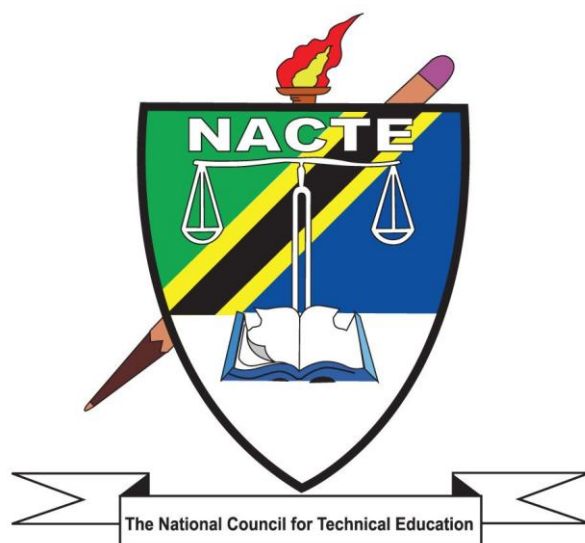


NATIONAL COUNCIL FOR TECHNICAL EDUCATION



NOVEMBER 2022

PROPOSED OCCUPATIONAL STANDARDS

FOR ELECTRICAL ENGINEERS

LEVEL: NTA 7

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FOREWORD

The National Council for Technical Education (NACTE) is a corporate body established by the National Council for Technical Education Act, Cap.129. The Act provides a legal framework for the Council to coordinate the provision of technical education and training in Tanzania. The mandate of NACTE is three-fold, namely: Regulatory, Quality Assurance and Policy Advisory.

In discharging its mandate, the Council has been charged with the responsibilities, among others, to:

- (a) assist technical institutions in the transmission of knowledge, principles and training in the field of technical education and training for the benefit of the people of Tanzania;
- (b) assist technical institutions in the overall development of the quality of education they provide and to promote and to maintain approved academic standards;
- (c) establish and make awards in technical education which are consistent in standard and comparable to related awards in Tanzania and internationally; and
- (d) ensure that the quality of education required for the awards is met and maintained throughout the duration of the delivery of the course.

In the course of execution of these responsibilities, the Council has been instituting various measures aiming at advancing the quality of training provided in technical institutions in respect of the changing demands of the labour market, both local and international.

To achieve the above obligation, NACTE, under the Ministry of Education, Science and Technology implemented the East Africa Skills for Transformation and Regional Integration Project (EASTRIP), a project aiming at promoting regional integration through supporting the regional corridors and sector markets, developing common standards and qualifications, and promoting mobility of students, faculty, and graduates. The project supports the Government of Tanzania to address shortage of skills in five sectors namely:

- (a) Energy;
- (b) Construction;
- (c) Information and Communication Technology (ICT);
- (d) Transportation; and
- (e) Agribusiness

To address the skills miss-match and shortage in the five (5) sectors in the country, the project funded, among others, a component of Development of Occupational Standards for Technical and Vocational Education and Training (TVET). In this regard, NACTE endeavoured to identify qualified and highly experienced experts in the five sectors from both the industry and training institutions to carry out the development of Occupational Standards. The exercise was carried out at Morogoro Teachers College – Morogoro from 16th July to 10th August, 2021. The output of the exercise is Occupational Standards for 12 occupations. Occupational standards for Electrical Engineers are among the occupational standards for 12 occupations which have been developed.

Since Occupational Standards are statements of work performance reflecting the ability to successfully complete the functions required in an occupation, as well as the application of knowledge, skills, attitudes and understanding in an occupation, it is the Council's expectations that the developed standards will form a robust base for decision making and provide explicit guidance to policy makers, curriculum developers, educators, employers and other stakeholders in matters related to manpower planning as well as execution of Technical and Vocational Education and Training undertakings.

Prof. J. W. Kondoro
Chairman

Dar es Salaam
October 2022

ACKNOWLEDGEMENT

The National Council for Technical Education (NACTE) is charged with the mandate to be the Quality Assurance organ of the Government in matters related to Technical and Vocational Education and Training (TVET) and production of qualified manpower for both local and international labour markets. In order to realize this obligation, NACTE endeavours to institute policies, guidelines and standards and to set the quality benchmarks for training institutions.

However, this is only possible if there is a strong base, linking the training institutions on one hand and the demands of the industry/labour market for relevant manpower on the other hand. Therefore, the Council undertook a step to develop Occupational Standards in sectors considered to be the engine to steer the country's desire to achieve an industrial economy. This exercise would not be a success without the input and support from our stakeholders. I am indebted to acknowledge some of them here.

I wish to acknowledge and appreciate the support from the Ministry of Education, Science and Technology through the East Africa Skills for Transformation and Regional Integration Project (EASTRIP) for the financial support which facilitated the preparation of this document. I wish also to appreciate Mrs Leah Lukindo and Eng. Dr. Simon Baregu for the tireless efforts and commitment in facilitating and guiding the standards development process, Ms. Eileen Tzamburakis and Ms. Chausiku Yakweli Ibrahim for compiling and type setting the final document; and the NACTE Secretariat for coordinating the whole activity.

