

**REPUBLIC OF KENYA**

**COMPETENCY BASED CURRICULUM**

**FOR**

**INSTRUMENTATION AND CONTROL LEVEL 4**

**(SIMPLE AUTOMATION AND CONTROL INSPECTION)**



TVET CDACC

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NAIROBI

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# 

# FOREWORD

The provision of quality education and training is fundamental to the Government’s overall strategy for social economic development. Quality education and training will contribute to achievement Kenya’s development blueprint and sustainable development goals.

Reforms in the education sector are necessary for the achievement of Kenya Vision 2030 and meeting the provisions of the Constitution of Kenya 2010. The education sector had to be aligned to the Constitution and this resulted to the formulation of the Policy Framework for Reforming Education and Training. A key feature of this policy is the radical change in the design and delivery of the 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 allows for multiple entry and exit in TVET programmes.

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 Engineering sector’s growth and sustainable development.

**PRINCIPAL SECRETARY, VOCATIONAL AND TECHNICAL TRAINING**

**MINISTRY OF EDUCATION**

# PREFACE

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

The Technical and Vocational Education and Training Act No. 29 of 2013 on Reforming Education and Training in Kenya, emphasized the need toreform 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 Kenyan labour force.

TVET Curriculum Development, Assessment and Certification Council (TVET CDACC), in conjunction with Instrumentation and Control Sector Skills Advisory Committee (SSAC) have developed this curriculum.

This curriculum has been developed following the CBET framework policy; the CBETA Standards and guidelines provided by the TVET Authority and the Kenya National Qualification framework designed by the Kenya National Qualification Authority.

This curriculum is designed and organized with an outline of learning outcomes; suggested delivery methods, training/learning resources and methods of assessing the trainee’s achievement. The curriculum is competency-based and allows multiple entry and exit to the course.

I am grateful to the Council Members, Council Secretariat, Instrumentation and Control SSAC, expert workers and all those who participated in the development of this curriculum.

**CHAIRPERSON, 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 various organizations.

I recognize with appreciation the role of the Instrumentation and Control Sector Skills Advisory Committee (SSAC) in ensuring that competencies required by the industry are addressed in the curriculum. I also thank all stakeholders in Engineering 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 Engineering Sector acquire competencies that will enable them to perform their work more efficiently.

**CEO /COUNCIL SECRETARY**

**TVET CDACC**

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ACRONYMNS AND ABBREVIATIONS

A Control Action

AIDS Acquired Immunodeficiency Syndrome

BC Basic Competencies

CBET Competency Based Education and Training

BJTs Bipolar Junction Transitor

CC Common Competencies

CDACC Curriculum Development, Assessment and Certification Council

CEO Council Secretary

CR Core Competencies

CU Curriculum

DC Direct Current

DOL Direct Online Starter

EHS Environment, Health and Safety

ENG Engineering

EPRA Energy and Petroleum Regulatory Authority

FETs Field Effect Transitor

HIV Human Immunodeficiency Virus

IAC Instrumentation and Control

IBMS Integrated Building Management System

IEE Institute of Electrical engineers

IEC International Electrotechnical Commission

KCSE Kenya Certificate of Secondary Education

KEBS Kenya Bureau of Standards

KNQA Kenya National Qualification Authority

LCD Liquid Crystal Display

NCA National Construction Authority

NPN Negative Positive Negative

OSH Occupational Safety and Health

OSHA Occupational Safety and Health Act

OS Occupational Standards

PCBs Printed Circuit Board

PESTEL Political, Environmental, Social, Technological Economical and Legal

PID Proportional Integral Controllers

PPE Personal Protective Equipment

Q&A Questions and Answer

SACs Simple Automation Control

SSAC Sector Skill Advisory Committee

SWOT Strength Weakness Opportunity and Threat

TVET Technical and Vocational Education and Training

WIBA Work Injury Benefits Act

**KEY TO UNIT CODE**

ENG/CU/IAC/BC/01/4/A

Industry or sector

Curriculum

Occupational area

Type of competency

Competency number

Competency level

Control Version

**Course Description**

Instrumentation and control (simple automation control inspection) level 4 qualification consists of competencies that a person must achieve to enable him/her install and service stand-alone controllers, perform electrical installation, measure process control parameters and install and maintain transmission system components

**Units of Learning**

The course consists of basic, common and core units of learning as indicated below:

**Basic Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Duration in Hours** | **Credit Factors** |
| ENG/CU/IAC/BC/01/4/A | Communication Skills | 20 | 2.0 |
| ENG/CU/IAC/BC/02/4/A | Digital Literacy | 35 | 3.5 |
| ENG/CU/IAC/BC/03/4/A | Entrepreneurial Skills | 60 | 6.0 |
| ENG/CU/IAC/BC/04/4/A | Employability Skills | 30 | 3.0 |
| ENG/CU/IAC/BC/05/4/A | Environmental Literacy | 20 | 2.0 |
| ENG/CU/IAC/BC/06/4/A | Occupational Safety and Health Practices | 20 | 2.0 |
| **Subtotal 1** | | **185** | **18.5** |

**Common Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Duration in Hours** | **Credit Factors** |
| ENG/CU/IAC/CC/01/4/A | Numerical Skills | 40 | 4.0 |
| ENG/CU/IAC/CC/02/4/A | Workshop Processes | 40 | 4.0 |
| ENG/CU/IAC/CC/03/4/A | Electrical and Electronics Principles | 40 | 4.0 |
| ENG/CU/IAC/CC/04/4/A | Technical Drawing | 30 | 3.0 |
| **Subtotal 2** | | **150** | **15** |

**Core Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Duration in Hours** | **Credit Factors** |
| ENG/CU/IAC/CR/01/4/A | Installation and Servicing of Stand-Alone Controllers | 110 | 11.0 |
| ENG/CU/IAC/CR/02/4/A | Electrical Installation | 60 | 6.0 |
| ENG/CU/IAC/CR/03/4/A | Measurement of Process Control Parameters | 80 | 8.0 |
| ENG/CU/IAC/CR/04/4/A | Installation and Maintenance of Transmission Components | 80 | 8.0 |
| ENG/CU/IAC/CR/05/4/A | Industrial Attachment | 300 | 30.0 |
| **Subtotal 3** | | **630** | **63** |
| **Grand Total** | | **965** | **96.5** |

The total duration of the course is 965 hours

**Entry Requirements**

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

1. Kenya Certificate of Secondary Education (K.C.S.E) Grade E

Or

1. Instrumentation and control level 3 qualification

Or

1. Equivalent qualifications as determined by Kenya National Qualifications Authority (KNQA)

**Industrial attachment**

An individual enrolled in this course will be required to undergo an industrial attachment in Instrumentation and control firm for a period of at least 300 hours. Attachment will be undertaken upon completion of the course or the unit of learning.

