NESA NATIONAL EXAMINATION AND SCHOOL INSPECTION AUTHORITY

ELT- Industrial electrical system installation and maintenance

T2-034

Thursday, 10 July 2025
8:30 AM to 11:30 AM

Names:.....

Index number :.....

TSS NATIONAL EXAMINATIONS, LEVEL 5, 2024-2025

QUESTIONS and ANSWERS BOOKLET

TRADE (s): ELETRICAL TECHNOLOGY (ELT)

SUBJECT: INDUSTRIAL ELECTRICAL SYSTEM INSTALLATION AND MAINTENANCEE

DURATION: 3 Hours

Read carefully the instructions on page 3

TOTAL MARKS...../100

FOR EXAMINER'S USE ONLY

QUESTIONS	1	2	3	4	5	6	7	8	9	10	Total
Marks											

QUESTIONS	11	12	13	14	15	16	17	18	19	20	Total
Marks											

QUESTIONS	21	22	23	24	25	26	27	28	29	30	Total
Marks											

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DURATION: 3 HOURS

INSTRUCTIONS TO CANDIDATE:

1. 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 which are **Compulsory** **55 marks**

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

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

2. Fill in your actual **names** and **Index number** on the provided space(Cover).
3. Do not remove or tear any page or part of this Questions and Answers Booklet.
4. Answer in the language in which the Examination is set.
5. In section **A**, answer questions in the provided space. In case of multiple-choice questions, just **circle** the letter corresponding to the correct option.
6. In section **B** and **C**, answer questions in the provided space after section C questions.
7. **Allowed materials:**
   - Blue or Black pen.
   - Geometrical Instruments
   - Silent non-programmable calculators

SECTION A: Attempt all questions **(55 marks)**

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01. Complete the following statements using provided electrical components: **Fuses**, **Relays** or **Contactors**. **(3 Marks)**

a) .....: Test for proper switching action and coil energization.

b) .....: Verify mechanical operation, contact integrity, and coil functionality.

c) .....: Confirm continuity and proper rating to avoid circuit damage.

02. Circle the correct answer to the following sub-questions. **(4 Marks)**

(i) Which of the following instruments is commonly used to check for continuity in an electrical control circuit?

A) Oscilloscope,
B) Thermometer,
C) Multimeter
D) Wattmeter

(ii) The purpose of testing an electrical control circuit is:

A) To measure the efficiency of electrical components.
B) To analyze the temperature of electrical wires.
C) To reduce the power consumption of the circuit.
D) To ensure the correct operation of the control system and troubleshoot any faults.

03. Circle the correct answer to the following sub-questions. **(4 Marks)**

(i) The main function of the stator in an electrical rotating machine is:

A) To rotate the rotor.
B) To supply power to the rotor.

C) To generate the magnetic field.

D) To convert electrical energy to mechanical energy.

(ii) What is the purpose of laminating stator core in an electrical rotating machine?

A) Increase the mechanical strength.

B) Reduce eddy current losses.

C) Reduce the weight of the machine.

D) Improve cooling efficiency.

04. Use **True(T)** or **False(F)** in the provided space to identify the relevance of options given to the question statement below. **(4 Marks)**

When fabricating a rotor for an electrical rotating machine, the following is an important factor to consider for efficiency:

a) The number of cooling fans .....

b) The type of insulation used in the windings .....

c) The material and construction of the core .....

d) The shape of the stator housing. .....

05. Choose by circling the correct answer to each of the following sub-questions statements: **(4 Marks)**

(i) In which two (2) sectors are industrial drawings commonly used?

A) Fashion industry

B) Engineering and manufacturing sectors

C) Entertainment industry

D) Food industry

(ii) What does technical drawing help to communicate?

A) Creative writing

B) Aesthetic preferences

C) Promotional strategies

D) How something functions or is constructed

06. Use **True(T)** or **False(F)** in the provided space to identify the relevance of options given to the question statement below. **(4 Marks)**

The laminations are used in the construction of electrical machines for:

a) Improving the appearance of the machine. .....
b) Isolating the magnetic flux. .....
c) Reducing eddy current losses. .....
d) Increasing mechanical strength. .....

07. Match the rotor core fabrication operation in Column A with its primary purpose or method described in Column B. Write the letter of the correct answer from Column B in the space provided next to each item in Column A. **(4 Marks)**

Answers	**Column A: Rotor Core Fabrication Operation**	**Column B: Purpose/Method**
1. =...	1. Lamination Stampings	A. Ensures rotor rotates smoothly with minimal vibration
2. =...	2. Core Stacking	B. Mechanically joins the rotor core to the rotating shaft
3. =....	3. Core Balancing	C. Reduces eddy current losses in the rotor core
4. =....	4. Shaft Attachment	D. Creates the overall shape and length of the rotor core from layers

08. Fill in the blank space with provided terms used in electrical rotating machines: **Heat, Squirrel-cage, Eddy current or Shaft.** **(4 Marks)**

A) The ..... rotor is known for its simple and robust construction.