In a very special way I wish further to extend my sincere gratitude to this team of wonderful experts who tirelessly dedicated their time and availed their invaluable intellect in the preparation of this document. I would like to recognise the colossal inputs of the following experts:

S/N	Name	Designation	Organization
1	Eng. Decklan P. Mhaiki	Chief Technical Advisor	Tanzania Electric Supply Company Limited (TANESCO)
2	Eng. Sophia Mgonja	Chief Technical Advisor	Tanzania Electric Supply Company Limited (TANESCO)
3	Eng. Msherwa John	Principal Coordinator	The National Council for

4	Eng. Mary K. Mhayaya	Consulting Engineer	Technical Education (NACTE) Tanzania Ports Authority (TPA)
5	Dir. Erick Mgya	Senior Lecturer	Arusha Technical College (ATC)

In addition, the Council hopes to further enhance the internationalization of Occupational Standard and promote the modernization and internationalization of industries in Tanzania, so as to facilitate Tanzania's integration into the international market and tap its development potential. Therefore, the Council invited the China - Africa Vocational Education Alliance, China - Africa (Chongqing) Vocational Education Alliance, and Chinese vocational colleges to participate in the development, revision, and review of the Occupational Standard documents. It is firmly believed that they will provide strong support for the development of vocational education and related industries in Tanzania based on their rich experience in vocational education, relying on China's advanced and complete industrial chain as well as its status in the international market.

Therefore, I would like to express my heartfelt appreciation to this professional team composed of Chinese colleges, institutions and experts for their hard work and dedication. They've made great contributions to the compilation of this document. I would like to thank the following colleges and experts for their support.

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4	Zhengzhou Electric Power College	Wang Wenwu	Lecturer / Power System Automation Technology
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			Automation
7	Zibo Vocational Institute	Ma Wenying	Lecturer / Electrical Automation
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9	Zibo Vocational Institute	Zhang Xufen	Lecturer / Electrical Automation
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11	Shandong Vocational College of Industry	Liu Na	Associate Professor / Automation
12	Shandong Vocational College of Industry	Nie Bing	Associate Professor / Power System Automation
13	Shandong Vocational College of Industry	Li Dongjing	Associate Professor / Industrial Automation Instrumentation

Dr. A. B. Rutayuga
Executive Secretary

Dar es Salaam
October 2022

ABBREVIATIONS

ABC	Aerial Bundle Conductor
AC	Alternating Current
CAD	Computer Aided Design
CBET	Competence Based Education and Training
DC	Direct Current
GPS	Global Positioning Systems
HV	High Voltage
KVA	Kilo Volt Ampere
LV	Low Voltage
MV	Medium Voltage
NACTE	National Council for Technical Education
NOS	National Occupational Standards
OS	Occupational Standards
PLC	Programmable Logical Circuit
PPE	Personal Protective Equipment
TET	Technical Education and Training
TVET	Technical and Vocational Education and Training

GLOSSARY OF TERMS

Circumstantial Knowledge:	Detailed knowledge, which allows the decision-making in regard to different circumstances and cross cutting issues.
Competence:	The ability to use knowledge, understanding, practical and thinking skills to perform effectively to the workplace standards required in employment.
Competency:	A description of the ability one possesses when able to perform a given occupational task effectively and efficiently.
Competency-Based Education:	An instructional program that derives its content from validated tasks and bases assessment on the learner's performance
Curriculum:	A description or composite of statements about “what is to be learned” by the trainee/student in a particular instructional programme; a product that states the “intended learning outcomes”.
Educational/Training Programme:	The complete curriculum and instruction (what and how) that is designed to prepare a person for employment in a job or other particular performance situation.
Occupation:	A specific position requiring the performance of specific tasks – essentially the same tasks are performed by all employees having the same title. (Example: baker)
Occupational Analysis:	A process used to identify the tasks that are important to employees in any given occupation.
Occupational Area	This is a broad grouping of related jobs. Example: food service
Occupational Competence:	The application of knowledge and skills to perform consistently to the standards required in the work context.
Occupational Standards:	Specific requirements of competences people are expected to demonstrate in a particular occupational area, including knowledge and relevant attitudes. They also act as performance tool of assessment of the pre – scribed

outcomes.