**Trainer qualification**

The trainer for this course must have a qualification higher than these course

**Assessment**

The course will be assessed at two levels: internally and externally. Internal assessment is continuous and is conducted by the trainer who is monitored by an internal accredited verifier while external assessment is the responsibility of TVET/CDACC.

**Certification**

A candidate will be issued with a Certificate of Competency on demonstration of competence in a unit of competency. To attain the qualification Instrumentation and Control Inspector (Simple Automation Control Inspection) Level 4, the candidate must demonstrate competence in all the units of competency as given in qualification pack. These certificates will be issued by TVET CDACC in conjunction with training provider.

# BASIC UNITS OF LEARNING

# COMMUNICATION SKILLS

**UNIT CODE: ENG/CU/IAC/BC/01/4/A**

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate Communication Skills

**Duration of Unit:** 20 Hours

**Unit Description**

This unit covers the competencies required demonstrate communication skills. It involves obtaining and conveying workplace information, completing relevant work-related documents, communicating information about workplace processes, leading workplace discussion and communicating workplace issues.

**Summary of Learning Outcomes**

1. Obtain and convey workplace information
2. Complete relevant work-related documents
3. Communicate information about workplace processes
4. Lead workplace discussions
5. Identify and communicate issues arising in the workplace

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Obtain and convey workplace information | * Communication process * Modes of communication * Medium of communication * Effective communication * Barriers to communication * Flow of communication * Sources of information * Types of questions * Organizational policies * Workplace etiquette * Ethical work practices in handling communication | * Interview * Third party reports |
| 1. Complete relevant work-related documents | * Types and purposes of workplace documents and forms * Methods used in filling forms and documents * Recording workplace data * Process of distributing workplace forms and documents * Report writing * Types of workplace reports | * Interview * Third party reports |
| 1. Communicate information about workplace processes | * Communication process * Modes of communication * Medium of communication * Effective communication * Barriers to communication * Flow of communication * Sources of information * Organizational policies * Organization requirements for written and electronic communication methods * Report writing * Effective questioning techniques (clarifying and probing) * Workplace etiquette * Ethical work practices in handling communication | * Interview * Portfolio |
| 1. Lead workplace discussion | * Methods of discussion e.g.   + Coordination meetings   + Toolbox discussion   + Peer-to-peer discussion * Solicitation of response | * Interview * Third party reports |
| 1. Identify and communicate issues arising in the workplace | * Identification of problems and issues * Organizing information on problems and issues * Relating problems and issues * Communication barriers affecting workplace discussions | * Interview * Portfolio |

**Suggested Methods of Instruction**

* Direct instruction
* Demonstration
* Practice assignment
* Discussion
* Role play
* Brainstorming

**Recommended Resources**

* Desktop computers/laptops
* Internet connection
* Projectors
* Telephone
* Report writing templates

# 

# DIGITAL LITERACY

**UNIT CODE: ENG/CU/IAC/BC/02/4/A**

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate Digital Literacy

**Duration of Unit:** 35 hours

**Unit Description**

This unit covers the competencies required to demonstrate digital literacy in a working environment. It entails identifying computer software and hardware, applying security measures to data, hardware, software, applying computer software in solving task sand applying internet and email in communication at workplace.

**Summary of Learning Outcomes**

1. Identify computer software and hardware
2. Apply security measures to data, hardware and software
3. Apply computer software in solving tasks
4. Apply internet and email in communication at workplace

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify computer hardware and software | * Meaning of a computer * Functions of a computer * Components of a computer * Classification of computers | * Written tests * Oral * Observation |
| 1. Apply security measures to data, hardware and software | * Data security and control * Security threats and control measures * Types of computer crimes * Detection and protection against computer crimes | * Written tests * Oral presentation * Observation * Projects |
| 1. Apply computer software in solving tasks | * Operating system * Word processing * Spread sheets * Data base | * Oral questioning * Observation * Project |
| 1. Apply internet and email in communication at workplace | * Computer networks * Uses of internet * Electronic mail (e-mail) concept | * Oral questioning * Observation * Oral presentation * Written report |

**Suggested Methods of Instruction**

* Instructor led facilitation of theory
* Demonstration by trainer
* Practical assignment
* Viewing of related videos
* Project
* Group discussions

**Recommended Resources**

* Desktop computers
* Laptop computers
* Other digital devices
* Printers
* Storage devices
* Internet access
* Computer software

# ENTREPRENEURIAL SKILLS

**UNIT CODE: ENG/CU/IAC/BC/03/4/A**

**Relationship to occupational standards**

This unit addresses the Unit of Competency: Demonstrate Entrepreneurial Skills

**Duration of unit:** 60 hours

**Unit description**

This unit covers the competencies required for creating and maintaining small scale business, establishing small business customer base, managing and growing a micro/small-scale business.

