonstration
- Question and answer
- Problem solving
- Experiential
- Team training
- Guest speakers

Recommended Resources for 25 trainees

S/No.	Category/Item	Description/ Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
1.	Textbooks	J. Bird Electrical and Electronic Principles V.K. Mehta & R. Mehta Basic Electrical Engineering	5 pcs for each	1:5
2.		Newspapers and Handouts	5 pcs	1:5
3.		Business Journals	1 pc for each	1:25
4.		Case studies	5 pcs	1:5
5.		Business plan templates	5 pcs	1:5
6.	Power point presentations	For trainer's use	1	1:25
B	**Learning Facilities & Infrastructure**			
6.	Lecture/theory room	$60m^2$	1	1:25
7.	Computer laboratory	$100m^2$	1	1:25

ENGINEERING MATHEMATICS I

UNIT CODE: 0541 441 05A

TVETCDACC UNIT CODE: ENG/CU/SPV/CC/01/5/MA

UNIT DURATION: 80 HOURS

Relationship to Occupational Standards

This unit addresses the Unit of Competency: Apply engineering mathematics

Unit Description

This unit describes the competencies required to apply a wide range of engineering mathematics. Competencies include: applying number systems, applying algebra, applying trigonometry and hyperbolic functions, performing coordinates geometry and carrying out binomial expansions.

Summary of Learning Outcomes

By the end of this unit of learning the trainee will be able to:

S/NO	Learning Outcome	Duration (Hours)
1.	Apply number systems	5
2.	Apply algebra	20
3.	Apply Trigonometry and Hyperbolic functions	20
4.	Perform coordinates geometry	15
5.	Carry out binomial expansions	20
TOTAL		**80**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Apply number systems	1.1 Types of numbers 1.1.1 Rounding off numbers to the nearest tens, 1.1.2 hundreds, thousands, millions and billions 1.1.3 Whole numbers 1.1.4 Odd numbers 1.1.5 Even numbers 1.1.6 Prime number 1.1.7 Ratio and proportions 1.2 Percentages 1.2.1 Word problems involving natural 1.2.2 Numbers 1.3 Factors 1.3.1 Factors of composite numbers 1.3.2 Prime factors 1.3.3 Factors in power form 1.4 Divisibility Test 1.4.1 GCD 1.4.2 Application of GCD/HCF to real life situations 1.5 LCM 1.5.1 Multiples of a number 1.5.2 LCM of a set of numbers 1.5.3 Application of LCM in real life situations 1.6 Integers 1.6.1 The number line 1.6.2 Operation on integers 1.6.3 Order of operations 1.6.4 Application to real life situation 1.7 Fractions	• Written assessment • Practical assessment • Oral Questioning

	1.7.1 Proper, improper fractions and mixed numbers 1.7.2 Conversion of improper fractions to mixed numbers and vice versa 1.7.3 Comparing fractions 1.7.4 Operations on fractions 1.7.5 Order of operations on fractions 1.7.6 Word problems involving fractions in real life situations 1.8 Decimals 1.8.1 Fractions and decimals 1.8.2 Recurring decimals 1.8.3 Recurring decimals and fractions 1.8.4 Decimal places 1.8.5 Standard form 1.8.6 Operations on decimals 1.8.7 Order of operations 1.8.8 Real life problems involving decimals 1.9 Arithmetic operation 1.9.1 Addition 1.9.2 Subtraction 1.9.3 Multiplication 1.9.4 Division 1.10 Squares and square roots 1.10.1 Squares by multiplication 1.10.2 Square roots by factorization 1.10.3 Squares and Square roots using Calculators	
2. Apply algebra	2.1 Indices and logarithms 2.1.1 Indices (powers) and base	• Written assessment

	2.1.2 Laws of indices (including positive 2.1.3 integers, negative integers and fractional 2.1.4 indices) 2.1.5 Powers of 10 and common logarithms 2.1.6 Common logarithms; 2.1.7 characteristics 2.1.8 mantissa 2.1.9 Logarithm tables 2.1.10 Application of common logarithms in 2.1.11 multiplication, division and finding 2.1.12 roots 2.2 Algebra 2.2.1 Algebraic expressions including algebraic fractions 2.2.2 Simplification of algebraic expressions 2.2.3 Factorization by grouping 2.2.4 Removal of brackets 2.2.5 Substitution and evaluation 2.2.6 Problem solving in real situation 2.3 Simultaneous Equation 2.4 Solve simultaneous equation by; 2.4.1 Elimination method 2.4.2 Substitution method 2.4.3 Graphical method 2.4.4 Solve real life problems 2.5 Quadratic expressions and equations 2.5.1 Expansion of algebraic expressions 2.5.2 The three quadratic identities	• Practical assessment • Oral Questioning

	2.5.3 Using the three quadratic identities 2.5.4 Factorization of quadratic expressions 2.5.5 Solutions of quadratic equations by factor method 2.5.6 Formation and solution of quadratic equations	
3. Apply trigonometry and hyperbolic functions	3.1 Importance of trigonometry in engineering. 3.2 Trigonometric Ratios and Functions 3.2.1 Definitions of sine, cosine, tangent, cosecant, secant, and cotangent. 3.2.2 Unit circle and angle measurement 3.2.2.1 Degrees and radians 3.2.2.2 Graphs of trigonometric functions. 3.3 Trigonometric Identities 3.3.1 Fundamental identities 3.3.1.1 Pythagorean 3.3.1.2 Reciprocal 3.3.1.3 Quotient identities 3.3.2 Co-function identities and even-odd properties. 3.3.3 Sum and difference formulas, double-angle, and half-angle formulas. 3.4 Solving Trigonometric Equations 3.4.1 Basic Trigonometric Equations 3.4.1.1 Solving equations involving basic trigonometric functions. 3.4.1.2 Using identities to simplify and solve equations.	1. Written assessment 2. Oral assessment 3. Practical 4. Project 5. Third party report 6. Portfolio of evidence •

	3.4.2 Inverse Trigonometric Functions 3.4.2.1 Definition and properties. 3.4.2.2 Solving equations using inverse trigonometric functions. 3.4.3 Applications of Trigonometric Equations 3.4.3.1 Engineering problems involving periodic functions and waveforms. 3.4.3.2 Harmonic motion and oscillations in mechanical systems. 3.5 Trigonometry in Triangles 3.5.1 Right-Angle Triangles 3.5.1.1 Solving for sides and angles using trigonometric ratios. 3.5.1.2 Applications in engineering problems such as inclined planes and forces. 3.5.2 Non-Right-Angle Triangles 3.5.2.1 Law of Sines and Law of Cosines. 3.5.2.2 Solving oblique triangles. 3.5.2.3 Applications in engineering fields of structural analysis and navigation. 3.6 Introduction to Hyperbolic Functions 3.6.1 Definitions of hyperbolic sine, cosine, tangent, and their reciprocals. 3.6.2 Graphs and properties of hyperbolic functions. 3.7 Hyperbolic Identities	

	3.7.1 Fundamental identities 3.7.1.1 Pythagorean-like identities 3.7.2 Sum and difference formulas, double-angle, and half-angle formulas. 3.8 Solving Hyperbolic Equations 3.8.1 Basic Hyperbolic Equations 3.8.1.1 Solving equations involving basic hyperbolic functions. 3.8.1.2 Using identities to simplify and solve equations. 3.8.2 Inverse Hyperbolic Functions 3.8.2.1 Definition and properties. 3.8.2.2 Solving equations using inverse hyperbolic functions. 3.9 Applications of Hyperbolic Functions in Engineering	
4. Perform coordinates geometry	4.1 Polar equations 4.1.1 Definition of polar coordinates 4.1.2 Definition and examples of polar equations. 4.1.3 Representing curves using polar equations. 4.2 Cartesian equation 4.2.1 Definition of Cartesian coordinates. 4.2.2 Definition of a point in cartesian coordinates 4.2.3 Relationship between Cartesian and polar coordinates.	1 Written assessment 2 Oral assessment 3 Practical 4 Project 5 Third party report • Portfolio of evidence

	4.2.4 Definition and examples of Cartesian equations. 4.2.5 Representing lines, circles, parabolas, ellipses, and hyperbolas using Cartesian equations. 4.2.6 Conversion Between Polar and Cartesian Equations. 4.3 Graphs of polar equations 4.3.1 Plotting Polar Equations 4.3.1.1 Definition of a point in polar coordinates 4.3.1.2 Steps to graph polar equations. 4.3.1.3 Using symmetry and periodicity in polar graphs. 4.3.2 Analyzing Polar Graphs 4.3.2.1 Identifying key features intercepts, maxima, minima 4.3.3 Applications in engineering 4.4 Normal and tangents 4.4.1 Tangents to Curves 4.4.1.1 Definition of a tangent line. 4.4.1.2 Finding the slope of a tangent to a curve at a given point. 4.4.2 Normals to Curves 4.4.2.1 Definition of a normal line. 4.4.2.2 Finding the equation of a normal to a curve at a given point. 4.4.3 Tangents and Normals in Polar Coordinates	

	4.4.3.1 Techniques for finding tangents and normals to curves defined by polar equations. 4.5 Loci 4.5.1 Introduction to Loci 4.5.1.1 Definition of Locus 4.5.1.2 Understanding the concept of a locus. 4.5.1.3 Importance of loci in engineering. 4.5.2 Locus in Relation to a Circle 4.5.2.1 Equations and properties of loci relative to circles. 4.5.2.2 Common loci problems involving circles 4.5.3 Applications in Engineering 4.5.3.1 Using loci to solve engineering problems: robotic arm movement 4.5.3.2 Analyzing Loci of Points: tracing the path of a point on a rotating arm 4.5.3.3 Using loci to optimize mechanical systems: designing cams, robotic path planning.	
5. Carry out binomial expansion	5.1 Basic concepts of binomial theorem 5.1.1 Binomial expressions and notation. 5.1.2 Factorials and their use in binomial coefficients. 5.1.3 Binomial Coefficients	6 Written assessment 7 Oral assessment 8 Practical