Performance Criteria:	It indicates the expected end results or outcome in form of evaluative statements.
Skill:	The ability to perform occupational tasks with a high degree of proficiency within a given occupation. Skill is conceived of as a composite of three completely interdependent components: cognitive, affective, and psychomotor.
Standards:	It is a set of statement, which if proved true under working conditions, means that an individual is meeting an expected level and type of performance
Task Analysis:	The process of analysing each task to determine the steps, related knowledge, attitudes, performance standards, tools and materials needed, and safety concerns required of employees performing it.
Tasks:	A work activity that has a definite beginning and ending, is observable or measurable, consists of two or more definite steps, and leads to a product, service, or decision.
Underpinning Knowledge:	This is crucial knowledge that an individual must acquire in order to demonstrate competences that are associated in performing a given task.
Verification Process:	The process of having experts review and conform the importance of the task (competency) statements identified through occupational analysis. Other questions, such as the degree of task learning difficulty are also frequently asked. This process is also sometimes referred to as validation.

1.0. INTRODUCTION

Technical Education and Training (TET) is one of the most important education sub-sectors in Tanzania, responsible for developing a skilled workforce to support the country's industrialization economic agenda. Tanzania's Development Vision 2025 intends to raise the country's economy to a middle-income status. This requires a skilled workforce that is aligned with the needs of the public and private sectors of the economy. The National Council for Technical Education has begun the job of drafting Occupational Standards that will eventually be adopted as National Occupational Standards for TET in order to ensure that it meets the needs of the labour market and the country's economic agenda.

National Occupational Standards (NOS) are performance criteria that are matched with labour market demands. Each National Occupation Standard describes functions, performance standards, and knowledge/understanding for one important function or task. They combine skills, knowledge, and attitudes to describe best practice. They are useful tools for establishing job roles, personnel recruiting, supervision, and appraisal, as well as TET standards. They're also helpful for benchmarking and harmonizing qualifications on a national and international level. Standards, in general, provide a solid framework for high-quality TET that is labour market-relevant, current and consistent in delivery across all public and private institutions.

However, it must be noted that, Occupational Standards and Training standards/qualifications standards are different. Occupational standards are defined in terms of activities performed by a person in a selected occupation (e.g., an electrical engineer designs electrical wiring circuits, performs trouble shooting in electrical wiring, etc.) and they are usually defined by employers following procedures agreed upon by all stakeholders. Education and training standards are developed from the activities defined in occupational standards, and they include learning objectives to ensure that the necessary skills and knowledge are developed by a person to enable him or her to function at an agreed level in an occupation. Education and Training standards are used to define curricula in training institutions. It is however critical that there must be a direct link between the occupational standards and the training standards to respond to demands of the labour market.

In TET delivery, Tanzania adopted the Competence Based Education (CBET) approach. The CBET approach focuses on providing learners with the skills and knowledge required to meet the occupational standards. Occupational standards are thus the starting point for developing

competency-based training (CBET) programs. TET institutions will be required to benchmark their curricula with relevant occupational standards.

Occupational Standards are developed based on a given occupation's current and future demands. As a result, they serve as a means of bridging the gap between the worlds of employment and technical education and training (TET).

The Electrical Engineer Occupation as its own set of occupational standards. The document explains how the occupational standards were developed, as well as the scope, the occupational profile in the form of DACUM charts, and the Occupational Standards.

2.0. OCCUPATIONAL STANDARD DEVELOPMENT PROCESS

The Occupational standards development process began with an examination of major documents that guide Tanzanian skill development. The 10-year National Skills Development Strategy (2016-2026) was one of the documents reviewed, and it outlined six (6) economic sectors that should be prioritized when developing skills development programmes. These sectors include: Transport and logistics, Tourism and Hospitality, Agribusiness, Construction, Energy and ICT. NACTE labour market reports were also used in the literature review to determine the skills demand in the Tanzanian labour market as a whole.

After the literature review, a workshop comprised of expert workers and educators with substantial knowledge and experience in the occupation conducted an occupational analysis utilizing the DACUM approach to produce the occupational profile. The analysis resulted in DACUM Charts, which are attached as **Appendix 1** to this document.

The occupational standards were then developed. Experts in Occupational Analysis and the Development of Occupational Standards facilitated the workshop. Interviews, online surveys, and a stakeholder forum were used to validate the occupational standards. Engineers, supervisory technicians on the job, and experienced Electrical Engineering technicians were key informants in the survey to discover occupational trends. This information was used to gain insight from the workplaces regarding trends and changes in the profession, including how well graduates are prepared for working in the occupation. A total of online surveys were completed by experts from the labour market across the country. Apart from the survey aiding in defining the scope for the occupational analysis, they served to engage a

wide cross-section of experts in the occupation. The stakeholders' forum was attended by participants from different parts of the country representing various companies.

3.0. THE SCOPE AND OVERVIEW OF THE OCCUPATION STANDARDS FOR ELECTRICAL ENGINEERS

These standards cover a broad range of duties and tasks that can be performed by an Electrical Engineer. However, the occupational standards are not meant to replace individual job descriptions, they are to be used for guidance in defining skill levels and knowledge for the technician in specific settings or positions. The Electrical Engineer may perform tasks in a number of key areas of the occupational standards, but not necessarily in all areas. For example, in large operations other individuals may be employed or designated to perform specific tasks.