**Summary of Learning Outcomes**

1. Create and maintain small scale business
2. Establish small scale business customer base
3. Manage small scale business
4. Grow/expand small scale business

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Create and maintain small scale business | * Starting a small business * Legal regulatory requirements in starting a small business * SWOT/ PESTEL analysis * Conducting market/industry survey * Generation and evaluation of business ideas * Matching competencies with business opportunities * Forms of business ownership * Location of a small business * Legal and regulatory requirement * Resources required to start a small business * Common terminologies in entrepreneurship * Entrepreneurship in national development * Self-employment * Formal and informal employment * Entrepreneurial culture * Myths associated with entrepreneurship * Types, characteristics, qualities & role of entrepreneurs * History, development and importance of entrepreneurship * Theories of entrepreneurship * Quality assurance for small businesses * Policies and procedures on occupational safety and health and environmental concerns | * Individual/group assignments * projects * Written * Oral |
| 1. Establish small scale business customer base | * Good staff/workers and customer relations * Marketing strategy * Identifying and maintain new customers and markets * Product/ service promotions * Products / services diversification * SWOT / PESTEL analysis * Conducting a business survey * Generating Business ideas * Business opportunities | * Individual/group assignments * projects * Written * Oral |
| 1. Manage small scale business | * Organization of a small business * Small business’ business plan * Marketing for small businesses * Managing finances for small business * Production/ operation process for goods/services * Small business records management * Book keeping and auditing for small businesses * Business support services * Small business resources mobilization and utilization * Basic business social responsibility * Management of small business * Word processing concepts in small business management * Computer application software * Monitoring and controlling business operations | * Oral * Individual/group assignments * projects * Written |
| 1. Grow/expand small scale business | * Methods of growing small business * Resources for growing small business * Small business growth plan * Computer software in business development * ICT and business growth | * Individual/group assignments * projects * Written |

**Suggested Methods of Instruction**

* Instructor led facilitation of theory
* Demonstration by trainer
* Practice by trainee
* Role play
* Case study

**Recommended Resources**

* Case studies for small businesses
* Business plan templates
* Lap top/ desk top computer
* Internet
* Telephone
* Writing materials

# EMPLOYABILITY SKILLS

**UNIT CODE:** ENG/CU/IAC/BC/05/4/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate Employability Skills

**Duration of Unit:** 30 hours

**Unit Description**

This unit covers competencies required to demonstrate employability skills. It involves conducting self-management, demonstrating critical safe work habits, demonstrating workplace learning and workplace ethics.

**Summary of Learning Outcomes**

1. Conduct self-management
2. Demonstrate critical safe work habits
3. Demonstrate workplace learning
4. Demonstrate workplace ethics

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Conduct self-management | * Self-awareness * Formulating personal vision, mission and goals * Strategies for overcoming life challenges * Emotional intelligence * Assertiveness * Expressing personal thoughts, feelings and beliefs * Developing and maintaining high self-esteem * Developing and maintaining positive self-image * Articulating ideas and aspirations * Accountability and responsibility * Good work habits * Self-awareness * Self-development * Financial literacy * Healthy lifestyle practices | * Written tests * Oral questioning * Portfolio of evidence * Third party report |
| 1. Demonstrate critical safe work habits | * Stress and stress management * Punctuality and time consciousness * Interpersonal communication * Sharing information * Leisure * Integratingpersonal objectives into organizational objectives * Resource’s utilization * Setting work priorities * HIV and AIDS * Drug and substance abuse * Handling emerging issues | * Written tests * Oral questioning * Portfolio of evidence * Third party report |
| 1. Demonstrate workplace learning | * Personal training needs identification and assessment * Managing own learning * Contributing to the learning community at the workplace * Cultural aspects of work * Variety of learning context * Application of learning * Safe use of technology * Identifying opportunities * Workplace innovation * Performance improvement * Handling emerging issues * Future trends and concerns in learning | * Written tests * Oral questioning * Portfolio of evidence * Third party report |
| 1. Demonstrate workplace ethics | * Meaning of ethics * Ethical perspectives * Principles of ethics * Values and beliefs * Ethical standards * Organization code of ethics * Common ethical dilemmas * Organization culture * Corruption, bribery and conflict of interest * Privacy and data protection * Diversity, harassment and mutual respect * Financial responsibility/accountability * Etiquette * Personal and professional integrity * Commitment to jurisdictional laws * Emerging issues in ethics | * Written tests * Oral questioning * Portfolio of evidence * Third party report |

**Suggested Methods of Instruction**

* Simulation/Role play
* Group Discussion
* Presentations
* Q&A
* Case studies
* Assignments

**Recommended Resources**

* Computers
* Stationery
* Charts
* Video clips
* Audio tapes
* Radio sets
* TV sets
* LCD projectors

# ENVIRONMENTAL LITERACY

**UNIT CODE:** ENG/CU/IAC/BC/05/4/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate Environmental Literacy

**Duration of Unit:** 20hours

**Unit Description**

This unit specifies the competencies required to demonstrate environmental literacy. It involves controlling environmental hazard, controlling environmental pollution, demonstrating sustainable resource use and evaluating current practices in relation to resource usage.

**Summary of Learning Outcomes**

1. Control environmental hazard
2. Control environmental pollution
3. Demonstrate sustainable use of resources
4. Evaluate current practices in relation to resource usage

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Control environmental hazard | * Purposes and content of Environmental Management and Coordination Act 1999 * Purposes and content of Solid Waste Act * Storage methods for environmentally hazardous materials * Disposal methods of hazardous wastes * Types and uses of PPE in line with environmental regulations * Occupational Safety and Health Standards (OSHS) | * Written tests * Oral questions * Observation of work procedures |
| 1. Control environmental Pollution | * Types of pollution * Environmental pollution control measures * Types of solid wastes * Procedures for solid waste management * Different types of noise pollution * Methods for minimizing noise pollution | * Written tests * Oral questions * Observation of work procedures * Role play |
| 1. Demonstrate sustainable resource use | * Types of resources * Techniques in measuring current usage of resources * Calculating current usage of resources * Methods for minimizing wastage * Waste management procedures * Principles of 3Rs (Reduce, Reuse, Recycle) * Methods for economizing or reducing resource consumption | * Written tests * Oral questions * Observation of work procedures |
| 1. Evaluate current practices in relation to resource usage | * Collection of information on environmental and resource efficiency systems and procedures, * Measurement and recording of current resource usage * Analysis and recording of current purchasing strategies. * Analysis of current work processes to access information and data * Identification of areas for improvement | * Written tests * Oral questions * Observation of work procedures |
| 1. Identify Environmental legislations/conventions for environmental concerns | * Environmental issues/concerns * Environmental legislations /conventions and local ordinances * Industrial standard /environmental practices * International Environmental Protocols (Montreal, Kyoto) * Features of an environmental strategy | * Written tests * Oral questions * Observation of work procedures |