	5.1.3.1 Definition and calculation using combinations (nCr). 5.1.3.2 Pascal's Triangle as a tool for finding binomial coefficients. 5.2 Binomial Expansion 5.2.1 General form of the binomial expansion expression 5.2.2 Binomial Expansion of $(a+b)^n$ where $n = 2,3,4...$ 5.2.3 Special cases 5.2.3.1 When $(1+x)^n$ 5.2.3.2 Negative and fractional binomial expansions using the binomial series 5.3 Applications of Binomial Expansion 5.3.1 Simplifying algebraic expressions using binomial expansion. 5.3.2 Solving polynomial equations. 5.4 Engineering Applications 5.5 Estimating values in engineering calculations.	9 Project 10 Third party report • Portfolio of evidence

Suggested Methods of Instruction

1. Practical
2. Demonstrations
3. Group discussion
4. Direct instructions

Recommended Resources for 25 Trainees

S/No.	Category/Item	Description/ Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
1.	Textbooks	Engineering Mathematics by John bird 8th edition	5 pcs	1:5
2.		Engineering Mathematics by A.K stround 8th edition	5 pcs	1:5
3.		SMP	25	1:1
B	**Learning Facilities & infrastructure**			
1	Lecture/theory room	50 m^2	1	1:25
C	**Consumable materials**			
1.	Charts	Manila papers		
2.	marker pens	Erasable		
D	**Tools and Equipment**			
24.	Calculators	Scientific	25 pcs	1:1

ELECTRICAL PRINCIPLES I

UNIT CODE:0713 441 07A

TVETCDACC UNIT CODE: ENG/CU/SPV/CC/02/5/MA

UNIT DURATION: 50 HOURS

Relationship to Occupational Standards

This unit addresses the Unit of Competency: Apply electrical principles I

UNIT DESCRIPTION

This unit describes competences required to apply electrical principles I in their work. It involves Applying Electrical quantities, using cells and batteries, applying magnetism and electromagnetism.

Summary of Learning Outcomes

By the end of this unit of learning the trainee will be able to:

S/NO	Learning Outcome	Duration (Hours)
1.	Applying Electrical quantities	10
2.	Using cells and batteries	10
3.	Applying magnetism and electromagnetism	20
TOTAL		**50**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Applying Electrical quantities	1.1 The meaning of SI unit 1.2 SI unit of various types of Electrical parameters 1.3 Ohm's law	• Practical • Project • Third party report • Portfolio of evidence • Written tests

	1.4 Calculations involving various Electrical parameters e.g. Power, Current, Voltage, Resistance 1.5 Instruments used in measuring various types of Electrical parameters	• Oral questioning
2. Using cells and batteries	2.1 Sources of electricity 2.2 electrolysis and its applications 2.3 Simple cells 2.4 Primary and secondary cells 2.5 Types of cells and batteries 2.5.1 Dry cells 2.5.2 Leclanché 2.5.3 Mercury 2.5.4 Lead-acid 2.5.5 Alkaline 2.5.6 Lithium 2.6 E.m.f and internal resistance of cells 2.7 Maintenance of batteries 2.8 Applications of batteries	• Practical • Project • Third party report • Portfolio of evidence • Written tests • Oral questioning
3. Apply magnetism and electromagnetism concepts	3.1 Magnetic and non-magnetic materials 3.2 Concepts of magnetic fields and field distribution 3.3 Concepts of electromagnetism 3.4 Laws of electromagnetic induction 3.5 Concepts of self and mutual induction	• Practical • Project • Third party report • Portfolio of evidence • Written tests • Oral questioning

Suggested Methods of Instruction

- Practical
- Projects
- Demonstrations
- Group Discussions
- Field trips
- On-job-training

Recommended Resources for 25 trainees

S/No.	Category/Item	Description/ Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
1.	Textbooks	J. Bird Electrical and Electronic Principles V.K. Mehta & R. Mehta Basic Electrical Engineering	5 pcs	1:5
2.	Installation manuals	Electronic components datasheets	5 pcs	1:5
3.	Charts	Circuit diagrams Colour codes	1 pcs for each	1:25
4.	Scientific Calculators		25	1:1
5.	Power point presentations	For trainer's use	1	1:25

B	**Learning Facilities & infrastructure**			
6.	Lecture/theory room	$60m^2$	1	1:25
7.	Workshop	$150m^2$	1	1:25
8.	Laboratory	$100m^2$	1	1:25
9.	Computer laboratory	$100m^2$	1	1:25
C	**Consumable materials**			
10.	Connector wires	Jumper wires,	5 pkts	1:5
11.	Insulation tapes		25 pcs	1:1
12.	Circuit boards	Bread board, copper strip boards	25 pcs	1:1
13.	Assorted electronic components	Resistors, diodes, capacitors, transistors, ICs, Transformers, Inductors, Batteries	25 pcs	1:1
14.	Soldering wires		5 rolls	1:5
D	**Tools and Equipment**			
15.	Striping knives		25 pcs	1:1
16.	Side cutters		25 pcs	1:1

17.	Pliers		25 pcs	1:1
18.	Assorted Screw driver		25 pcs	1:1
19.	Crimping tools		5 pcs	1:5
20.	PPEs		25 pcs	1:1
21.	Multimeters		5 pcs	1:5
22.	Oscilloscope		5 pcs	1:5
23.	Function generator		5 pcs	1:5
24.	Spectrum analyser		5 pcs	1:5
25.	Variable power supply		5 pcs	1:5
26.	Solder guns		25 pcs	1:1
27.	Hot air gun		5 pcs	1:5
28.	Work stations		25	1:1

SOLAR PV SYSTEMS DESIGN

UNIT CODE: 0713 451 11A

TVETCDACC UNIT CODE: ENG/CU/SPV/CR/01/5/MA

UNIT DURATION: 90 HOURS

Relationship to Occupational Standards

This unit addresses the Unit of Competency: Design solar PV systems

Unit Description

This unit covers the competencies required to design solar PV systems. Competencies include: surveying solar PV system site, sizing DC and AC components, sizing cables, bus bars and earth strips and also preparing solar PV drawings and bill of quantities.

Summary of Learning Outcomes

By the end of this unit of learning the trainee will be able to:

S/NO	Learning Outcome	Duration (Hours)
1.	Survey Solar PV System Site	10
2.	Size DC and AC components	40
3.	Size cables, bus bars and earth strips	20
4.	Prepare Solar PV drawings and Bill of Quantities	20
TOTAL		**90**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Survey Solar PV System Site	1.1.PPE 1.2.Site survey map and interpretation 1.3.Transport logistics 1.4.Site survey tools, equipment and instruments 1.5.Site conditions 1.5.1. Ground level 1.5.2. Weather conditions 1.5.3. Soil type 1.5.4. Buildings 1.6.Meaning of solar system 1.7.Meaning of terms 1.8.Size and rating of solar panel 1.9.Factors to consider in site survey Selection and installation 1.9.1. Solar system components 1.9.1.1.Solar modules; types, advantages, disadvantages 1.9.2. Charge controllers; mppt, pwm, advantages, disadvantages 1.9.3. Inverters; mppt, PWM, advantages, disadvantages 1.9.4. Batteries; Type Advantages, Disadvantages 1.9.5. solar PV accessories 1.9.6. solar system wiring 1.10. Human resource for site surveying 1.11. Site safety	• Written assessment • Practical assessment • Projects • Oral Questioning • Third party report • Portfolio of evidence

	1.12. Meteological records interpretation 1.13. Region Solar potential; insolation, irradiance, wind profile 1.14. Types of mounting 1.14.1. Solar tracking 1.15. Civil works 1.16. Site plan 1.17. Documentation 1.18. Site survey variables	
2. Size DC and AC components	1.2 Energy requirement 1.3 Load estimation 1.4 System voltage selection criteria; load criteria; daily energy criteria 1.5 Battery /battery bank sizing; DoD, days of autonomy, battery capacity 1.6 PV array sizing; PSH, Standard test conditions, watt peak, power tolerance 1.6.1 Number of solar cells 1.6.2 Solar PV Parameters 1.6.3 Solar module selection 1.7 Charger controller sizing; series fuse sizing 1.8 Inverter sizing 1.9 Determination the size of dc & ac protective device and other accessories	• Written assessment • Practical assessment • Projects • Oral Questioning • Third party report • Portfolio of evidence
3. Size cables, bus bars and earth strips	3.1 Determination of load current. 3.2 Cable/bus bar sizing/balance of system; cable sizes vs voltage drop; allowable voltage drop; 3.3 Cable size by voltage drop method	• Practical demonstration • Projects • Written tests • Oral Questioning

4. Prepare Solar PV drawings and Bill of Quantities	1.1.Electrical & Solar PV system Symbols 1.2.Single line diagram 1.2.1. Intake point 1.2.2. Lighting plan 1.2.3. Power circuit 1.2.4. Change over switching 1.3.Schematic diagram 1.4.Wiring diagram 1.5.CAD e.g. Aurora, Solar, open solar, helioscope, solar edge, solo, pylon, PV syst, RET screen 1.6.Bill of quantities; panel schedule/list of materials	• Written assessment • Practical assessment • Projects • Oral Questioning • Third party report • Portfolio of evidence

Suggested Methods of Instruction

Practical

Projects

Demonstrations

Group discussion

Direct instructions

Field trips

On-job-training

Recommended Resources for 25 Trainees

Tools	**Materials and supplies**
1 Excavation tools 2 Measuring tools e.g. a) 25 Tape measure b) 1 surveyor tape	• Stationery • Chalkline
Equipment	**Reference materials**
1 PPEs (Personal Protective Equipment)	

	• British standards (BS 3939;BS7671 • Occupational Safety and Health Act (OSHA) • National Environmental Management Authority (NEMA) regulations • IEEE regulations • EPRA regulation • PV system requirement refer KEBS Standards of 1673-1:2004

MODULE IV

DIGITAL ELECTRONICS I

UNIT CODE: 0714 541 13A

TVETCDACC UNIT CODE: ENG/CU/SPV/CC/03/5/MA

UNIT DURATION: 60Hours

Relationship to Occupational Standards

This unit addresses the Unit of Competency: Apply Digital Electronics I

Unit Description

This unit describes competences required to apply digital electronics I. Competences include applying knowledge of number systems, applying knowledge of binary code and applying logic gates and Boolean algebra concepts.

