

TVET NATIONAL EXAMINATIONS, LEVEL 5, 2022-2023

INSTRUCTIONS TO CANDIDATES (ANSWER BOOKLET)

1. A candidate should fill in the actual names and the Index number on the cover of this questions and answer booklet on the provided place.
2. It is illegal for a candidate to write any of names, Index number or school name inside the answer booklet.
3. No candidate should remove or tear any pages or part of it in the answer booklet.
4. A candidate should answer in the language in which the examination is set.
5. A candidate should sign on the sitting plan when submitting the answer booklet. He/she has also to check if the answer booklet is well sealed.
6. No extra paper is allowed in the examinations room. If a candidate is caught with it his/her results will be nullified.
7. No candidate is allowed to write answers not related to the subject being sat for, otherwise it will be considered as a cheating case.
8. Write your answers on the 16 lined pages (From page 7 to page 22).
9. Use the last non-lined pages as draft.
10. Results for any candidate who is caught in examination malpractices are nullified. The cheating can be recognized during examinations administration, marking exercise or even thereafter.

- N.B:** 1) After results publication, there is no remarking and no candidate is given his/her answer booklet for review. This answer booklet is a property of NESAS.
- 2) Claims are only received online within 30 days after results publication. A link will be provided after results publication.

T 051 *Electrical machines operations*

TVET NATIONAL EXAMINATIONS, LEVEL 5, 2022-2023

OPTION/TRADE: INDUSTRIAL ELECTRICITY

SUBJECT/EXAM: ELECTRICAL MACHINES OPERATIONS

DURATION: 3 HOURS

INSTRUCTIONS TO CANDIDATES

This Exam paper is composed of Three Sections (A, B, and C). Follow the instructions given below, and answer the indicated questions for a total of 100 marks

Section A: Fourteen (14) questions, all **Compulsory** **55 marks**

Section B: Among the five (5) questions, attempt any three (3) **30 marks**

Section C: Among the two (2) questions, attempt any one (1) **15 marks**

Allowed materials:

- Blue or black pen
- Mathematical set
- Non-programmable calculator

Note:

Every candidate is required to carefully comply with the provided assessment instructions.

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SECTION A: Attempt all questions

(55 marks)

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- 01.** Give any six (6) elements of a generator's nameplate. **(3marks)**
- 02.** List any four (4) mounting and coupling accessories of dc generator. **(2marks)**
- 03.** a) Mention the three (3) types of losses for three phase induction motor. **(3marks)**
b) Show three (3) status indicators of an electrical moto
- 04.** Explain the following excitations of a synchronous motor: **(3marks)**
a) Normal excitation;
b) Under excitation;
c) Over-excitation.
- 05.** Identify any four (4) possible reasons that cause a dc motor to produce heavy sparks at the commutator. **(4marks)**
- 06.** Explain the following generator's protections: **(3marks)**
a) Short circuit protection;
b) Ground fault protection;
c) Overload protection.
- 07.** Enumerate any five (5) mechanical parts of a motor. **(5marks)**
- 08.** Write the general procedures to be followed for disassembling an electrical motor. **(5marks)**
- 09.** Draw the two (2) types of three-phase induction motor connections and their corresponding terminal links. **(4marks)**
- 10.** Identify any four (4) electrical faults that can occur in maintenance of an electrical motor. **(4marks)**
- 11.** Compare the slip ring motor and squirrel cage induction motor. **(5marks)**

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12. With the help of flow chart, illustrate the general faults of rotating machine. **(4marks)**
13. What are any ten (10) primary functions of lubricant? **(5marks)**
14. A 4 pole, 220V shunt motor has 540 lap-wound conductors. It takes 32A from the supply mains and develops output power of 5.595KW. The field winding takes 1A. The armature resistance is 0.09Ω and the flux per pole is 30mWb. Calculate the speed. **(5marks)**

Section B: Attempt any three (3) questions

(30 marks)

15. a) Propose any three (3) disadvantages of single-phase induction motor. **(10marks)**
- b) Suggest any three (3) benefits of testing a motor.
- c) Mr. XY has a milling machine driven by three phase induction motor of 2.5KW. If start push button is pressed, the electrical motor starts to drive milling machine to mill the cassava. When the milling process is ended, the stop push button is pressed to stop the electrical motor.
- Draw the **control** and **power** circuit of the system. Note that the motor is protected against overcurrent and continuous heating.
16. a) Can any voltage be applied at primary winding of a transformer? **(10marks)**
Justify your answer.
- b) A single-phase transformer has 480 turns on the primary winding and 90 turns on the secondary winding. The maximum value of the magnetic flux density is 1.1T when 2200 volts, 50Hz is applied to the transformer primary winding. Calculate:
- The cross-sectional area of the core;
 - Secondary induced e.m.f.

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17. a) Describe the two (2) main parts of electrical machine. **(10marks)**
- b) The frequency of the supply to the stator of an 8-pole induction motor is 50HZ and the rotor frequency is 3HZ. Determine:
- i) the slip;
 - ii) Rotor speed.
18. a) Differentiate the periodic maintenance from the breakdown maintenance. **(10marks)**
- b) Draw a developed winding diagram of a three-phase motor that has 24 slots, 4 poles and using wave connection.
19. a) Explain the working principle of a three-phase induction motor. **(10marks)**
- b) A company X has the system of conveying the load upward and downward by using three-phase induction motor. Draw the power and control circuit of that system.

Section C: Attempt only one (1) question

(15 marks)

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20. a) Compare a squirrel cage rotor type with wound rotor type used in ac generator/induction generator. **(15marks)**
- b) A long-shunt compound generator delivers a load current of 50A at 500V and has armature, series field and shunt resistances of 0.05Ω , 0.03Ω and 250Ω respectively. Calculate the generated voltage and the armature current. Allow 1V per brush for contact drop.
- c) A 10kW shunt generator having an armature circuit resistance of 0.75 and a field resistance of 125Ω , generates a terminal voltage of 250V at full load. Determine the efficiency of the generator at full load, assuming the iron, friction and windage losses amount to 600W.

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21. a) What are any two (2) types of relays based on their sensing elements? **(15marks)**
- b) Sketch a power stage of dc motor.
- c) A 4-pole, 240V, wave connected shunt motor gives 11.19Kw when running at 1000rpm and drawing armature and field current of 50A and 1A respectively. It has 540 conductors. Armature resistance is 0.1Ω . assuming a drop of 1Volt per brush, find the:
- i) Total torque
 - ii) Useful torque
 - iii) Useful flux per pole
 - iv) Rotational losses
 - v) Efficiency.

END OF ASSESSMENT