**Suggested Methods of Instruction**

* Instructor led facilitation of theory
* Practical demonstration of tasks by trainer
* Practice by trainees/ role play
* Discussion
* Observations and comments and corrections by trainers

**Recommended Resources**

* Computers
* Stationery
* Charts
* Video clips
* Audio tapes
* Radio sets
* TV sets
* LCD projectors
* Standard operating and/or other workplace procedures manuals
* Specific job procedures manuals
* Machine/equipment manufacturer’s specifications and instructions
* Personal Protective Equipment (PPE)

# OCCUPATIONAL SAFETY AND HEALTH PRACTICES

**UNIT CODE:** ENG/CU/IAC/BC/06/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Demonstrate Occupational Safety and Health Practices

**Duration of Unit:** 20 hours

**Unit Description**

This unit specifies the competencies required to practice safety and health and comply with OSH requirements relevant to work. It involves adhering to workplace procedures for hazards and risk prevention and participating in arrangements for workplace safety and health maintenance.

**Summary of Learning Outcomes**

1. Adhere to workplace procedures for hazards and risk prevention
2. Participate in arrangements for workplace safety and health maintenance

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment**  **Methods** |
| 1. Adhere to workplace procedures for hazards and risk prevention | * Arrangement of work area and items in accordance with Company housekeeping procedures * Adherence to work standards and procedures * Application of preventive and control measures, including use of safety gears/PPE * Study and apply standards and procedures for incidents and emergencies. | * Oral questions * Written tests * Portfolio of evidence * Third party report |
| 1. Participate in arrangements for workplace safety and health maintenance | * Participating in orientations on OSH requirements/regulations of tasks * Providing feedback on health, safety, and security concerns to appropriate personnel as required in a sufficiently detailed manner * Practice workplace procedures for reporting hazards, incidents, injuries and sickness * OSH requirements/ regulations and workplace safety and hazard control procedures are reviewed, and compliance reported to appropriate personnel * Identification of needed OSH-related trainings are proposed to appropriate personnel | * Oral questions * Written tests * Portfolio of evidence * Third party report |

**Suggested Methods of Instruction**

* Assignments
* Discussion
* Q&A
* Role play
* Viewing of related videos

**Recommended Resources**

* Computers
* Stationery
* Charts
* Video clips
* Audio tapes
* Radio sets
* TV sets
* LCD projectors
* Standard operating and/or other workplace procedures manuals
* Specific job procedures manuals
* Machine/equipment manufacturer’s specifications and instructions
* Personal Protective Equipment (PPE) e.g.
* Mask
* Face mask/shield
* Safety bootsn
* Safety harness
* Arm/Hand guard, gloves
* Eye protection (goggles, shield)
* Hearing protection (ear muffs, ear plugs)
* Hair Net/cap/bonnet
* Hard hat
* Face protection (mask, shield)
* Apron/Gown/coverall/jump suit
* Anti-static suits
* High-visibility reflective vest

# COMMON UNITS OF LEARNING

# NUMERICAL SKILLS

**UNIT CODE:** ENG/CU/IAC/CC/01/4/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Apply numerical skills

**Duration of Unit:** 40 hours

**Unit Description**

This unit covers the competencies required to demonstrate numeracy skills. Competencies include applying algebra, trigonometric and hyperbolic functions, applying coordinate geometry, carrying out mensuration, applying matrix and vectors

**Summary of Learning Outcomes**

1. Apply algebra.
2. Apply trigonometry and hyperbolic functions.
3. Apply coordinate geometry.
4. Carry out mensuration
5. Apply matrix
6. Apply vectors

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * 1. Apply algebra | * Base and Index * Law of indices * Laws of logarithm * Logarithmic equations * Conversion of bases * Use of calculator * Reduction of equations * Solution of equations reduced to quadratic form * Solutions of simultaneous equations with two unknowns | * Written tests * Oral presentation * Observation |
| 1. Apply Trigonometry and hyperbolic function | * Half -angle formula * Factor formula * Trigonometric functions * Measures calculation * Meaning of hyperbolic equations * Properties of hyperbolic functions * Evaluations of hyperbolic functions Hyperbolic identities | * Written tests * Oral presentation * Observation |
| 1. Apply coordinate geometry | * Polar equations * Cartesian equation * Graphs of polar equations * Normal and tangents * Definition of a point * Locus of a point in relation to a circle * Loci of points for given mechanism | * Written tests * Oral questioning * Assignments |
| 1. Carry out mensuration | * Units of measurement * Perimeter of regular and irregular figures * Area of regular and irregular figures * Surface are of regular solids * Volume of regular and irregular solids | * Oral questioning * Observation * Practical test |
| 1. Apply Matrix | * Matrix operation * Determinant of 2x2 matrix * Inverse of 2x2 matrix * Solutions of linear simultaneous equations in three unknowns * Application of matrices | * Oral questioning * Observation * Assignments |
| 1. Apply vectors | * Definition of dot and cross product of vectors * Solution of problems involving dot and cross production of cross * Definition of operators | * Oral questioning * Observation * Assignments |

**Ssuggested Methods of Instruction**

* Group discussions
* Demonstration by trainer
* Exercises by trainee

**Recommended Resources**

* Scientific Calculators
* Rulers, pencils, erasers
* Charts with presentations of data
* Graph books

# WORKSHOP PROCESSES

**UNIT CODE:** ENG/CU/IAC/CC/02/4/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Perform workshop processes

**Duration of Unit:** 40 hours

**Unit Description**

This unit covers the competencies required to perform workshop processes.it involves applying workshop safety, using workshop tools, equipment and materials, storing tools, equipment and materials, troubleshooting and repairing/replacing workshop tools and equipment.