Summary of Learning Outcomes

By the end of this unit of learning the trainee will be able to:

S/NO	Learning Outcome	Duration (Hours)
1.	Apply knowledge of number systems	10
2.	Apply knowledge of binary codes	20
3.	Apply Logic gates and Boolean algebra concepts	30
TOTAL		**60**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Apply knowledge of number systems	1.1 Numbers systems e.g. 1.1.1 Decimal 1.1.2 Octal	1 Observation 2 Written test 3 Practical

	1.1.3 Hexadecimal 1.1.4 Binary 1.2 Number system representation 1.3 Conversion of number systems 1.4 Perform 1's and 2's complement	4 Demonstration 5 Oral questioning 6 Third party report
2. Apply knowledge of binary codes	2.1 BCD (Binary Coded Decimal) 2.2 Gray Code 2.3 Excess 3 code	1 Observation 2 Written test 3 Practical 4 Demonstration 5 Oral questioning 6 Third party report
3. Apply Logic gates and Boolean algebra concepts	3.1 Basic logic gates 3.2 Universal logic gates operation 3.3 Special purpose gates 3.4 laws of Boolean algebra 3.5 Logic expressions simplification 3.6 K-MAPS	1 Observation 2 Written test 3 Practical 4 Demonstration 5 Oral questioning 6 Third party report

Suggested Methods of Instruction

- Role playing
- Viewing of related videos
- Discussion
- Direct Instruction

Recommended Resources for 25 Trainees

S/No.	Category/Item	Description/ Specifications	Quantity	Recommended Ratio (Item: Trainee)

A	**Learning Materials**			
1.	Reference books	Digital Electronics: Principles, Devices and Applications By Anil K. Maini	5 pcs	1:5
2.	Installation manuals	Assorted Systems component Manufacturer's manuals and data sheets Instrumentation Handbooks	5 pcs	1:5
3.	Charts	Assorted Circuit diagrams charts	1 pcs for each	1:25
4.	Software	Assorted simulation software e.g Deeds,	25	1:1
5.	Audio visual presentations	Projector	1	1:25
B	**Learning Facilities & infrastructure**			
1.	Lecture/theory room	$60m^2$	1	1:25
2.	Workshop	$150m^2$	1	1:25
3.	Computer laboratory	$100m^2$	1	1:25
C	**Consumable materials**			
1.	Assorted electronics components	ICs, resistors, capacitors	25 pcs	1:1

D	Tools and Equipment			
1.	Assorted tools and equipment	Side cutters, Side cutters, Pliers, Screw driver, Multi-meter, Oscilloscope, Solder guns, breadboards	25 pcs	1:1
2.	PPEs	Safety boots, overall	25 pcs	1:1
3.	Function generator		5 pcs	1:5
4.	Variable power supply		5 pcs	1:5
5.	Trainers kit	Assorted logic gate, combinational circuits trainer kits with component Manufacturer's manuals and data sheets	5 pcs	1:5
6.	Hot air gun		5 pcs	1:5
7.	Work stations		25	1:1

ANALOGUE ELECTRONICS I

UNIT CODE: 0714 541 12A

TVETCDACC UNIT CODE: ENG/CU/SPV/CC/04/5/MA

Relationship to Occupational Standards

This unit addresses the unit of competency: apply analogue electronics 1.

Duration of Unit: 50 Hours

UNIT DESCRIPTION

This unit describes the competencies required to apply analogue electronics 1. These competencies include; applying semiconductor theory, applying semiconductor diodes, applying understanding of transistors, applying special semiconductor devices and performing rectification.

Summary of Learning Outcomes

By the end of this unit of learning the trainee will be able to:

S/NO	Learning Outcome	Duration (Hours)
1.	Understand semiconductor theory	10
2.	Apply semiconductor diode	10
3.	Apply transistors	10
4.	Apply special semiconductor devices	10
5.	Perform rectification	10
TOTAL		**50**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Understand semiconductor theory	1.1 Atomic structure 1.1.1. Structure of the Atom 1.1.2. Electron Configuration 1.1.3. Ions and Charge Carriers 1.2 Types of materials 1.2.1. Insulators 1.2.2. Conductors 1.2.3. Semiconductors 1.2.4. Semiconductor materials 1.3 Types of semiconductors materials 1.3.1. Intrinsic semiconductors 1.3.2. Extrinsic semiconductors 1.3.2.1. n-type extrinsic semiconductor 1.3.2.2. p-type extrinsic semiconductor 1.4 The pn junction 1.4.1. Properties of pn junction 1.4.2. Current flow in a forward biased pn junction 1.4.3. Current flow in a reverse biased pn junction 1.4.4. V-I characteristics of a pn junction	1 Practical test 2 Project 3 Third Party Report 4 Portfolio of evidence 5 Written test 6 Oral questioning

Learning Outcome	Content	Suggested Assessment Methods
2. Apply semiconductor diodes.	2.1 Introduction to the crystal diode 2.2 Characteristics of the crystal diode 2.2.1. Resistance of a crystal diode 2.2.2. Equivalent circuit of the crystal diode 2.3 Biasing of the crystal diode 2.3.1 Foreward biasing 2.3.2 Reverse biasing 2.4 Limitations in the operating conditions of a crystal diode 2.4.1 forward current rating 2.4.2 PIV 2.4.3 power rating 2.5 Special purpose diodes 2.5.1 LED 2.5.2 Photodiode 2.5.3 Optoisolator 2.5.4 Tunnel diode 2.5.5 Varactor diode 2.5.6 Schockley diode 2.6 Application of semiconductor diodes	1 Practical test 2 Third Party Report 3 Portfolio of evidence 4 Written test 5 Oral questioning
3. Apply transistors.	3.1 Bipolar junction transistors (BJTs) 3.1.1 Types and construction of BJT transistors 3.1.2 Operation of NPN and PNP transistors	1 Practical test 2 Third Party Report 3 Portfolio of evidence 4 Written test 5 Oral questioning

Learning Outcome	Content	Suggested Assessment Methods
	3.1.3 Characteristics of BJTs, i.e., V-I, and gain 3.2 BJT configurations 3.2.1 Common emitter 3.2.2 Common base 3.2.3 Common collector 3.3 Characteristics of BJT connections 3.4 BJT transistor load line analysis 3.4.1 DC load line 3.4.2 AC load line 3.5 BJT transistor biasing methods 3.5.1 Key terms in transistor biasing (faithful amplification, variation of transistor parameters, stabilisation) 3.5.2 Base resistor, emitter bias, collector feedback, voltage divider biasing techniques 3.6 Field Effect Transistors (FETs) – JFET & MOSFET 3.7 P and N channels of FETs 3.8 Operation of FETs 3.9 Characteristics of FETs 3.10 Biasing techniques of FETs 3.11 Application of FETs	

Learning Outcome	Content	Suggested Assessment Methods
4. Apply special semiconductor devices.	4.1 Special semiconductor devices 4.1.1 SCR 4.1.2 LASCR 4.1.3 TRIAC 4.1.4 DIAC 4.1.5 SCS 4.1.6 UJT 4.2 Operation principle of special semiconductor devices 4.3 Schematic symbols of special semiconductor devices 4.4 Application of special semiconductor devices	1 Practical test 2 Third Party Report 3 Portfolio of evidence 4 Written test 5 Oral questioning
5. Perform rectification.	5.1 Types of rectifiers 5.1.1 Half wave rectifiers 5.1.2 Full wave rectifiers (center-tap and bridge) 5.2 Classes of rectifiers 5.2.1 Uncontrolled Rectifier 5.2.2 Controlled Rectifier 5.2.3 Half-Controlled Rectifier 5.2.4 Fully-Controlled Rectifier 5.3 Application of rectifiers 5.4 Types of converters 5.4.1 AC to DC converter (rectifier) 5.4.2 DC to AC Converter (Inverter)	1 Practical test 2 Third Party Report 3 Portfolio of evidence 4 Written test 5 Oral questioning

Learning Outcome	Content	Suggested Assessment Methods
	5.4.3 DC to DC Converter 5.4.4 AC to AC Converter 5.5 Application of converters	

Suggested Methods of Instruction

- Practical
- Project
- Group discussions
- Demonstration
- Visit to manufacturing and processing industries
- On-job-training
- Charts and Audio-visual presentations

S/No.	Category/Item	Description/ Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
1.	Reference books	Mehta, V. K., & Mehta, R. (2020). Principles of electronics (12 edition). S. Chand and Company Limited, Theraja, B. L., & Theraja, A. K. (2005). A textbook of electrical technology (1st multicolour ed., Multicolour illustrative	10 pcs for each book	1:2.5

		ed., 23rd rev. multicoloured ed). S. Chand & Co. Bird, J. O. (2022). Bird's electrical and electronic principles and technology (Seventh edition). Routledge, Taylor & Francis Group.		
2.	Software	Assorted simulation software e.g., Circuit wizard.	25	1:1
3.	Audio visual presentations	Projector	1	1:25
B	**Learning Facilities & infrastructure**			
4.	Lecture/theory room	$60m^2$	1	1:25
5.	Workshop	$150m^2$	1	1:25
6.	Computer laboratory	$100m^2$	1	1:25
C	**Consumable materials**			
7.	Electronic components	Breadboards, Stripboards, Jumper wires, Assorted resistors, Assorted capacitors, Assorted MOSFETs, Assorted JFETs, 555 timers, Solder wire, LEDs, Assorted BJT transistors, LDRs, OPAMPs, thermistors, 12V DC motors	25 pcs	1:1