Electrical engineers usually do research, design, develop, test, or supervise the manufacturing and installation of electrical equipment, components, or systems for commercial, industrial, military, or scientific use.

Electrical equipment is any item for such purposes as generation, conversion, transmission, distribution or utilization of electrical energy such as machines, transformers, and apparatus, measuring instruments, protective devices, wiring materials, accessories and appliances.

It is the job of electrical engineers to ensure the effective, safe, environmentally friendly and both economically and socially acceptable functioning of electrical systems and equipment. This Occupational Standards highlight core knowledge, skills, competences and personal attributes that Electrical Engineers must possess to be successful in their daily duties, that include:

- a) Supervising maintenance of electrical systems
- b) Supervising maintenance of electrical machines
- c) Supervising installation of electrical machines and systems
- d) Carrying out design of electrical systems
- e) Carrying out design of electrical machines
- f) Managing projects
- g) Managing resources
- h) Commissioning installed electrical machines and systems
- i) Conducting applied research on electrical works

The Occupational standards have been clustered into NTA qualification levels i.e. NTA level 7 and 8.

4.0. VALIDITY PERIOD

The occupational standards will be valid for 3-5 years due to the fast-changing nature of technology. The review will proceed in the same manner as the previous one, with new occupational standards being developed based on current labour market Information.

5.0. OCCUPATIONAL STANDARDS

5.1. OCCUPATIONAL STANDARDS FOR ELECTRICAL ENGINEERS – NTA 7

OCCUPATION	ELECTRICL ENGINEERING	OCCUPATION CODE	
DUTY TITLE	SUPERVISE MAINTENANCE ON ELECTRICAL SYSTEMS	DUTY NO.	701
TASK TITLE	SUPERVISE PREVENTIVE MAINTENANCE ON ELECTRICAL SYSTEMS	TASK NO.	7011
PERFORMANCE CRITERIA	A person carrying out this task should be able to apply knowledge, skills and understanding to supervise preventive maintenance on electrical systems in factories and industries as per preventive maintenance schedule and in accordance with standard principles and current versions of regulations & standards governing the electrical field.		
RANGE STATEMENTS	The task will be performed in factories and industries. For successful performance of the task, the following will be required Tools and Equipment: Personal Protective Equipment (PPE), Measuring equipment & instruments (Digital Multi-meter, Megger tester & Phase tester), Electrician’s toolkit, PLC Kit, Manufacture instruction’s manual, Injection kit, Protection relay test kit, Infrared camera, Computer and cable fault indicator. Materials: Mutton cloth.		
EVIDENCE REQUIREMENTS			
PRACTICAL PERFORMANCE	UNDERPINNING KNOWLEDGE		
The person performing this task must be able do the following: 1. Analyse typical cause of major system failures; 2. Select the type of preventive action to take to prevent recurrence; 3. Follow manufacturers’ guidelines on maintenance schedules for specific electrical system; 4. Utilize a computer maintenance management system; (CMMS) to schedule preventive maintenance tasks for various electrical systems; 5. Describe the sequence of activities; 6. Determine which activities should be given priority; 7. Determine what level of skill is required; 8. Confirm that all required resources: materials, labour,	Detailed knowledge about: 1.0. Methods This person performing this task must be able to explain how to: 1.1. Test electrical systems; 1.2. Perform preventive maintenance on electrical systems. 2.0. Principles The person must be able to explain the principles of: 2.1. Isolation of electrical systems for safety of personnel and equipment; 2.2. Operation of electrical systems. 3.0. Theories The person must be able to explain: 3.1. Electrical Engineering; 3.2. Network Analysis; 3.3. Ohms Law; 3.4. Watt’s Law; 3.5. Kirchhoff’s Current Law; 3.6. Kirchhoff’s Voltage Law; 3.7. Mesh Current Analysis; 3.8. Nodal Voltage Analysis;		

equipment and tools are available; 9. Explain instructions clearly to subordinates; 10. Liaise with user department for power cut; 11. Acquire the permit to commence the preventive maintenance tasks; 12. Monitor the preventive maintenance of electrical systems as appropriate; 13. Monitor the test of electrical systems in accordance with the drawings and manuals; 14. Connect the electrical systems to power supply; 15. Oversee adherence to health and safety precautions when the task is performed 16. Confirm the cleanness of tools and working area; 17. Confirm that tools and safety gears are well stored; 18. Review the prepared report	3.9. Simulation of electrical systems; 3.10. Mathematical modelling of electrical systems; 3.11. Electrical systems power layout interpretation 3.12. Electronic circuit design. 4.0. Essential skills 4.1. Numerical analysis skills; 4.2. Communication skills; 4.3. Problem solving skills; 4.4. Leadership skills; 4.5. Time management; 4.6. Punctuality; 4.7. Team Spirit; 4.8. Trustworthy; 4.9. Dedication; 4.10. Materials science; 4.11. Computer skills; 4.12. Report writing Skills. 5.0. Math Skills 5.1. Material & labour cost estimation.
DESCRIPTION OF THE END PRODUCTS / SERVICE	After supervision of preventive maintenance, the electrical systems are functioning properly with minimum interruptions.
CIRCUMSTANTIAL KNOWLEDGE	Detailed knowledge about: 1. International colour code regulation; 2. Safe handling of tools and equipment; 3. Health, safety and environment; 4. Waste disposal methods; 5. Financial and accounting regulations of the organization.