**Summary of Learning Outcomes**

1. Apply workshop safety
2. Use workshop tools, equipment and materials
3. Store tools, equipment and materials
4. Troubleshoot and repair/replace workshop tools and equipment

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Apply workshop safety | * Meaning of PPE * Standard operating procedure in PPE * Workshop rules * Classes of fire and fire extinguishing methods * Electrical hazards e.g. * Electric shock. * Fire * Classes of fire * Causes of fire * Various methods of fire extinguishing * First Aid | * Written tests * Oral presentation * Observation * Practical tests |
| 1. Use workshop tools, equipment, and materials | * Meaning of workshop tools, instruments and equipment * Uses of workshop tools, equipment and materials * Classification of workshop tools and equipment * Calibration of workshop tools and equipment * Care and Maintenance of workshop tools and Instruments | * Written tests * Oral presentation * Observation * Practical tests |
| 1. Store tools, equipment, and materials. | * Use of checklist in the issuing of tools, equipment and materials * Use of manufacturer’s manuals in storage of tool, equipment and materials * Methods of cleaning of tools and equipment * Waste material disposal | * Written tests * Oral presentation * Observation * Practical tests |
| 1. Troubleshoot and repair/replace workshop tools and equipment | * Meaning of troubleshooting * Common faults in Electrical equipment * Fault diagnosis procedure * Repair/Replace of components in Electrical equipment | * Oral questioning * Observation * Oral presentation * Written report |

**Suggested Methods of Instruction**

* Demonstration by trainer
* Practice by the trainee
* Field trips
* On-job-training
* Discussions
* Instructor led facilitation of theory
* Viewing of related videos
* Project

**Recommended Resources**

* Set of screw drivers
* Pliers
* Phase testers
* Multimeter
* Stationery
* Cables
* Lubricants
* Service parts
* PPE –hand gloves, dust coat, dust masks
* Multimeter
* Clamp meter
* Earth electrode resistance meter
* Phase sequence meter Reference materials
* IEE regulations
* Organizational procedures manual

# ELECTRICAL AND ELECTRONICS PRINCIPLES

**UNIT CODE:** ENG/CU/IAC/CC/03/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply electrical and electronics and principles skills

**Duration of Unit:** 40 hours

**Unit Description**

This unit describes the competencies required to apply electrical principles in their work. It involves using the concept of basic electrical quantities, using the concepts of D.C and A.C circuits in electrical installation, using basic electrical machine, applying semiconductor theory, applying semiconductor diodes, using earthing in electrical installations and demonstrating understanding of transistors

**Summary of Learning Outcomes**

1. Use the concept of basic Electrical quantities
2. Use the concepts of D.C and A.C circuits in electrical installation
3. Use of basic electrical machine
4. Apply semiconductor theory
5. Apply semiconductor diode
6. Use of earthing in electrical installations
7. Demonstrate understanding of transistors

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * + 1. Use the concept of basic Electrical quantities | * The meaning of SI unit * SI unit of various types of Electrical parameters * Ohm’s law * Calculations involving various Electrical parameters e.g Power, Current, Voltage, Resistance * Instruments used in measuring various types of Electrical parameters | * Written tests * Oral questioning * Assignments * Practical tests |
| * + 1. Use the concepts of D.C and A.C circuits in electrical installation | * Meaning of terms * AC and DC, parallel and series circuits * AC and DC network theorems * Kirchoff’s laws * Superposition theorem * Thevenin’s theorem * Norton’s laws | * Written tests * Oral questioning * Assignments * Practical tests |
| * + 1. Use of basic electrical machine | * Types of Electrical machines * DC machines, * AC Single and three phase motors, generators and Transformers * Motor starting methods e.g * DOL * Star-Delta * Auto-transformer * Resistance starter * Shaded pole * Split phase * Capacitor start * Capacitor Start and run * Face plate Starting * Application of AC and DC machines | * Written tests * Oral questioning * Assignments * Practical tests |
| * + 1. Apply semiconductor theory | * Meaning of terms * Types of materials * Insulators * Conductors * Semiconductors * Semiconductor materials * Types of semiconductors materials * Intrinsic and Extrinsic | * Written tests * Oral questioning * Assignments * Practical tests |
| * + 1. Apply semiconductor diodes | * Meaning of terms * P-N juction * Semiconductor diodes * Foreward and reverse Characteristics * Types of semiconductor diodes * Application of semiconductors diodes | * Written tests * Oral questioning * Assignments * Practical tests |
| * + 1. Use of earthing in Electrical installations | * + Terms in Earthing   + Earthing points in Electrical installation   + Methods of earthing   + Factors to consider in selecting an earthing method   + Testing an earthing system | * Written tests * Oral questioning * Assignments * Practical tests |
| * + 1. Demonstrate understanding of transistors | * Bipolar junction transistors * Operation of NPN and PNP * Field effect transistors * Operation N and P channels * Types of FETs * BJTs and FETs biasing * BJTs and FETs configuration * Characteristics of transistors * Gain of transistors   + DC/AC load lines Maintenance of lightening system | * Written tests * Oral questioning * Assignments * Practical tests |

**Suggested Methods of Instruction**

* Group discussions
* Demonstration by trainer
* Exercises by trainee

**Recommended Resources**

* Set of screw drivers
* Electrical workshop
* Relevant practical materials
* Phase testers
* Multimeter
* Stationery
* Cables
* Diodes
* Transistors
* PPE –hand gloves, dust coat, dust masks
* Multimeter
* Clamp meter
* Earth electrode resistance meter
* Phase sequence meter
* IEE regulations
* Organizational procedures manual

# TECHNICAL DRAWING

**UNIT CODE:** ENG/CU/IAC/CC/04/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Prepare and interpret technical drawings

**Duration of Unit:** 40hours

**Unit Description**

This unit covers the competencies required to prepare and interpret technical drawings. It involves using and maintaining drawing equipment and materials, producing plain geometry drawings, solid geometry drawings and electrical drawings