D	Tools and Equipment			
8.	Assorted tools and equipment	Side cutters, Side cutters, Pliers, Screw driver, Crimping tools, Mult-meter, Solder guns	25 pcs	1:1
9.	Assorted electrical gadgets	Solder gun, Heat sink, Hot air guns, function generator	25 pcs	1:1
10.	Assorted measuring instruments	Digital Oscilloscope,	5 for each category	1:5
11.	Digital Multimeter,			
12.	Digital functional generator		3 pcs	1:8
13.	Laser jet printer		2 pcs	1:13
14.	Power supply	Variable power supply, 5V Power adapters, 9V Power adapters, 12V Power adapters.	10 pcs	1:3
15.	Trainers kit	Analogue training kits, PWM kit	5 pcs	1:5
16.	PCB prototyping material	Copper board, ferrite chloride solution, see-through printing paper, HASL finishing PCB	25 for each category	1:1
17.	Drilling gun		3 pcs	1:8
18.	Work stations		25	1:1

WORK ETHICS AND PRACTICES

UNIT CODE: 0417 451 03B

TVETCDACC UNIT CODE: ENG/CU/SPV/BC/03/5/MA

Relationship to Occupational Standards

This unit addresses the unit of competency: Apply work ethics and practices.

Duration of Unit: 40 Hours

Unit Description

This unit covers the competencies required to apply work ethics and practices. It involves applying self-management skills, promoting ethical practices and values, promoting teamwork, maintaining professional and personal development, applying problem-solving skills, and promoting customer care.

Summary of Learning Outcomes

By the end of this unit, the learner should be able to:

S/NO	LEARNING OUTCOMES	DURATION(HOURS)
1.	Apply self-management skills	10
2.	Promote ethical practices and values	4
3.	Promote teamwork	10
4.	Maintain professional and personal development	10
5.	Apply problem-solving skills	4
6.	Promote customer care.	2
	TOTAL HOURS	**40**

Learning Outcomes, Content, and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Apply self-management skills	1.1.Self-awareness 1.2.Formulating personal vision, mission, and goals 1.3.Healthy lifestyle practices 1.4.Strategies for overcoming work challenges 1.5.Emotional intelligence 1.6. Coping with Work Stress. 1.7.Assertiveness versus aggressiveness and passiveness 1.8.Developing and maintaining high self-esteem 1.9.Developing and maintaining positive self-image 1.10. Time management 1.11. Setting performance targets 1.12. Monitoring and evaluating performance targets	1. Written Assessment 2. Oral Questioning 3. Practical Assessment 4. Project 5. Third party report 6. Portfolio of evidence
2. Promote ethical practices and values	2.1.Integrity 2.2.Core Values, ethics and beliefs 2.3.Patriotism 2.4.Professionalism 2.5.Organizational codes of conduct 2.6.Industry policies and procedures	1. Written Assessment 2. Oral Questioning 3. Practical Assessment 4. Project 5. Third party report 6. Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
3. Promote Teamwork	3.1.Types of teams 3.2.Team building 3.3.Individual responsibilities in a team 3.4.Determination of team roles and objectives 3.5.Team parameters and relationships 3.6.Benefits of teamwork 3.7.Qualities of a team player 3.8.Leading a team 3.9.Team performance and evaluation 3.10. Conflicts and conflict resolution 3.11. Gender and diversity mainstreaming 3.12. Developing Healthy workplace relationships 3.13. Adaptability and flexibility 3.14. Coaching and mentoring skills	1. Written Assessment 2. Oral Questioning 3. Practical Assessment 4. Project 5. Third party report 6. Portfolio of evidence
4. Maintain professional and personal development	4.1.Personal vs professional development and growth 4.2.Avenues for professional growth	1. Written Assessment 2. Oral Questioning 3. Practical Assessment

Learning Outcome	Content	Suggested Assessment Methods
	4.3.Recognizing career advancement 4.4.Training and career opportunities 4.5.Assessing training needs 4.6.Mobilizing training resources 4.7.Licenses and certifications for professional growth and development 4.8.Pursuing personal and organizational goals 4.9.Managing work priorities and commitments 4.10. Dynamism and on-the-job learning	4. Project 5. Third party report 6. Portfolio of evidence
5. Apply Problem-solving skills	5.1 Causes of problems 5.2 Methods of solving problems 5.3 Problem-solving process 5.4 Decision making 5.5 Creative thinking and critical thinking process in development of innovative and practical solutions	1. Written Assessment 2. Oral Questioning 3. Practical Assessment 4. Project 5. Third party report 6. Portfolio of evidence
6. Promote Customer care.	6.1 Identifying customer needs 6.2 Qualities of good customer service	1. Observation 2. Written assessment

Learning Outcome	Content	Suggested Assessment Methods
	6.3 Customer feedback methods 6.4 Resolving customer concerns 6.5 Customer outreach programs 6.6 Customer retention	3. Oral assessment 4. Third party reports 5. Portfolio of evidence

Suggested Delivery Methods

2. Demonstrations
3. Simulation
4. Role play
5. Group Discussion
6. Presentations
7. Projects
8. Case studies
9. Assignments

Recommended Resources for 25 Trainees

S/No.	Category/Item	Description/ Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
1.	Textbooks	The 7 Habits of Highly Effective People by Stephen R. Covey.	10 pcs 10 pcs	1:3 1:3

		The Courage to Meet the Demands of Reality by Dr. Henry Cloud. The Five Dysfunctions of a Team by Patrick Lencioni. Drive: The Surprising Truth About What Motivates Us by Daniel H. Pink	10 pcs 10 pcs	1:3 1:3
2.	Online resources	MindTools, Coursera, and LinkedIn	Online	
3.	Ethical guidelines	Industry-specific ethical guidelines and codes of conduct	10 copies	1:3
4.	Workplace etiquette manuals	Guides on professional behavior, dress code, punctuality, and communication in the workplace	10 copies	1:3
5.	Employee handbooks	Sample handbooks that outline expectations, policies, and procedures related to work ethics	10 copies	1:3
6.	Videos	Short films or documentaries on ethics	25 samples	1:1
7.	Podcasts	Episodes focused on work ethics	5 samples	1:5
B	**Learning Facilities & infrastructure**			

8.	Lecture/theory room	60m^2	1	1:25
9.	Computer workshop	160 m^2	1	1:25
10.	Computers	Operating System: 64-bit Windows 11 or 10 version 1809 or above Processor: 3 GHz (3+ GHz recommended), Memory: 8 GB (32GB recommended) Disk space: 10 GB Display: 1920 x 1080 resolution Display Card: 2 GB GPU (8 GB recommended) and DirectX 11 compliant (DirectX 12 recommended)	25 pcs	1:1
11.	Projector	high-resolution projectors with HDMI input	1	1:25
12.	Smartboard/Smart TV	Specifications: 77-inch interactive whiteboard with touch and pen functionality.	1	1:25
13.	Whiteboard	Traditional whiteboard	1	1:25
14.	Printers	With Print, Copy, Scan and Fax	2	1:13
C	**Software**			

15.	Operating systems	Windows/Linux/Macintosh Operating System	Installed in 25 computers	1:1
16.	Web Browsers	Chrome, Firefox, Edge, Safari	Installed in 25 computers	1:1
17.	Ethical decision-making tools	Online simulations that present ethical dilemmas for trainees to navigate	Installed in 25 computers	1:1
18.	Survey and Feedback Tools	Google forms, survey-monkey	Installed in 25 computers	1:1
D	**Consumables**			
19.	Pens, pencils, rulers and paper	Whiteboard markers, 2H pencils, plastic rulers, A2 white papers	Enough	
20.	Printing papers	A4 and A3	Enough	
21.	Flashcards	Assorted colours	Enough	
22.	Charts	Assorted colours	Enough	

ELECTRICAL INSTALLATION III

UNIT CODE: 0713 451 10A

TVETCDACC UNIT CODE: ENG/CU/SPV/CR/02/5/MA

UNIT DURATION: 120 HOURS

Relationship to Occupational Standards

This unit addresses the Unit of Competency: Perform electrical installation III

Unit Description

This unit specifies the competencies required for performing electrical installation III.

Competencies required includes; Performing installation system sizing and installation of electrical system, testing electrical installation and maintaining electrical installation.