OCCUPATION	ELECTRICAL ENGINEERING	OCCUPATION CODE	
DUTY TITLE	SUPERVISE MAINTENANCE ON ELECTRICAL SYSTEMS	DUTY NO	701
TASK TITLE	SUPERVISE CORRECTIVE MAINTENANCE ON ELECTRICAL SYSTEMS	TASK NO	7012
PERFORMANCE CRITERIA	A person carrying out this task must be able to apply knowledge, skills and understanding to supervise corrective maintenance on electrical systems in factories and industries as per technical requirement and in accordance with standard principles and the current versions of regulations and standards governing the electrical field.		
RANGE STATEMENTS	The task will be performed in factories and industries. For successful performance of the task, the following will be required: Tools and Equipment needed: Personal Protective Equipment (PPE), Computer, Measuring equipment & instruments (Digital Multi-meter, Megger tester & Phase tester), simulators, Electrician’s toolkit, PLC Kit, Vacuum cleaner and cable fault locator, spikes, wire stringing machine, Voltage detector, compression tool, Manufacture Instruction’s Manual, Injection Kit, Protection relay test kit, conduit bender, coil winding machine and Infrared camera. Materials needed: Lubricants, mutton cloth, oil, silica gel, wire, connectors, conduit, conduit bender, cable lugs and cable ties.		
EVIDENCE REQUIREMENTS			
PRACTICAL PERFORMANCE		UNDERPINNING KNOWLEDGE	
The person performing this task must be able do the following: 1. Identify malfunction of electrical system; 2. Allocate tasks to subordinates with instructions; 3. Assist subordinates to identify tools, equipment and measuring instruments to be used during corrective maintenance; 4. Isolate power supply to faulty electrical system; 5. Review layout drawings of electrical systems together with subordinates; 6. Monitor the investigation of the cause of failure; 7. Review estimated cost of maintenance and repair; 8. Review and approve work plan;		Detailed knowledge about: 1.0. Methods This person performing this task must be able to explain how to: 1.1. Perform corrective maintenance of electrical systems; 1.2. Test electrical systems. 2.0. Principles The person must be able to explain the principles of: 2.1. Troubleshooting and repair of electrical systems; 2.2. Isolation of electrical systems for safety of personnel and equipment. 3.0. Theories The person must be able to explain: 3.1. Preventive and corrective maintenance concepts 3.2. Electrical Engineering; 3.3. Network Analysis; 3.4. Ohms Law; 3.5. Watt’s Law; 3.6. Kirchhoff’s Current Law;	

9. Approve requisition of resources: material, labour, equipment and tools; 10. Plan the work schedule; 11. Communicate with sections that will be affected with shutdown during corrective maintenance; 12. Acquire the permit to commence the preventive maintenance tasks; 13. Monitor repair of the electrical system while adhering to safety rules; 14. Monitor adherence to safety rules and regulations; 15. Monitor tests on the electrical systems as appropriate and in accordance with drawings and maintenance manuals; 16. Restore power supply to the electrical systems; 17. Monitor cleaning of tools and working area; 18. Monitor storage of tools and safety gears; 19. Review work report.	3.7. Kirchhoff's Voltage Law; 3.8. Mesh Current Analysis; 3.9. Nodal Voltage Analysis; 3.10. Electrical systems power layout interpretation; 3.11. Simulation of electrical systems; 3.12. Mathematical modelling of electrical systems; 3.13. Electronic circuit design. 4.0. Essential skills 4.1. Measurements & instrumentation; 4.2. Communication skills; 4.3. Problem solving skills; 4.4. Leadership skills; 4.5. Punctuality; 4.6. Team spirit; 4.7. Trustworthy; 4.8. Dedication; 4.9. Time management; 4.10. Materials science; 4.11. Computer skills; 4.12. Report writing skills; 5.0. Math Skills 5.1. Material Costs Estimation
DESCRIPTION OF THE END PRODUCTS / SERVICE	After corrective maintenance is performed, the electrical systems should function properly.
CIRCUMSTANTIAL KNOWLEDGE	Detailed knowledge about: 1. International Colour code regulation; 2. Safe handling of tools and equipment; 3. Health, safety and environment; 4. Waste disposal Methods; 5. Financial and accounting regulations of the organization.