**Summary of Learning Outcomes**

1. Use and maintain drawing equipment and materials
2. Produce plane geometry drawings
3. Produce solid geometry drawings
4. Produce electrical drawings

**Learning Outcomes, Content and Suggested Assessment Methods:**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Use and maintain drawing equipment and materials | * Identification and care of drawing equipment * Identification and care of drawing materials * Reference to manufacturer’s instructions and work place procedures on use and maintenance of drawing equipment and materials * Reference to relevant environmental legislation * Use of Personal Protective Equipment (PPEs) | * Observation * Oral questioning * Written tests * Practical tests |
| 1. Produce plane geometry drawings | * Types of lines in drawings * Construction of geometric forms e.g. squares, circles * Construction of different angles * Measurement of different angles * Bisection of different angles and lines * Standard drawing conventions | * Oral questioning * Practical tests * Observation * Practical tests |
| 1. Produce solid geometry drawings | * Interpretation of sketches and drawings of patterns e.g. cylinders, prisms and pyramids * Sectioning of solids e.g. prisms, cones * Development and interpretations of solids e.g. cylinder to cylinder and cylinder to triangular, prism | * Observation * Practical tests * Oral questioning * Practical tests |
| 1. Produce electrical drawings | * Electrical symbols and abbreviations * Meaning of electrical drawings * Drawing of electrical diagrams e.g. block, schematic, circuit, line and wiring | * Observation * Oral questioning * Practical tests |

**Suggested Methods of Instruction**

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

**Recommended Resources**

* Drawing room
* Drawing instruments e.g. T-squares, set squares, drawing sets
* Drawing tables
* Pencils, papers, erasers
* Masking tapes

# CORE UNITS OF LEARNING

# INSTALLATION AND SERVICING OF STAND-ALONE CONTROLLERS (SACs)

**UNIT CODE:** ENG/CU/IAC/CR/01/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Install and service stand-alone controllers (SACs)

**Duration of Unit:** 110 hours

**Unit Description**

This unit specifies the competencies required in installing and servicing stand-alone controllers. it involves preparing a list of tool, equipment and materials, performing marking and laying of conduits and cables, installing stand-alone controller components, configuring stand-alone controller components, terminating controller installation, inspecting and testing controller installation, documenting stand alone control installation and maintaining stand alone controllers.

**Summary of Learning Outcomes**

1. Prepare a list of tools equipment and materials
2. Perform marking and laying of conduits and cables.
3. Install stand-alone controller components
4. Configure stand-alone controller components
5. Terminate controller installation
6. Inspect and test controller installation
7. Document stand alone control installation
8. Maintain stan alone controllers

**Learning Outcomes, Content and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Prepare a list of tools equipment and materials | * Tools, equipment and materials e.g. * Cutting tools * Measuring tools * Measuring equipment * Cables and conductors * Crimping tools * Conduits * Trunking * Consumables * Tools specifications * Types, application, care, maintenance and storage of: * Tools e.g. * Cable strippers * Pliers * Screw drivers * Hammers * Chisels * Allen keys * Equipment e.g. * Stock and die * Vice * Materials e.g. * Cables * Fittings * Accessories * Assemble tools, equipment and materials | * Oral questioning * Written tests * Observation * Practical |
| 1. Perform marking and laying of conduits and cables. | * Meaning of terms * Conduiting and marking procedures * Working drawings * Cables and cable joints * Wiring systems and accessories * Types and applications e.g. * Conduits * Cable trays * Cable ducts * Trunkings * Preparation of wiring systems * Marking out, cutting, bending, threading, chiselling, trenching * Draw –in/Lay of cables routes * Cable Identification * IEE regulations in wiring | * Written tests * Observation * Oral questioning * Practical test |
| 1. Install stand-alone controller components | * Meaning of terms * Types of stand-alone controllers and their operation * Stand-alone controller design interpretation * Stand-alone controller components * IEE regulations in installation of controllers * Safety in controller installation | * Written tests * Oral questioning * Practical tests * Observation |
| 1. Configure stand-alone controller components | * Meaning of Terms * Configuration of controllers * Programming of the controllers * Configuration software * Importance of controller components manufactures manuals in configuration of controllers * Configuration procedures | * Written tests * Oral questioning * Practical tests * Observation |
| 1. Terminate Controller Installation | * Importance of termination * Cable labelling * Cable lugging * Tools used in cable termination e.g. * Crimping tool * Strip Knife | * Written tests * Oral questioning * Practical tests * Observation |
| 1. Inspect and test controller installation | * Types of tests on controllers * Testing instruments * Testing procedures and parameters * IEE regulations in regard to controller testing | * Written tests * Oral questioning * Practical tests * Observation |
| 1. Document an Electrical installation | * Report preparation * Sharing of the installation report * Report filing | * Written tests * Oral questioning * Practical tests * Observation |
| 1. Maintain stan alone controllers | * Meaning of terms * Fault diagnosis of stand-alone controllers * Maintenance procedures * Maintenance schedule and activities | * Written tests * Oral questioning * Practical tests * Observation |

**Suggested Methods of Instruction**

* Demonstration by trainer
* Practice by the trainee
* Field trips
* On-job-training
* Discussions

**Recommended Resources**

* + Hand drill machine
  + Software
  + Measuring tools
  + Cutting tool
  + Drawing tools
  + Drilling tools
  + Fastening tools
  + Bending Spring
  + Draw wire
  + Soldering Iron
  + Portable power
  + Stationery
  + Assorted Cables
  + Assorted protective devices
  + Pipes and trunkings
  + Cable lugs
  + Joints
  + Accessories
  + Configuration equipment
  + PPEs (Personal Protective Equipment)
  + Measuring equipment
  + Communication equipment
  + Standards
  + Occupational Safety and Health Act (OSHA)
  + IEE tables

# ELECTRICAL INSTALLATION

**UNIT CODE:** ENG/CU/IAC/CR/01/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Perform Electrical Installation

**Duration of Unit:** 60 hours

**Unit Description**

This unit specifies the competencies required for performing electrical installation. It involves preparing a list of tools equipment and materials, performing piping, and laying of cables, installing of electrical components, terminating of electrical installation and inspecting and testing the installation and documenting an electrical installation.