Summary of Learning Outcomes

By the end of this unit of learning the trainee will be able to:

S/NO	Learning Outcome	Duration (Hours)
1.	Perform installation system sizing	30
2.	Install electrical system	40
3.	Test electrical installation	30
4.	Maintain electrical installation	20
TOTAL		**120**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Perform installation system sizing	1.1 Electrical load 1.1.1 Electrical & electronic appliances 1.1.2 Appliances specifications 1.1.3 Calculate Energy requirement & power consumption 1.1.4 Lighting load calculations 1.1.5 Motor & appliances calculations 1.2 Protective devices 1.2.1 Fuses; Types of fuses, advantages, disadvantages 1.2.2 Circuit Breakers: AC & DC MCB, ELCB, RCD 1.2.3 Isolators, 1.2.4 Ratings of the protective devices &applications 1.3 Electrical Cables 1.3.1 Types, sizes and construction 1.3.2 Cable sizing: resistance, current carrying capacity 1.3.3 Calculation of voltage drop 1.3.4 Factors affecting cable ratings 1.4 Accessory rating; switches, socket outlets 1.5 Phase balancing 1.5.1 Single phase 1.5.2 Three phase 1.5.3 Balance loads 1.6 IEE Regulations	• Written assessment • Practical assessment • Projects • Oral Questioning • Third party report • Portfolio of evidence

2. Install electrical system	2.1 Safety; PPE, handling of equipment 2.2 Cable management systems Conduits 2.2.1 Bus-bars 2.2.2 Raising mains 2.3 Armored Cable Termination 2.4 Lightning protection system 2.4.1 Domestic 2.4.2 Residential 2.4.3 Commercial (introduced) 2.5 Installation of final circuits 2.5.1 Distribution panels and switchboards 2.5.2 Installation and connection of distribution components 2.5.3 Lighting circuits 2.5.4 Power circuits 2.5.5 Heating circuits 2.5.6 Single phase motors 2.6 Electrical machines 2.6.1 3 phase motors 2.6.2 Direct online (DOL) 2.6.3 Star Delta 2.6.4 Labelling of installation work	• Written assessment • Practical assessment • Projects • Oral Questioning • Third party report • Portfolio of evidence
3. Test electrical installation	3.1 Definition of terms: inspection; testing 3.2 Visual inspection: Colour codes, labelling, Termination 3.3 Electrical tests; continuity test; Insulation resistance test polarity test,	•

	earth resistance test, earth loop impedance test 3.4 IEE Regulations	
4. Maintain electrical installation	4.1 Definition; maintenance; servicing; repair; fault, diagnosis/troubleshooting 4.2 Importance of maintenance 4.3 Cause of equipment failure 4.4 Types of maintenance; preventive, corrective, planned, routine 4.5 Maintenance schedule; format, content 4.6 Types of Maintenance Schedules 4.6.1 Preventive Maintenance Schedule 4.6.2 Corrective Maintenance Schedule 4.6.3 Predictive Maintenance Schedule 4.6.4 Condition-Based Maintenance Schedule 4.7 Types of repair aids 4.8 Maintenance manuals 4.9 Maintenance tools, equipment, materials and measuring instruments. 4.10 Identification equipment 4.11 Common faults in electrical circuits and components 4.11.1 Short circuit 4.11.2 Open circuit 4.11.3 Loose connection 4.11.4 Bad connection	•

	4.11.5 Earth fault 4.12 Testing procedures for common faults; 4.13 Methods of fault location 4.14 Selection of appropriate test instruments, tools and materials 4.15 Identification of test points and test parameters 4.16 Performing maintenance and repair activities 4.16.1 Visual Inspection 4.16.2 Cleaning 4.16.3 Lubrication 4.16.4 Testing and calibration 4.16.5 Electrical safety checks 4.16.6 Reassembly and restoration 4.16.7 Updating maintenance documents 4.16.8 Disposal of waste materials 4.16.9 Cleaning and storage of tools and measuring instruments. 4.16.10 Cleaning 4.16.11 Storage 4.17 Maintenance report	

Suggested Methods of Instruction

1 Practical
2 Projects
3 Demonstrations
4 Group discussion
5 Direct instructions

6 Field trips

7 On-job-training

Recommended Resources for 25 Trainees

Tools	**Materials and supplies**
1 Cutting tools e.g. a) 25 Hacksaws b) 25 Stripping knives c) 25 Side cutters d) 25 Pliers 2 Measuring tools e.g. a) 25 Tape measure b) 25 Tri-square c) 25 Steel rule d) 25 Spirit level 3 Fixing tools e.g. a) Assorted hammers b) Assorted Screw drivers 4 Fastening tools 4.1 Assorted spanners and wrenches 5 Lifting and tensioning tools	• Stationery • Assorted Cables • Assorted protective devices • Assorted solar system components • conduits and trunkings • Accessories • Lubricants • Screw • Adhesives • Cable clips
Equipment	**Reference materials**
1 PPEs (Personal Protective Equipment) 2 Measuring equipment a) 25 digital Multimeter b) 12 Insulation resistance meter c) 12 Earth resistance meter d) 12 Clamp meter	• British standards (BS 3939;BS7671 • Occupational Safety and Health Act (OSHA) • National Environmental Management Authority (NEMA) regulations

e) 12 AC power supply(to provide lab voltage ie 40-50V AC) 3 Others e.g. a) 10 Draw wire b) 10 Bending spring c) 5 Drilling machines d) 12 Work stations	• IEEE regulations • EPRA regulation

TECHNICAL DRAWINGS

UNIT CODE: 0732 441 08A

TVETCDACC UNIT CODE: ENG/CU/SPV/CC/07/5/MA

UNIT DURATION:100 HOURS

Relationship to Occupational Standards

This unit addresses the unit of competency: Prepare technical drawings

UNIT DESCRIPTION

This unit covers competences required to prepare technical drawings. Competences include preparing drawing equipment and materials, producing plane geometry drawings, Producing pictorial and orthographic drawings of components.

Summary of Learning Outcomes

By the end of this unit of learning the trainee will be able to:

S/NO	Learning Outcome	Duration (Hours)
1.	Prepare drawing equipment and materials	20
2.	Produce plane geometry drawings	40
3.	Produce pictorial and orthographic drawings of components	40
TOTAL		**100**

Learning Outcomes, Content and Suggested Assessment Methods:

Learning Outcome	Content	Suggested Assessment Methods
1. Prepare drawing equipment and materials	1.1 Identification and care of drawing equipment 1.1.1Drawing boards	• Practical • Project • Third party report

Learning Outcome	Content	Suggested Assessment Methods
	1.1.2T and set squares 1.1.3Drawing set 1.2 Identification and care of drawing materials 1.2.1Drawing papers 1.2.2Pencils 1.2.3Erasers 1.2.4Masking tapes 1.2.5 Paper clips 1.3 Reference to manufacturer's instructions and work place procedures on use and maintenance of drawing equipment and materials	• Portfolio of evidence • Written tests • Oral questioning
2. Produce plane geometry drawings	2.1 Types of lines in drawings 2.2 Freehand printing of letters 2.3 Borderlines and title blocks 2.4 Construction of different angles 2.5 Measurement of different angles 2.6 Bisection of different angles and lines 2.7 Construction of geometric figures 2.7.1Circles 2.7.2Triangles 2.7.3Rectangles 2.7.4Parallelogram 2.7.5Polygons 2.7.6Pyramids	• Practical • Project • Third party report • Portfolio of evidence • Written tests • Oral questioning

Learning Outcome	Content	Suggested Assessment Methods
	2.7.7Conic sections 2.7.8Prisms 2.8 Patterns development e.g cones, pyramids, prisms, cylinders 2.9 Different types of Tangents 2.9.1Exterior tangents to a circle 2.9.2Interior tangents to a circle 2.10 Standard drawing conventions	
3. Produce pictorial and orthographic drawings of components	3.1 Meaning of pictorial and orthographic drawings 3.2 Meaning of symbols and abbreviations 3.3 Free hand sketching of different types of geometric forms, tools and equipment 3.4 Drawing and interpretation of orthographic elevations 3.5 Drawing objects in isometric view 3.6 Drawing objects in oblique view	4. Practical • Project • Third party report • Portfolio of evidence • Written tests • Oral questioning

Suggested Methods of Delivery

- Projects
- Demonstration by trainer
- Practice by the trainee
- Discussions

Recommended Resources for 25 trainees

S/No.	Category/Item	Description/ Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
1.	Textbooks	K.Morling Geometric and Engineering drawing	5 pcs	1:5
2.	Drawing instruments	T-squares, set squares, drawing sets, Masking tapes	25	1:1
3.	Power point presentations	For trainer's use	1	1:25
B	**Learning Facilities & infrastructure**			
4.	Lecture/theory room	$50m^2$	1	1:25
5.	Drawing tables		25	1:1

MODULE V

ENGINEERING MATHEMATICS II

UNIT CODE: 0541 441 05A

TVETCDACC UNIT CODE: ENG/CU/SPV/CC/05/5/MA

UNIT DURATION: 80 HOURS

Relationship to Occupational Standards

This unit addresses the Unit of Competency: Apply engineering mathematics II

Unit Description

This unit describes the competencies required to apply a wide range of engineering mathematics II. Competencies include applying calculus, applying statistics and probability, applying matrices, applying vector theory and applying complex numbers.

Summary of Learning Outcomes

By the end of this unit of learning the trainee will be able to:

S/NO	Learning Outcome	Duration (Hours)
1.	Apply Calculus	15
2.	Apply Statistics and probability	20
3.	Apply matrices	15
4.	Apply Vector Theory	15
5.	Apply Complex Numbers	15
TOTAL		**80**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Apply Calculus	1.6 Introduction to calculus 1.7 Functional notation 1.8 The gradient of a curve 1.9 Differentiation from first principles 1.10 Differentiation of y = axn by the general rule 1.11 Differentiation of sine and cosine functions 1.12 Differentiation of eax and ln ax 1.13 Methods of differentiation 1.13.1 Differentiation of common functions 1.13.2 Differentiation of a product 1.13.3 Differentiation of a quotient 1.13.4 Function of a function 1.13.5 Successive differentiation 1.14 Some applications of differentiation 1.14.1 Rates of change 1.14.2 Velocity and acceleration 1.14.3 Turning points 1.15 Practical problems involving 1.16 Tangents and normal 1.17 Small changes 1.18 Logarithmic differentiation 1.19 Introduction to logarithmic differentiation 1.19.1 Laws of logarithms 1.19.2 Differentiation of logarithmic functions	1 Written assessment 2 Practical assessment **3** Oral Questioning

	1.19.3 Differentiation of further logarithmic functions 1.19.4 Differentiation of [f (x)] 1.20 Integral Calculus 1.21 Standard integration 1.22 The process of integration 1.23 The general solution of integrals of the form axn 1.24 Definite integrals 1.25 Integration using algebraic substitutions 1.26 Algebraic substitutions algebraic substitutions 1.27 Further worked problems on integration using algebraic substitutions 1.28 Change of limits 1.29 Integration using trigonometric substitutions 1.30 Integration using partial fractions 1.31 The t = tan θ substitution 1.32 Integration by parts 1.33 Numerical integration 1.34 The trapezoidal rule 1.35 The mid-ordinate rule 1.36 Simpson's rule	
2. Apply statistics and probability	2.1 Measures of central tendency mean, mode and median 2.2 Measures of dispersion 2.3 Variance and standard deviation 2.4 Definition of probability 2.5 Laws of probability	1. Written assessment