OCCUPATION	ELECTRICAL ENGINEERING	OCCUPATION CODE	
DUTY TITLE	SUPERVISE MAINTENANCE ON ELECTRICAL MACHINES	DUTY NO	702
TASK TITLE	SUPERVISE PREVENTIVE MAINTENANCE ON ELECTRICAL MACHINES	TASK NO	7021
PERFORMANCE CRITERIA	A person carrying out this task should be able to apply knowledge, skills and understanding to monitor preventive maintenance on electrical machines in factories and industries as per preventive maintenance schedule and in accordance with standard principles and current versions of regulations & standards governing the electrical field.		
RANGE STATEMENTS	The task will be performed in factories and industries. For successful performance of the task, the following will be required: Tools and Equipment: Personal Protective Equipment (PPE), Computer, Measuring equipment & instruments (Digital Multi-meter, Megger tester & Phase tester), Electrician’s toolkit, PLC Kit, Manufacture Instruction’s Manual, Injection Kit, Protection relay test kit, Infrared camera and cable fault indicator. Materials: Mutton cloth, lubricants, grease, oil, silica gel and diesel.		
EVIDENCE REQUIREMENTS			
PRACTICAL PERFORMANCE		UNDERPINNING KNOWLEDGE	
The person performing this task must be able do the following: 1. Analyse typical cause of major machine failures; 2. Select the type of preventive action to take to prevent recurrence; 3. Follow manufacturers’ guidelines on maintenance schedules for specific electrical machine; 4. Utilize a computer maintenance management system; (CMMS) to schedule preventive maintenance tasks for various electrical machines; 5. Provide description of the sequence of activities; 6. Determine which activities should be given priority; 7. Determine what level of skill is required;		Detailed knowledge about: 1.0. Methods This person performing this task must be able to explain how to: 1.1. Test electrical machines; 1.2. Perform preventive maintenance on electrical machines. 2.0. Principles The person must be able to explain the principles of: 2.1. Isolation of electrical machines for safety of personnel and equipment; 2.2. Operation of electrical machines. 3.0. Theories The person must be able to explain: 3.1. Electrical Engineering; 3.2. Network Analysis; 3.3. Ohms Law; 3.4. Watt’s Law; 3.5. Kirchhoff’s Current Law; 3.6. Kirchhoff’s Voltage Law; 3.7. Mesh Current Analysis; 3.8. Nodal Voltage Analysis;	

8. Confirm that all required resources: material, labour, equipment and tools are available; 9. Provide clear instructions clearly to subordinates; 10. Liaise with user department for machine outage; 11. Acquire the permit to commence the preventive maintenance tasks; 12. Monitor the preventive maintenance of electrical machines as appropriate; 13. Monitor the test of electrical machines in accordance with the drawings and manuals; 14. Connect the electrical machine to power supply; 15. Confirm the cleanness of tools and working area; 16. Confirm that tools and safety gears are well stored; and 17. Review the prepared report.	3.9. Simulation of electrical machines; 3.10. Mathematical modelling of electrical machines and 3.11. Electronic circuit design. 4.0. Essential skills 4.1. Numerical analysis skills; 4.2. Communication skills; 4.3. Problem solving skills; 4.4. Leadership skills; 4.5. Time management; 4.6. Punctuality; 4.7. Team Spirit; 4.8. Trustworthy; 4.9. Dedication; 4.10. Materials science; 4.11. Computer skills; 4.12. Report writing Skills and 4.13. Electrical machines power layout interpretation. 5.0. Math Skills 5.1. Material & labour cost estimation
DESCRIPTION OF THE END PRODUCTS / SERVICE	After Supervision of preventive maintenance, the electrical machines are functioning properly with minimum interruptions.
CIRCUMSTANTIAL KNOWLEDGE	Detailed knowledge about: 1. International colour code regulation; 2. Safe handling of tools and equipment; 3. Health, safety and environment; 4. Waste disposal methods; 5. Financial and accounting regulations of the organization.