**Summary of Learning Outcomes**

1. Prepare list of tools, equipment, and materials
2. Perform piping and laying of cables
3. Install electrical components
4. Terminate electrical installation
5. Inspect and test installation
6. Document an Electrical installation

**Learning Outcomes, Content and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Prepare a list of tools, equipment and materials | * Identification of tools and materials e.g. * Cutting tools * Measuring tools * Measuring equipment * Cables and conductors * Crimping tools * Conduits * Trunking * Consumables * Types, application, care, maintenance and storage of: * Tools e.g. * Cable strippers * Pliers * Screw drivers * Hammers * Chisels * Allen keys * Electrician knives * Crimping tools * Bending springs * Steel tapes * Draw wires * Hack saws * Drills * Equipment e.g. * Stock and die * Vice * Materials e.g. * Cables * Fittings * Accessories * Assemble tools, equipment and materials | * Oral questioning * Written tests * Observation * Practical |
| 1. Perform piping and laying of cables | * Meaning of terms * Procedures for piping * Cables and cable joints * Wiring systems and accessories * Types and applications e.g. * Conduits * Cable trays * Cable ducts * Trunkings * Preparation of wiring systems * Marking out, cutting, bending, threading, chiselling, trenching * Draw –in/Lay of cables routes * Cable Identification * IEE regulations | * Written tests * Observation * Oral questioning * Practical test |
| 1. Install electrical components | * Meaning of terms * Electrical components e.g. * Junction boxes * Ceiling rose * Switches * Socket outlets * Bulb holders * IEE regulations * Safety in electrical installation | * Written tests * Oral questioning * Practical tests * Observation |
| 1. Terminate electrical installation | * Meaning of Terms * Importance of termination * Cable labelling * Cable lugging * Tools used in cable termination e.g. * Crimping tool * Strip Knife * IEE regulations * Disposal of waste materials | * Written tests * Oral questioning * Practical tests * Observation |
| 1. Inspect and test installation | * Types of tests on an electrical installation system * IEE regulations in regard to electrical installation testing and inspection * Electrical testing instruments | * Written tests * Oral questioning * Practical tests * Observation |
| 1. Document an Electrical installation | * Report preparation * Sharing of the installation report * Report filing | * Written tests * Oral questioning * Practical tests * Observation |

**Suggested Methods of Instruction**

* Demonstration by trainer
* Practice by the trainee
* Field trips
* On-job-training
* Discussions

**Recommended Resources**

* Measuring tools
* Cutting tool
* Drawing tools
* Drilling tools
* Fastening tools
* Bending Spring
* Draw wire
* Stationery
* Assorted Cables
* Assorted protective devices
* Pipes and trunkings
* Cable lugs
* Joints
* Accessories
* PPEs (Personal Protective Equipment)
* Measuring equipment
* Communication equipment
* Occupational Safety and Health Act (OSHA)
* IEE tables

# MEASUREMENT OF PROCESS CONTROL PARAMETERS

**UNIT CODE:** ENG/CU/IAC/CR/02/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Measure process control parameters

**Duration of Unit:** 80 hours

**Unit Description**

This unit covers the competencies required to measure process control parameters. It involves identifying process control strategies, components and instruments on the process control strategy, measuring process control parameters, calibrating instruments on the process control strategy and documenting instrument calibrations

**Summary of Learning Outcomes**

1. Identify process control strategies
2. Identify components of the process control strategies
3. Measure process control parameters
4. Calibrate instruments on process control
5. Document instrument calibration

**Learning Outcomes, Content and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Identify process control strategies | * Meaning of terms * Types process control strategies e.g. * Proportional * Integral * Derivative * PID * Feed forward/back * Block diagrams of control process strategies | * Oral questioning * Written tests * Observation * Practical test |
| 1. Identify components of the process control strategies | * Meaning of terms * Components of process control strategies * Types of plant layouts * Process layout * Product layout * Combined layout * Fixed position layout | * Written tests * Observation * Oral questioning * Practical test |
| 1. Measure process control parameters | * Meaning of terms * Process control parameters * Process control equipment * Temperature measuring instruments eg * Temperature controllers * Heaters * Temperature switches * Temperature transmitters * Thermowells * Pressure measuring instruments eg * Pressure controllers * Pressure gauges * Pressure regulators * Pressure switches * Diaphragm seals * Level measuring instruments eg, * Continuous level instruments * Point level instruments * Level measurement accessories * Flow rate measuring instruments eg * Coriolis flow * Differential pressure flow meter * Control valves * Ultrasonic flow meters * Electromagnetic flow meters * Humidity measuring instruments * Power measuring instruments * Gas analytics e.g. * Continuous gas analysers * Toxic gas detectors * Flame detection sensors * Liquid analytics * Mounting of process control parameters measuring equipment | * Written tests * Oral questioning * Practical tests * Observation |
| 1. Calibrate instruments on the process control | * Process control limitations * Process requirement * Use of manufacturer’s manuals in calibration and tuning * Calibration and tuning of process control measuring equipment * Monitoring the results | * Written tests * Oral questioning * Practical tests * Observation |
| 1. Document instrument calibration | * + Report preparation   + Sharing of the report   + Report filing | * Written tests * Oral questioning * Practical tests   Observation |

**Suggested Methods of Instruction**

* Projects
* Demonstration by trainer
* Practice by the trainee
* Field trips
* On-job training
* Discussions

**Recommended Resources**

* Ammeters
* Voltmeters
* Ammeters
* Wattmeter
* Oscilloscope
* Heaters
* Temperature switches
* Pressure gauges
* Point level instruments
* Ultrasonic flow meters
* Electrician knives
* Calibrating instruments
* PPE – hand gloves, dust coats, dust masks, helmets, ear muffs, industrial boots
* Stationery
* Cables
* Drawing instruments
* Tubing
* IEE regulations
* Occupational safety and health act (OSHA)
* Work injury benefits act (WIBA)
* Manufacturers’ catalogues
* British standards
* KEBS standards