	2.6 Expectation variance and SD 2.7 Calculations involving discrete and continuous random variables. 2.8 Types of distributions 2.8.1 Binomial 2.8.2 Poisson 2.8.3 Normal 2.9 Mean, variance and SD of probability distributions 2.10 Application of probability distributions	2. Oral assessment 3. Practical 4. Project 5. Third party report 6. Portfolio of evidence •
3. Apply matrices I	3.1 Matrix 3.2 Order of a matrix 3.3 Square matrix 3.4 Compatibility in addition and 3.5 Multiplication of matrices 3.6 Multiplication of a matrix by a scalar Matrix multiplication 3.7 Identity matrix 3.8 Determinant of a 2 x 2 matrix 3.9 Inverse of a 2 x 2 matrix and 3.10 Singular matrix 3.11 Solutions of simultaneous equations in two unknowns by 3.12 Matrix method 3.13 Crammer rule	6 Written assessment 7 Practical assessment 8 Oral Questioning
4. Apply vector theorem	4.1 Vectors and scalar in two and three dimensions 4.1.1 Operations on vectors: Addition and subtraction 4.2 Position vectors	1 Practical 2 Project 3 Written tests 4 Oral questioning

	4.3 Resolution of vectors 4.4 Scalar and vector product 4.5 Gradient, 4.6 Curl 4.7 Divergence	
5. Apply complex numbers	5.1 Argand diagrams 5.2 Complex numbers operations 5.3 De Moivre's theorem	1 Practical 2 Project 3 Written tests Oral questioning

Suggested Methods of Instruction

- Practical
- Demonstrations
- Group discussion
- Direct instructions

Recommended Resources for 25 Trainees

S/No.	Category/Item	Description/ Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
1.	Textbooks	Engineering Mathematics by John bird 8th edition	5 pcs	1:5
2.		Engineering Mathematics by	5 pcs	1:5

		A.K stround 8th edition		
3.		SMP	25	1:1
B	**Learning Facilities & infrastructure**			
4.	Lecture/theory room	50 m^2	1	1:25
C	**Consumable materials**			
5.	Charts	Manila papers		
6.	marker pens	Erasable		
D	**Tools and Equipment**			
7.	Calculators	Scientific	25 pcs	1:1

ELECTRICAL PRINCIPLES II

UNIT CODE:0713 441 06A

TVETCDACC UNIT CODE: ENG/CU/SPV/CC/06/5/MA

UNIT DURATION: 70 HOURS

Relationship to Occupational Standards

This unit addresses the Unit of Competency: Apply electrical principles II

UNIT DESCRIPTION

This unit describes competences required to apply electrical principles in their work. It involves applying electrostatics principles, apply concepts of D.C circuit theory and performing electrical measurements.

Summary of Learning Outcomes

By the end of this unit of learning the trainee will be able to:

S/NO	Learning Outcome	Duration (Hours)
1.	Applying Electrostatics principles	20
2.	Apply concepts of D.C circuit theory	20
3.	Performing electrical measurements.	30
TOTAL		**70**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Apply Electrostatics principles	1.1 Electrostatics quantities 1.2 Types of capacitors 1.3 Concept of charge and electrostatic field 1.4 Capacitors in series and parallel	• Practical • Project • Third party report • Portfolio of evidence

	1.5 Measurement of capacitance 1.6 Application of Capacitors 1.7 Testing of capacitor	• Written tests • Oral questioning
2. Apply concepts of D.C circuit theory	2.1 |Resistance and resistivity 2.2 Parallel and series circuits 2.3 Basic electrical laws 2.3.1 Ohms law 2.3.2 Kirchhoff's theorem	• Practical • Project • Third party report • Portfolio of evidence • Written tests • Oral questioning
3. Perform electrical measurements	3.1 Types of transducers 3.2 Types of electrical instruments 3.3 Measurements of electrical quantities using Instruments 3.4 Calculations involving electrical instruments 3.5 Instrumental/systematic errors 3.6 Calculations involving systematic errors	• Practical • Project • Third party report • Portfolio of evidence • Written tests • Oral questioning

Suggested Methods of Instruction

- Practical
- Projects
- Demonstrations
- Group Discussions
- Field trips
- On-job-training

Recommended Resources for 25 trainees

S/No.	Category/Item	Description/ Specifications	Quantity	Recommended Ratio

				(Item: Trainee)
A	**Learning Materials**			
1.	Textbooks	J. Bird Electrical and Electronic Principles V.K. Mehta & R. Mehta Basic Electrical Engineering	5 pcs	1:5
2.	Installation manuals	Electronic components datasheets	5 pcs	1:5
3.	Charts	Circuit diagrams Colour codes	1 pcs for each	1:25
4.	Scientific Calculators		25	1:1
5.	Power point presentations	For trainer's use	1	1:25
B	**Learning Facilities & infrastructure**			
6.	Lecture/theory room	$60m^2$	1	1:25
7.	Workshop	$150m^2$	1	1:25
8.	Laboratory	$100m^2$	1	1:25
9.	Computer laboratory	$100m^2$	1	1:25
C	**Consumable materials**			
10.	Connector wires	Jumper wires,	5 pkts	1:5

11.	Insulation tapes		25 pcs	1:1
12.	Circuit boards	Bread board, copper strip boards	25 pcs	1:1
13.	Assorted electronic components	Resistors, diodes, capacitors, transistors, ICs, Transformers, Inductors, Batteries	25 pcs	1:1
14.	Soldering wires		5 rolls	1:5
D	**Tools and Equipment**			
15.	Striping knives		25 pcs	1:1
16.	Side cutters		25 pcs	1:1
17.	Pliers		25 pcs	1:1
18.	Assorted Screw driver		25 pcs	1:1
19.	Crimping tools		5 pcs	1:5
20.	PPEs		25 pcs	1:1
21.	Multimeters		5 pcs	1:5
22.	Oscilloscope		5 pcs	1:5
23.	Function generator		5 pcs	1:5

24.	Spectrum analyser		5 pcs	1:5
25.	Variable power supply		5 pcs	1:5
26.	Solder guns		25 pcs	1:1
27.	Hot air gun		5 pcs	1:5
28.	Work stations		25	1:1

DIGITAL ELECTRONICS II

UNIT CODE: 0714 541 13A

TVETCDACC UNIT CODE: ENG/CU/SPV/CC/08/5/MA

UNIT DURATION: 50Hours

Relationship to Occupational Standards

This unit addresses the Unit of Competency: Apply Digital Electronics II

Unit Description

This unit describes competences required to apply digital electronics II. Competences include applying knowledge of digital logic circuits, applying knowledge of converters (ADC and DAC) and managing computer memories.

Summary of Learning Outcomes

By the end of this unit of learning the trainee will be able to:

S/NO	Learning Outcome	Duration (Hours)
1.	Apply knowledge of digital logic circuits	15
2.	Apply knowledge of advance digital logic and converter circuits	20
3.	Manage computer memories	15
TOTAL		**50**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Apply knowledge of digital logic circuits	1.1 Combinational logic circuits design and minimization 1.2 Logic families. 1.2.1 Bipolar Families 1.2.2 MOS Families 1.2.3 Hybrid Family 1.3 Sequential logic circuits Flip flops	1 Observation 2 Written test 3 Practical 4 Demonstration 5 Oral questioning 6 Third party report
2. Apply knowledge of advance digital logic and converter circuits	2.1 Counters 2.2 Data handling devices 2.2.1 Decoders 2.2.2 Encoders 2.2.3 Multiplexers 2.2.4 Demultiplexers 2.2.5 Shift registers 2.3 Arithmetic circuits 2.4 Digital converters (ADC)(DAC)	1 Observation 2 Written test 3 Practical 4 Demonstration 5 Oral questioning 6 Third party report
3. Manage computer memories	3.1 Introduction to Computer Memory systems 3.2 Types of memory devices 3.2.1 RAMs 3.2.2 ROMs 3.2.3 EEPROM 3.2.4 EPROM 3.3 Memory organization. 3.4 Memory expansion	1 Observation 2 Written test 3 Practical 4 Demonstration 5 Oral questioning 6 Third party report

Suggested Methods of Instruction

- Role playing

- Viewing of related videos
- Discussion
- Direct Instruction

Recommended Resources for 25 Trainees

S/No.	Category/Item	Description/ Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
1.	Reference books	Digital Electronics: Principles, Devices and Applications By Anil K. Maini	5 pcs	1:5
2.	Installation manuals	Assorted Systems component Manufacturer's manuals and data sheets Instrumentation Handbooks	5 pcs	1:5
3.	Charts	Assorted Circuit diagrams charts	1 pcs for each	1:25
4.	Software	Assorted simulation software e.g Deeds,	25	1:1
5.	Audio visual presentations	Projector	1	1:25
B	**Learning Facilities & infrastructure**			
6.	Lecture/theory room	$60m^2$	1	1:25

7.	Workshop	150m^2	1	1:25
8.	Computer laboratory	100m^2	1	1:25
C	**Consumable materials**			
9.	Assorted electronics components	ICs, resistors, capacitors	25 pcs	1:1
D	**Tools and Equipment**			
10.	Assorted tools and equipment	Side cutters, Side cutters, Pliers, Screw driver,Multi-meter, Oscilloscope, Solder guns, breadboards	25 pcs	1:1
11.	PPEs	Safety boots, overall	25 pcs	1:1
12.	Function generator		5 pcs	1:5
13.	Variable power supply		5 pcs	1:5
14.	Trainers kit	Assorted logic gate, combinational circuits trainer kits with component Manufacturer's manuals and data sheets	5 pcs	1:5
15.	Hot air gun		5 pcs	1:5
16.	Work stations		25	1:1

ANALOGUE ELECTRONICS II

UNIT CODE: 0714 541 12A

TVETCDACC UNIT CODE: ENG/CU/SPV/CC/09/5/MA

UNIT DURATION: 50 HOURS

UNIT DESCRIPTION

This unit describes the competencies required to apply analogue electronics II. These competencies include; applying amplifiers, use of oscillators and application of opto-electronics.

