TEVETA

Technical Education, Vocational and Entrepreneurship Training Authority

DIPLOMA IN BIOMEDICAL ENGINEERING

LEVEL 6 YEAR II EXAMINATIONS

FINAL INTEGRATED SUMMATIVE EXAMINATIONS

SITTING: JULY / AUGUST 2026

SUBJECT: ELECTRICAL TECHNOLOGY II

TIME: THREE (3) HOURS **TOTAL MARKS: 100**

INSTRUCTIONS TO CANDIDATE **PASS MARK: 50**

1. Write your Examination number and National Registration Card (NRC) number on the answer booklet provided. Ensure you append your signature in the space provided on the answer booklet.
2. Write the ANSWER SCRIPT SERIAL NUMBER on the examination register and on the entry slip.
3. This paper has TWO (2) Sections.
   - Answer ALL questions in section A
   - Answer FIVE (5) questions in Section B. Question one (1) is compulsory.
4. Diagrams may be used where necessary to clarify your answer.
5. Cell phone and programmable calculators are not allowed in the examination room

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

SECTION A: MULTIPLE CHOICE QUESTIONS TOTAL MARKS: 20

ANSWER ALL QUESTIONS BY CHOOSING THE BEST OPTION.

1. Which DC generator characteristic causes terminal voltage to decrease as load current increases?
A. Residual magnetism
B. Armature reaction and voltage drop
C. Increased field strength
D. Reduced armature current

2. Which test is commonly used to determine transformer core losses?
A. Short-circuit test
B. Open-circuit test
C. Load test
D. Polarity test

3. Transformer efficiency is highest when:
A. Copper losses equal iron losses
B. Copper losses are zero
C. Iron losses are zero
D. Load is disconnected

4. An autotransformer differs from a two-winding transformer because it :
A. uses no magnetic core
B. has a single tapped winding
C. operates only on DC
D. has two separate cores

5. Which precaution should be observed when using a CT?
A. Secondary may be left open-circuited
B. Primary must be disconnected first
C. Secondary should never be open-circuited while energized
D. Core must be removed

6. Which transformer connection provides a neutral point for distribution systems?
A. Delta-delta
B. Open-delta
C. Star-star
D. Delta-open

7. A DC shunt motor is best known for:
A. Poor speed regulation
B. Nearly constant speed operation
C. Very high starting torque only
D. Low efficiency

8. Which motor is most commonly used for constant-speed industrial applications?
A. Stepper motor
B. Universal motor
C. Three-phase squirrel cage induction motor
D. Repulsion motor

9. At synchronous speed, the slip of an induction motor is:
A. 1
B. 50%
C. 100%
D. 0

10. Which induction motor allows external resistance to be inserted into the rotor circuit?
A. Shaded-pole motor
B. Universal motor
C. Squirrel-cage motor
D. Wound-rotor motor

11. Which motor is commonly used where precise angular positioning is required?
A. Universal motor
B. Stepper motor
C. Shaded-pole motor
D. Repulsion motor

12. In a direct-on-line (DOL) starter, the motor:
A. Starts through an autotransformer
B. Starts through rotor resistance
C. Is connected directly to the supply
D. Starts at reduced frequency

13. Carbon brushes are preferable to copper brushes because they_____
A. have longer life
B. reduce armature reaction
C. have lower resistance
D. reduce sparking

14. The no-load input power to a transformer is practically equal to _____ loss in the transformer.
A. copper
B. iron
C. eddy current
D. eddy current and copper

15. The rotor winding of a 3-phase wound rotor is generally _____ connected.
A. Star
B. Delta
C. Delta-Star
D. Star-Delta

16. An earth-fault test is carried out mainly to:
A. Measure transformer ratio
B. Detect unwanted leakage paths to earth
C. Measure power factor
D. Determine slip

17. A universal motor can operate on:
A. DC only
B. AC only
C. Both AC and DC
D. Three-phase AC only

18. Which transformer type is commonly used for metering and protection systems?
A. Instrument transformer
B. Autotransformer
C. Isolation transformer
D. Power transformer

19. The _____ motor has the best speed regulation.
A. series
B. cumulatively compounded
C. shunt
D. differently compounded

20. The amount of back e.m.f of a shunt motor will increase when the _____
A. load is increased
B. field is strengthened
C. field is weakened
D. load is decreased

SECTION B: **TOTAL MARKS: 80**

THERE ARE SEVEN (7) QUESTIONS IN THIS SECTION. ANSWER FIVE (5) QUESTIONS QUESTION ONE (1) IS COMPULSOR

QUESTION 1 (COMPULSORY)

a) State the importance of dc machines [1 mark]

b) A 6 pole lap wound d.c generator has 600 conductors on its armature. The flux per pole is 0.02wb. Calculate.

i. the speed at which the generator must be run to generate 300V. [6 marks]

ii. the speed if the generator were wave-wound. [5 marks]

c) An 8 pole, lap wound armature rotated at 350 r.p.m is required to generate 260V. The useful flux per pole is 0.05Wb. if the armature has 120 slots, calculate the number of conductors per slot. [8 marks]

[TOTAL: MARKS 20]

QUESTION 2

A 100 KVA, 2200/440V transformer has $R_1 = 0.3\Omega$; X_1 1.1Ω; $R_2 = 0.01$ and $X_2 = 0.035\Omega$.

Calculate.

a) the equivalent impedance of the transformer referred to the primary. [9 marks]

b) total copper losses. [6 marks]

[TOTAL: MARKS 15]

QUESTION 3

a) A 6-pole alternator running at 1000r.p.m supplies an 8-pole induction motor. Find the actual speed of the motor if the slip is 2.5%. [7 marks]

b) A slip-ring induction motor runs at 290 r.p.m at full-load when connected to a 50Hz supply. Determine the number of poles and slip. [8 marks]

[TOTAL: MARKS 15]

QUESTION 4

A 110V battery is connected to the same busbars as a d.c. generator. Battery resistance is 0.025Ω and generator resistance is 0.1Ω. The battery floats when the current load is 100A. Find the generator output when.

a) the battery floats [5 marks]
b) when the load current is 50 A [10 marks]

[TOTAL: MARKS 15]

QUESTION 5

a) Explain three **(3)** methods of starting squirrel cage motors. [9 marks]
b) A 3 phase squirrel cage induction motor takes a starting current of 6 times the full-load current. Find the starting torque as a percentage of full-load torque if the motor is started.
   i. Direct-on-line [3 marks]
   ii. Through the Star-delta starter. [3 marks]

   N.B: The full-load slip of the motor is 0.04.

[TOTAL: MARKS 15]

QUESTION 6

Calculate the % regulation of a transformer in which the percentage resistance drop is 1% and percentage reluctance drop is 5% when the power factor is;

a) 0.8 lagging [5 marks]
b) Unit [5 marks]
c) 0.8 leading [5 marks]

[TOTAL: MARKS 15]

QUESTION 7

A 3-phase, 50 Hz, star connected, 1000KVA, 2300 V alternator gives a short- circuit current of 400A for a certain field excitation. With the same excitation, the open-circuit voltage was 1328V (phase value). The d.c resistance between two lines is 0.412Ω. Find;

a) Effective armature resistance. [3 marks]
b) Synchronous reactance. [5 marks]
c) the full load voltage regulation at 0.8 p.f. lagging [7 marks]

[TOTAL: MARKS 15]