OCCUPATION	ELECTRICAL ENGINEERING	OCCUPATION CODE	
DUTY TITLE	SUPERVISE MAINTENANCE ON ELECTRICAL MACHINES	DUTY NO	702
TASK TITLE	SUPERVISE CORRECTIVE MAINTENANCE ON ELECTRICAL MACHINES	TASK NO	7022
PERFORMANCE CRITERIA	A person carrying out this task must be able to apply knowledge, skills and understanding to supervise corrective maintenance on Electrical Machines in factories and industries as per technical requirement and in accordance with standard principles and the current versions of regulations and standards governing the electrical field.		
RANGE STATEMENTS	The task will be performed in factories and industries. For successful performance of the task, the following will be required: Tools and Equipment needed: Personal Protective Equipment (PPE), Computer, Measuring equipment & instruments (Digital Multi-meter, Megger tester & Phase tester), simulators, Electrician’s toolkit, ladder, Vacuum cleaner, compression tool, Manufacture Instruction’s Manual, Injection Kit, Protection relay test kit, conduit bender and coil winding machine. Materials needed: Lubricants, mutton cloth, oil, silica gel, insulation material, varnish, paint, wire, connectors, cable lugs and cable ties.		
EVIDENCE REQUIREMENTS			
PRACTICAL PERFORMANCE		UNDERPINNING KNOWLEDGE	
The person performing this task must be able do the following: 1. Identify malfunction of electrical machine; 2. Allocate tasks to subordinates with instructions; 3. Assist subordinates to identify tools, equipment and measuring instruments to be used during corrective maintenance; 4. Isolate part of the electrical machine with fault; 5. Review layout drawing of electrical machine together with subordinates; 6. Monitor the investigation of the cause of failure; 7. Review estimated cost of maintenance and repair; 8. Review and approve plan work plan; 9. Approve requisition of		Detailed knowledge about: 1.0. Methods This person performing this task must be able to explain how to: 1.1. Perform corrective maintenance of electrical machines; 1.2. How to test electrical machines. 2.0. Principles The person must be able to explain the principles of: 2.1. Troubleshooting and repair of electrical machines; 2.2. Isolation of electrical machines for safety of personnel and equipment. 3.0. Theories The person must be able to explain: 3.1. Electrical Engineering; 3.2. Machine technology; 3,3. Ohms Law; 3.4. Watt’s Law; 3.5. Kirchhoff’s Current Law; 3.6. Kirchhoff’s Voltage Law; 3.7. Mesh Current Analysis;	

resources: material, labour, equipment and tools; 10. Plan the work schedule; 11. Communicate with sections that will be affected with shutdown during corrective maintenance; 12. Acquire the permit to commence the preventive maintenance tasks; 13. Monitor the repair of the electrical machine; 14. Monitor adherence to safety rules and regulations; 15. Monitor tests on electrical machine as appropriate and in accordance with drawings and maintenance manuals; 16. Restore power for the affected areas; 17. Monitor cleaning of tools and working area; 18. Monitor storage of tools and safety gears; 19. Review work report.	3.8. Nodal Voltage Analysis; 3.9. Electronic circuit design; 3.10. Electrical systems power layout interpretation; 3.11. Simulation of electrical systems; 3.12. Mathematical modelling of electrical systems. 4.0. Essential skills 4.1. Measurements & instrumentation; 4.2. Communication skills; 4.3. Problem solving skills; 4.4. Leadership skills; 4.5. Punctuality; 4.6. Team spirit; 4.7. Trustworthy; 4.8. Dedication; 4.9. Time management; 4.10. Materials science; 4.11. Computer skills; 4.12. Report writing skills; 5.0. Math Skills 5.1. Material Costs Estimation
Description of the end Product or Service	After corrective maintenance is performed, the electrical machine should function properly.
CIRCUMSTANTIAL KNOWLEDGE	Detailed knowledge about: 1. International Colour code regulation; 2. Safe handling of tools and equipment; 3. Health, safety and environment; 4. Waste disposal methods; 5. Financial and accounting regulations of the organization.

OCCUPATION	ELECTRICAL ENGINEERING	OCCUPATION CODE	
DUTY TITLE	SUPERVISE INSTALLATION OF ELECTRICAL MACHINES & SYSTEMS	DUTY NO	703
TASK TITLE	SUPERVISE INSTALLATION OF ELECTRICAL MACHINES	TASK NO	7031
PERFORMANCE CRITERIA	The person carrying out this task should be able to apply knowledge, skills and understanding to supervise installation of electrical machines in factories and industries as per client/contract specifications and in accordance with standard principles and current versions of regulations & standards governing the electrical field.		
RANGE STATEMENTS	The task will be performed in factories and industries. For successful performance of the task, the following will be required: Tools and Equipment: P.P.E, Multi-meter, Computer, Combination Pliers, Voltage Tester, Hammer, Wire stripper, Electrician’s Toolkit, Insulation resistance tester, Ladder and Distribution boards. Materials: Insulation Material, Wires, Connectors, Conduits, Conduit Bender, Cable Lugs, Cable Ties, Other Electrical Accessories, Notebook and pen.		
EVIDENCE REQUIREMENTS			
PRACTICAL PERFORMANCE		UNDERPINNING KNOWLEDGE	
The person performing this task must be able do the following: 1. Prepare work plan for installation of electrical machine; 2. Provide work plan to subordinates; 3. Verify tools and measuring instruments to be used during installation; 4. Review & approve the costs of materials required for installation; 5. Review & approve manpower to be engaged in the installation task; 6. Monitor adherence to safety standards during work; 7. Acquire work permit to commence the installation; 8. Monitor the isolation of electrical power prior to commencing the installation process; 9. Monitor the installation of the		Detailed knowledge about: 1.0. Methods This person performing this task must be able to explain how to: 1.1. Effectively supervise installation of electrical machines. 2.0. Principles The person must be able to explain the principles of: 2.1. Installing electrical machines; 2.2. Earthing of electrical machines; 2.3. Starting of electric machines. 3.0. Theories The person must be able to explain: 3.1. Electrical Engineering; 3.2. Switching and controlling of electric machines; 3.3. Machines installation procedures; 3.4. Electrical installation/power layout interpretation; 3.5. Network analysis; 3.6. Ohms law; 3.7. Kirchhoff’s current law; 3.8. Kirchhoff’s voltage law; 3.9. Mesh current analysis; 3.10. Nodal voltage analysis;	