Summary of Learning Outcomes

By the end of this unit of learning the trainee will be able to:

S/NO	Learning Outcome	Duration (Hours)
1.	Apply amplifiers	15
2.	Use oscillators	20
3.	Apply opto-electronics	15
TOTAL		**50**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Apply amplifiers.	1.1 Classification of amplifiers based on; 1.1.1 Stages 1.1.2 Coupling method 1.1.3 Frequency 1.10 Types of amplifiers 1.10.1 RC coupled amplifiers 1.10.2 Power amplifiers 1.10.3 Tuned amplifiers	1 Practical test 2 Third Party Report 3 Portfolio of evidence 4 Written test 5 Oral questioning

Learning Outcome	Content	Suggested Assessment Methods
	1.11 Feedback 1.11.1 Principle of feedback 1.11.2 Positive feedback 1.11.3 Negative feedback 1.12 Operational amplifiers (OPAMPs) 1.12.1 Construction of opamps 1.12.2 Characteristics of the ideal and practical opamps 1.12.3 Opamp configurations 1.12.3.1 Inverting Amplifier 1.12.3.2 Non-Inverting Amplifier 1.12.3.3 Voltage Follower (Buffer) 1.12.3.4 Summing Amplifier 1.12.3.5 Differential Amplifier 1.12.3.6 Instrumentation Amplifier 1.12.3.7 Integrator 1.12.3.8 Differentiator 1.12.3.9 Comparator 1.12.3.10 Schmitt Trigger 1.13 Application of Amplifiers	
2 Use oscillators.	2.1 Sinusoidal oscillation 2.2 Types of sinusoidal oscillations 2.2.1 Damped oscillations 2.2.2 Undamped oscillations	1 Practical test 2 Third Party Report 3 Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	2.3 Components of transistor oscillators 2.4 Essential conditions for oscillations 2.5 Types of oscillators Colpitts 2.5.1 Hartley 2.5.2 Phase shift oscillator 2.5.3 Crystal oscillator 2.6 Applications of oscillators 2.7 Wave shaping and multivibrator circuits 2.8 Types of multivibrators 2.8.1 Astable 2.8.2 Monostable 2.8.3 Bistable 2.9 Passive filters 2.9.1 High pass 2.9.2 Low pass 2.9.3 Band pass 2.10 Clippers and clampers 2.11 Applications of wave shaping and multivibrator circuits	4 Written test 5 Oral questioning
3 Apply opto-electronics	3.1 Opto-electronic devices 3.1.1 LEDs 3.1.2 OLED 3.1.3 LASER diode 3.1.4 Photo transistors 3.1.5 Photo diodes 3.1.6 Optocoupler	1 Practical test 2 Third Party Report 3 Portfolio of evidence 4 Written test 5 Oral questioning

Learning Outcome	Content	Suggested Assessment Methods
	3.1.7 LASCR 3.2 Liquid crystal displays 3.2.1 Dynamic scattering LCDs 3.2.2 Field effect scattering LCDs 3.2.3 LASERs and MASERs 3.2.4 Applications of optoelectronics	

Suggested Methods of Instruction

- Practical
- Project
- Group discussions
- Demonstration
- Visit to manufacturing and processing industries
- On-job-training
- Charts and Audio-visual presentations

S/No.	Category/Item	Description/ Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
1.	Reference books	Mehta, V. K., & Mehta, R. (2020). Principles of electronics (12 edition). S. Chand and Company Limited,	10 pcs for each book	1:2.5

		Theraja, B. L., & Theraja, A. K. (2005). A textbook of electrical technology (1st multicolour ed., Multicolour illustrative ed., 23rd rev. multicoloured ed). S. Chand & Co. Bird, J. O. (2022). Bird's electrical and electronic principles and technology (Seventh edition). Routledge, Taylor & Francis Group.		
2.	Software	Assorted simulation software e.g., Circuit wizard.	25	1:1
3.	Audio visual presentations	Projector	1	1:25
B	**Learning Facilities & infrastructure**			
4.	Lecture/theory room	$60m^2$	1	1:25
5.	Workshop	$150m^2$	1	1:25
6.	Computer laboratory	$100m^2$	1	1:25
C	**Consumable materials**			
7.	Electronic components	Breadboards, Stripboards, Jumper wires, Assorted resistors, Assorted capacitors,	25 pcs	1:1

		Assorted MOSFETs, Assorted JFETs, 555 timers, Solder wire, LEDs, Assorted BJT transistors, LDRs, OPAMPs, thermistors, 12V DC motors		
D	**Tools and Equipment**			
8.	Assorted tools and equipment	Side cutters, Side cutters, Pliers, Screw driver, Crimping tools, Mult-meter, Solder guns	25 pcs	1:1
9.	Assorted electrical gadgets	Solder gun, Heat sink, Hot air guns, function generator	25 pcs	1:1
10.	Assorted measuring instruments	Digital Oscilloscope,	5 for each category	1:5
11.	Digital Multimeter,			
12.	Digital functional generator		3 pcs	1:8
13.	Laser jet printer		2 pcs	1:13
14.	Power supply	Variable power supply, 5V Power adapters, 9V Power adapters, 12V Power adapters.	10 pcs	1:3
15.	Trainers kit	Analogue training kits, PWM kit	5 pcs	1:5

16.	PCB prototyping material	Copper board, ferrite chloride solution, see-through printing paper, HASL finishing PCB	25 for each category	1:1
17.	Drilling gun		3 pcs	1:8
18.	Work stations		25	1:1

SOLAR PV PUMPS SYSTEM INSTALLATION

UNIT CODE: 0713 451 13A

TVETCDACC UNIT CODE: ENG/CU/SPV/CR/03/5/MA

UNIT DURATION: 80 HOURS

Relationship to Occupational Standards

This unit addresses the Unit of Competency: install solar PV pump systems

Unit Description

This unit covers the competencies required to install solar PV pumps system. Competencies include: surveying solar PV system site, sizing solar PV pump system, installing solar PV pump system components, testing solar PV pump system and maintaining solar PV pump system.

Summary of Learning Outcomes

By the end of this unit of learning the trainee will be able to:

S/NO	Learning Outcome	Duration (Hours)
1.	Survey Solar PV System Site	10
2.	Size solar PV pump system	30
3.	Install Solar PV pump system components	20
4.	Test solar PV pump system	10
5.	Maintain solar PV pump system	10
TOTAL		**80**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Survey Solar PV System Site	1.1.PPE 1.2.Site survey map and interpretation 1.3.Transport logistics 1.4.Site survey tools, equipment and instruments 1.5.Site conditions 1.5.1. Ground level 1.5.2. Weather conditions 1.5.3. Soil type 1.5.4. Buildings 1.6.Meaning of solar system 1.7.Meaning of terms 1.8.Size and rating of solar panel 1.9.Factors to consider in site survey Selection and installation 1.9.1. Solar system components 1.9.1.1.Solar modules; types, advantages, disadvantages 1.9.2. Charge controllers; mppt, pwm, advantages, disadvantages 1.9.3. Inverters; mppt, PWM, advantages, disadvantages 1.9.4. solar PV accessories 1.9.5. solar system wiring 1.10. Human resource for site surveying 1.11. Site safety 1.12. Meteological records interpretation 1.13. Region Solar potential; insolation, irradiance, wind profile	• Written assessment • Practical assessment • Projects • Oral Questioning • Third party report • Portfolio of evidence

	1.14. Types of mounting 1.15. Civil works 1.16. Site plan 1.17. Documentation 1.18. Site survey variables (rearrangement)	
2. Size solar PV pump system	2.1.System design consideration 2.1.1.Water demand 2.1.2.Water source 2.1.3.Design flow rate 2.1.4.Water storage 2.1.5.Total dynamic head 2.1.6.Location PV panels 2.2.Solar resource 2.3.Water pumping system sizing 2.4.Energy requirement; pump rating 2.5.Load estimation 2.6.System voltage selection criteria; load criteria; daily energy criteria 2.7.PV array sizing; PSH, Standard test conditions, watt peak, power tolerance 2.7.1.Number of solar cells 2.7.2.Solar IV Parameters 2.7.3.Solar module selection 2.8.Inverter sizing 2.9.Determination the size of DC & ac protective device and other accessories 2.10. Power conditioning 2.11. Sizing software 2.11.1. COMPASS	• Written assessment • Practical assessment • Projects • Oral Questioning • Third party report • Portfolio of evidence

	2.11.2. Grundfos Product Centre 2.11.3. PVSyst 2.11.4. HOMER	
3. Install Solar PV pump system components	3.1.Revolution of solar pumping 3.2.Advantages of solar pumping 3.3.Solar pumping applications 3.4.Solar pumping system 3.4.1. Three phase Pumps and motors; ac; dc 3.4.2. Types of pumps; Positive displacement: volumetric, helical rotor pump 3.4.3. Centrifugal pump 3.4.4. Submersible pump 3.4.5. Floating pumps 3.5.Power conditioning 3.6.System design consideration 3.6.1. Water demand 3.6.2. Water source 3.6.3. Design flow rate 3.6.4. Water storage 3.6.5. Total dynamic head 3.6.6. Location of PV panels 3.6.7. Solar resource	• Written assessment • Practical assessment • Projects • Oral Questioning • Third party report • Portfolio of evidence
4. Test solar PV pump system	4.1 Visual inspection checklist 4.2 Tests 4.2.1 Continuity test 4.2.2 Insulation resistance tes5t 4.2.3 Polarity test 4.2.4 Earth resistance tests	• Written assessment • Practical assessment • Projects • Oral Questioning • Third party report • Portfolio of evidence