# INSTALLATION AND MAINTENANCE OF TRANSMISSION SYSTEM COMPONENTS

**UNIT CODE:** ENG/CU/IAC/CR/03/4/B

**Relationship to Occupational Standards**

This unit addresses the unit of competency: install and maintain transmission system components

**Duration of Unit:** 80 hours

**Unit Description**

This unit covers the competencies required to install and maintain transmission system components transmission system. It involves preparing working drawings, assembling tools, equipment and materials, mounting transmission components, performing wiring, tubing and fitting of transmission system components, testing installed transmission system components and documenting installation and maintenance of transmission components

**Summary of Learning Outcomes**

1. Prepare working drawings
2. Assemble tools, equipment and materials
3. Mount transmission components
4. Perform wiring, tubing and fitting of transmission system components
5. Test installed transmission system components
6. Document installation and maintenance of transmission system components

**Learning Outcomes, Content and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Prepare working drawings | * Working drawings * Meaning of working drawings * Block * Circuits * Schematic * Wiring * Line * Basic components of a transmission system * Pneumatic components * Hydraulic components * Reading and Interpretation of drawings * Drawing tools and equipment e.g. * Drawing board * T- square | * Oral questioning * Written tests * Observation * Practical |
| 1. Assemble tools, equipment and materials | * Identification and documentation of maintenance tools * Specifications of identified maintenance tools * Classification of maintenance tools e.g. * Fastening tools * Measuring tools * Cutting tools * Calibration of tools * Soldering tools e.g. * Soldering guns * Soldering irons * Resistance soldering sets * Pencil iron * Solder sucker * Electrostatic wrist strap * Soldering materials e.g. * Solder wire * PCBs * Labels and tags * Cable ties * Stick glue * Cables * Tubing * Fittings | * Written tests * Observation * Oral questioning * Practical test |
| 1. Mount transmission system components | * Meaning of terms * Types of plant layouts * Process layout * Product layout * Combined layout * Fixed position layout * Components of pneumatic systems eg * Air compressor * Classification of air compressors * Positive displacement compressors * Dynamic compressors * Types of air compressors * Rotary screw * Reciprocating * Axial * Centrifugal * Piston compressors * Diaphragm compressors * Air drier * Types of air driers * Deliquescent * Regenerative desiccant * Refrigeration * Membrane * Air source treatment * Air filters * Air regulator * Air lubricator * Air valves * Types of air valves eg * Spring offset * Four way directional * Three way directional * Two way directional * Air cylinder * Single acting cylinders * Double acting cylinders * Air actuator * Types of pneumatic actuators eg * Tie rod cylinders * Rotary actuators * Rodless actuators * Grippers actuators * Vacuum generators * Components of a hydraulic transmission system eg * Hydraulic pump * Types of hydraulic pumps eg * Gear pumps * Rotary vane pumps * Screw pumps * Bent axis pumps * In line axial piston * Hydraulic control valve * Types of hydraulic control valves * Directional control * Pressure control * Flow control * Hydraulic actuator * Classification of hydraulic actuators * Linear actuators * Rotary actuators * Types of hydraulic actuators eg * Hydraulic helical valve * Electro-Hydraulic operator * Das hydraulic actuators * Subsea * Hydraulic cylinder * Components of a hydraulic cylinder eg * Hydraulic cylinder barrel * Hydraulic cylinder head * Hydraulic cylinder piston * Hydraulic cylinder rod * Cylinder seals * Self-locking nut * Spring ring * Cylinder flange * Bushes * Hydraulic motor * Types of hydraulic motors * Vane motors * Gear motors * Gerotor motors * Axial plunger motor * Radial piston motor * Hydraulic fluid reservoirs * Types of hydraulic fluid reservoirs eg * Vented reservoir * Pressurised reservoir * Electromechanical components eg * Electric motors * Solenoids * Electromechanical components e.g. * Relay * Reed relay * Motor * Mounting of other transmission system components eg * Sensors * Transmitters * Fittings * Pressure gauges * Tubing | * Written tests * Oral questioning * Practical tests * Observation |
| 1. Perform wiring, tubing and fitting of transmission system components | * Meaning of terms * Motor control circuits * Motor starters * Interlocking * Cable sizes and ratings * Type of wiring systems * Surface wiring * Batten wiring * Conduit wiring * Concealed wiring * Types of cables e.g. * Armored cables * Twisted cables * Stranded cables * Shielded cables * Coaxial cables * IEE regulations * Tubing in transmission system * Classification of tubing * Structural tubing * Mechanical tubing * Pressure tubing * Fittings in transmission systems * Types of fittings eg * Elbows * Tees * Wyes * Crosses * Coupling * Unions * Compression * Caps * Plugs * Valves | * Written tests * Oral questioning * Practical tests * Observation |
| 1. Test installed transmission system components | * Meaning of terms * Test instruments * Visual inspection of the system * Types of tests on transmission system e.g. * Test for input supply * Short circuit tests * Open circuit tests * Leak tests * Pressure tests * Temperature tests * Vibration tests * Safety during testing of a transmission system * IEE regulation * Use of manufacturer’s manuals during testing of system components * Test running the transmission system * Recording test results | * Written tests * Oral questioning * Practical tests * Observation |
| 1. Document system installation and maintenance | * Report preparation * Sharing of the report * Report filing | * Written tests * Oral questioning * Practical tests * Observation |

**Suggested Methods of Instruction**

* Projects
* Demonstration by trainer
* Practice by the trainee
* Field trips
* On-job training
* Discussions

**Recommended Resources**

* Ammeters
* Voltmeters
* Ammeters
* Wattmeter
* Oscilloscope
* Heaters
* Temperature switches
* Pressure gauges
* Point level instruments
* Ultrasonic flow meters
* Electrician knives
* Calibrating instruments
* • PPE – hand gloves, dust coats, dust masks, helmets, ear muffs, industrial boots Materials and supplies
* Stationery
* Cables
* Drawing instruments
* Tubing
* Fittings