electrical machines in accordance with technical requirements; 10. Monitor the installation of the cables and required accessories; 11. Monitor the testing process in accordance with manufacturer's recommendations; 12. Monitor cleaning of equipment, tools and working area; 13. Monitor dispose of wastes; 14. Monitor storage of equipment, tools and safety gears; 15. Commission and provide clear accurate information to the client/end user department; 16. Provide relevant documentation (installation drawings, instruction manuals & commissioning report) to the client/ end user department; 17. Handover the installed machines to the client/end user.	3.11. Switching and control of machines. 4.0. Essential skills 4.1. Measurements & Instrumentation skills; 4.2. Leadership skills; 4.3. Interpersonal skills; 4.4. Communication skills; 4.5. Judgmental skills; 4.6. Punctuality; 4.7. Team Spirit; 4.8. Trustworthy; 4.9. Dedication; 4.10. Time Management; 4.11. Computer skills; 4.12. Report writing skills. 5.0. Math Skills 5.1. Material Costs Estimation
DESCRIPTION OF THE END PRODUCTS / SERVICE	Supervision of installation of electrical machines is performed as per standard principles and approved rules & regulations.
CIRCUMSTANTIAL KNOWLEDGE	Detailed knowledge about: 1. International Colour code regulation; 2. Safe handling of tools and equipment; 3. Health, safety and environment; 4. Waste disposal methods.

TABLE NO. 1: DACUM CHART FOR ELECTRICAL ENGINEERING LEVEL 7

DUTIES	TASKS	ENABLERS
1.0. Supervise Maintenance on Electrical Systems	1.1. Supervise Preventive Maintenance on electrical systems 1.2. Supervise Fault Tracing on electrical systems 1.3. Supervise Corrective Maintenance on electrical systems	Generic Skills and Knowledge • Using communication skills to work with others, reporting to superiors • Knowledge on safety, health & environment • Use of manufacturer's manual • Skills and knowledge on: ✓ taking measurements & measuring units ✓ instrumentation ✓ Computer programming languages • Machine elements • Interpretation of technical drawing • Basic Material science Tools and Equipment • Personal Protective Equipment (PPE) such as Safety boots, safety goggle, gloves, hearing protection, helmets. • Measuring equipment & instruments • Toolbox • PLC Kit • Vacuum cleaner • Injection kit • Cable fault locator Materials Lubricants, grease, mutton cloth, oil, silica gel, diesel Worker Behaviours Team spirit, trustworthy, time management and dedication
2.0. Supervise Maintenance on Electrical Machines	2.1. Supervise Preventive Maintenance on Electrical Machines 2.2. Supervise Fault Tracing on Electrical Machines	Generic Skills and Knowledge • Using communication skills to work with others, reporting to superiors

DUTIES	TASKS	ENABLERS
	2.3. Supervise Corrective Maintenance on Electrical Machines	• Knowledge on safety, health & environment • Use of manufacturer's manual • Skills and knowledge on: ✓ taking measurements & measuring units ✓ instrumentation ✓ Computer programming languages • Machine elements • Interpretation of technical drawing • Basic Material science Tools and Equipment • Personal Protective Equipment (PPE) such as Safety boots, safety goggle, gloves, hearing protection, helmets. • Measuring equipment & instruments • Toolbox • PLC Kit • Vacuum cleaner • Injection kit • Cable fault locator Materials • Lubricants, grease, mutton cloth, oil, silica gel, diesel Worker Behaviours • Team spirit, trustworthy, time management and dedication
3.0. Supervise installation electrical Machines and systems	3.1. Supervise installation of Electrical Machines 3.2. Supervise installation of Electrical Systems	Generic Skills and Knowledge • Using communication skills to work with others, reporting to superiors • Knowledge on safety, health & environment • Use of manufacturer's manual • Skills and knowledge on:

DUTIES	TASKS	ENABLERS
		✓ taking measurements & measuring units ✓ instrumentation ✓ Computer programming languages • Machine elements • Interpretation of technical drawing • Basic Material science Tools and Equipment • Personal Protective Equipment (PPE) such as Safety boots, safety goggle, gloves, hearing protection, helmets. • Measuring equipment & instruments • Toolbox • PLC Kit • Vacuum cleaner Materials • Lubricants, grease, mutton cloth, oil, silica gel, diesel Worker Behaviours • Team spirit, trustworthy, time management and dedication