5. Maintain solar PV pump system	5.1 Maintenance schedule 5.2 Maintenance and care of Solar modules 5.3 Inverter maintenance 5.4 Balance of system maintenance 5.5 Faults 5.5.1 Ground faults 5.5.2 Short circuit 5.5.3 Open circuit 5.6 Control panel maintenance 5.7 Bonding/ grounding system 5.8 Troubleshooting procedures 5.8.1 Load troubleshooting 5.8.2 System trouble shooting case studies 5.9 Solar PV system monitoring 5.10 Signs and warning labels 5.11 Maintenance records 5.11.1 Maintenance checklist 5.11.2 Maintenance reports	• Written assessment • Practical assessment • Projects • Oral Questioning • Third party report • Portfolio of evidence

Suggested Methods of Instruction

1 Practical
2 Projects
3 Demonstrations
4 Group discussion
5 Direct instructions
6 Field trips

7 On-job-training

Recommended Resources for 25 Trainees

Tools	**Materials and supplies**
1. Inclinometer 2. Tape measure 3. MC4 Climping tool 4. Spanner 5. Pliers 6. Side cutter 7. Ladder 8. Module mover 9. ballast block carrier 10. Vent pipe cutter	1. Stationery 2. Mc4 clips 3. Clamp clips 4. Cable ties 5. Conduits 6. Bolt and nuts 7. Wall plug 8. Mounting brackets 9. cable lugs 10. racks 11. solar spacer 12. mounting spacer 13. ground mount pipe caps 14. solar panel cleaning kit 15. Locking tool clip **16.** Permanent roof anchor
Equipment	**Reference materials**
1. Digital Multimeter 2. Clamp meter 3. PPEs (Personal Protective Equipment) 4. Thermal camera 5. Continuity tester 6. Irradiance meter 7. Insulation resistance tester	1. British standards (BS 3939;BS7671 2. Occupational Safety and Health Act (OSHA) 3. National Environmental Management Authority (NEMA) regulations

8. Polarity tester 9. Earth resistance tester 10. Earth loop impedance tester	4. IEEE regulations 5. EPRA regulation 6. PV system requirement refer KEBS Standards of 1673-1:2004

SECURITY SYSTEM INSTALLATION

UNIT CODE: 0713 451 14A

TVETCDACC UNIT CODE: ENG/CU/SPV/CR/04/5/MA

UNIT DURATION: 70 HOURS

Relationship to Occupational Standards

This unit addresses the Unit of Competency: perform security system

Unit Description

This unit covers competences required in performing security system installation**.** Competences include applying health and safety measures, installing security systems, testing security system installation and maintaining security system installations.

Summary of Learning Outcomes

By the end of this unit of learning the trainee will be able to:

S/NO	Learning Outcome	Duration (Hours)
1.	Install security Systems	20
2.	Test security system installation	20
3.	Maintain security system installation	30
TOTAL		**70**

Learning Outcomes, Content and Suggested Assessment Methods:

Learning Outcome	Content	Suggested Assessment Methods
1. Install Security Systems	1.1 Types of cables in security system	1 Practical 2 Project 3 Third party

Learning Outcome	Content	Suggested Assessment Methods
	1.2 Factors to consider in security system cable laying 1.3 Segregation in cable laying 1.3.1 Importance segregations 1.4 Security system installation 1.5 CCTV system 1.5.1 Identification of materials and components 1.5.1.1 Cables 1.5.1.2 Conduits, trunking etc 1.5.1.3 CCTV system components 1.5.1.4 Backup system (data and power) 1.6 Specification of tools, equipment and materials 1.6.1 Tolerance/ range 1.6.2 Make / model 1.6.3 Size 1.6.4 Class 1.7 Wiring CCTV system 1.7.1 Schematic diagram 1.7.2 Wiring diagram 1.8 Alarm systems 1.8.1 Fire alarm 1.8.2 Burglar alarm 1.9 Identification of materials and components	report 4 Portfolio of evidence 5 Written tests 6 Oral questioning

Learning Outcome	Content	Suggested Assessment Methods
	1.9.1 Cables 1.9.2 Conduits, trunking etc 1.9.3 Alarm system components 1.9.4 Backup system(power) 1.10 Specification of tools, equipment and materials 1.10.1 Tolerance/range 1.10.2 Make/model 1.10.3 Size 1.10.4 Class 1.11 Wiring alarm system 1.11.1 Schematic diagram 1.11.2 Wiring diagram 1.12 Electric fence 1.13 identification of materials and components 1.13.1 Cables 1.13.2 Conduits, trunking etc 1.13.3 Electric fence components 1.13.4 Backup system(power) 1.14 Specification of tools, equipment and materials 1.14.1 Tolerance/ range 1.14.2 Make / model 1.14.3 Size 1.14.4 Class 1.15 Wiring electric fence system	

Learning Outcome	Content	Suggested Assessment Methods
	1.15.1 Schematic diagram 1.15.2 Wiring diagram 1.16 Insulation classes of enclosures e.g. 1.16.1 IP 44 (Ingress protection) 1.16.2 IP 55 1.16.3 IP 65 1.16.4 IP 66 1.16.5 IP 67 1.17 Cable labelling 1.18 Cable termination 1.18.1 Importance of termination 1.19 Tools used in cable termination e.g. 1.19.1 Strip Knife 1.20 Security system integration with other components 1.21 Housekeeping practices **Practical content** 1.22 Install security system 1.23 CCTV system 1.24 Alarm systems 1.25 Electric fence system 1.26 Coding/configuring security system 1.27 Proper disposal of waste material	

Learning Outcome	Content	Suggested Assessment Methods
	Practical content 1.28 Install security system 1.29 Coding security system 1.30 Proper disposal of waste material	
2. Test security system installation	**Theory content** 2.1 Visual inspection 2.2 Types of tests in security system e.g. 2.2.1 Insulation test 2.2.2 Short circuit test 2.2.3 Continuity test 2.2.4 Arming and disarming tests 2.2.5 Physical inspection of the system 2.3 Test results documentation 2.4 Security system commissioning **Practical content** 2.5 Test performance of system as per design specifications	1 Practical 2 Project 3 Third party report 4 Portfolio of evidence 5 Written tests 6 Oral questioning
3. Maintain security system installation	**Theory content** 3.1 Maintenance schedule preparation 3.2 System maintenance check list preparation 3.3 Maintenance tools and equipment selection	1 Practical 2 Project 3 Third party report 4 Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	3.4 Inspection and tests 3.5 Faults diagnosis 3.6 Faults rectification 3.7 Maintenance reports documentation **Practical Content** 3.8 Perform security system installation maintenance as per IEEE regulations 3.9 Inspection and tests 3.10 Faults diagnosis 3.11 Faults rectification 3.12 Maintenance reports documentation	5 Written tests 6 Oral questioning

Suggested Methods of Instruction

- Practical
- Projects
- Demonstrations
- Group Discussions
- Field trips
- On-job-training

Recommended Resources for 25 trainees

S/No.	Category/Item	Description/ Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			

1.	Textbooks	B. Scaddan Electrical installation work J. Hyde Electrical installation Principles and Practices	5 pcs	1:5
2.	Installation manuals	Equipment manuals Control panel manuals	5 pcs	1:5
3.	Charts	Single line diagram Circuit diagrams Colour codes	1 pcs for each	1:25
4.	Power point presentations	For trainer's use	1	1:25
B	**Learning Facilities & infrastructure**			
4.	Lecture/theory room	$60m^2$	1	1:25
5.	Workshop	$150m^2$	1	1:25
6.	Site			
C	**Consumable materials**			
7.	Assorted Electrical cables		5 rolls	1:5
8.	Insulation tapes		25 pcs	1:1

9.	Accessories	Switches, sockets, Junction boxes, Consumer units, Patrice boxes, Circuit breakers	25 pcs	1:1
10.	Assorted CCTV components	Cameras, Digital video recorder, power supply unit, TFT monitors,	5 pcs	1:5
11.	Security system components	Alarm panels, magnetic sensors, vibration sensors, motion detectors	5 pcs	1:5
12.	Fire Alarm system components	Addressable control panel, fire and heat detectors, call points, buzzers	5 pcs	1:5
13.	Electric fence components	Energizer, Insulators, wires, support	5 pcs	1:5
14.	Pipes and trunkings	PVC conduits, Steel conduits, Mini trunking	25 pcs	1:1
D	**Tools and Equipment**			
15.	Hacksaws		25 pcs	1:1

16.	Striping knives		25 pcs	1:1
17.	Side cutters		25 pcs	1:1
18.	Pliers		25 pcs	1:1
19.	Tape measure		25 pcs	1:1
20.	Try Square		25 pcs	1:1
21.	Spirit level		25 pcs	1:1
22.	Assorted Screw driver		25 pcs	1:1
23.	Assorted hammers		25 pcs	1:1
24.	Crimping tools		5 pcs	1:5
25.	PPEs		25 pcs	1:1
26.	Multimeters		5 pcs	1:5
27.	Clamp meters		5 pcs	1:5
28.	Earth resistance meter		5 pcs	1:5
29.	Stocks & Dies		5 pcs	1:5
30.	Vices		5 pcs	1:5
31.	Wire fasteners		5 pcs	1:5
32.	Oscilloscope		5 pcs	1:5
33.	Pipe bending Machine		5 pcs	1:5
34.	Bending spring		5 pcs	1:5
35.	Drilling machines		5 pcs	1:5
36.	Work stations		25	1:1
37.	Installation boards		13 pcs	1:2