B) The laminated core of a rotor reduces .....losses.

C) Cooling fans are used to dissipate ..... generated in the rotor.

D) The ..... connects the rotor to the mechanical load.

09. Use **True(T)** or **False(F)** in the provided space to answer the following questions related to the parameters of alternating current power supply. **(4 Marks)**

A) The frequency of an AC power supply determines how many times the current changes direction in one second. .....

B) In an AC power supply, the peak voltage is the same as the RMS (Root Mean Square) voltage. .....

C) Power factor is a parameter that shows how effectively electrical power is being converted into useful work output in an AC circuit. .....

D) The phase angle in an AC circuit indicates the time difference between voltage and current waveforms. .....

10. Complete the statements below using provided terminologies: **(4 Marks)**
Resultant pitch, Active side, Short pitch coil, Closed winding, Double layer winding.

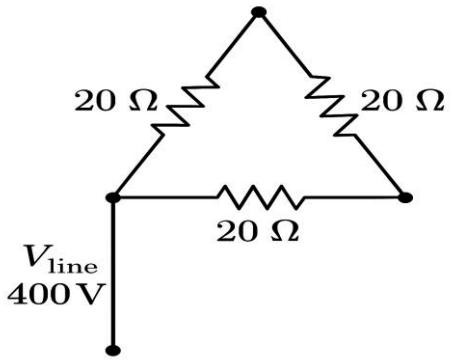
A) ..... is the winding with the number of coils is equal to the number of slots because each slot houses two coil sides.

B) ..... is the distance between the starting ends of two consecutive coils expressed in terms of coil sides.

C) ..... is the part of the coil which lies in the slot under a magnetic pole and EMF is induced in it.

D) ..... is a winding for which the part surrounding the periphery is closed. Closed winding is used in DC machines.

11. a) In a three-phase delta connection, each branch has a resistor of 20 Ω. If the line voltage is 400 V, calculate the total power consumed by the system. **(4 Marks)**



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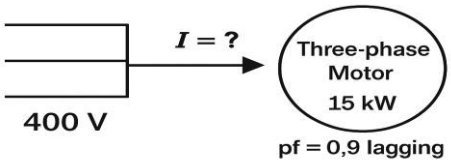
b) A three-phase motor draws 15 kW at a power factor of 0.9 lagging from a 400 V supply. Calculate the current drawn by the motor.



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12. Circle the correct answer to the following sub-questions about the Bearings and Shaft as mechanical parts of rotating machines. **(4 Marks)**

(i) During the assembly of a motor, you notice that the rotor is misaligned with wobbles when rotating. Which component would you most likely inspect or replace to correct this issue?

a) Terminal box,
b) Shaft,
c) End cover,
d) Cooling fan

(ii) A technician notices excessive noise and vibration in an electric motor during operation. Which part should be checked to reduce friction between rotating and stationary parts?

a) Shaft key,
b) Bearing,
c) Pulley,
d) Commutator

(iii) While upgrading a machine, a student replaces ball bearings with sleeve bearings. What is the primary function of the bearing in this scenario?

a) Increase the speed of rotation,
b) Transmit torque
c) Support radial and axial loads,
d) Reduce magnetic losses.

(iv) If the bearing in an induction motor fail, what is the most likely consequence?

a) Shaft will rotate faster,
b) Machine efficiency will increase,
c) Rotor will seize or vibrate excessively,
d) Windings will produce more flux.

13. Circle the right option to each of the following sub-question about production of an electrical rotating machine rotor. **(4 Marks)**

(i) A technician is assembling a rotor and notices that the lamination stack is loosely fitted onto the shaft. What action should the technician take to ensure proper mechanical performance?

a) Add extra insulation between laminations
b) Weld the laminations together,
c) Press-fit or shrink-fit the stack properly onto the shaft
d) Apply oil to improve rotation.

(ii) While winding the rotor coils, a student forgets to insert insulation between the winding and the iron core. What would be the practical result during motor operation?

a) The rotor will run faster,
b) The motor will operate normally,
c) The winding will short-circuit,
d) The magnetic field will increase

(iii) During production of a squirrel cage rotor, a trainee incorrectly installs the aluminum bars. What is the likely operational issue if the bars are not securely bonded to the end rings?

a) The rotor will overheat due to high resistance,
b) The motor will draw less current
c) The stator field will reverse,
d) The bearings will seize.

(iv) A technician uses oversized wire for rotor windings. What problem might occur during machine operation?

a) Excessive current draw,
b) Under-voltage at terminals
c) Rotor jamming in the stator,
d) Wire overheating and insulation failure.

14. Answer the following questions by circling the right option: **(4 Marks)**

(i) A technician is instructed to draw the layout of a 3-phase motor control circuit with a start/stop button.

What is the best way to show how each component is wired?

a) Use a mechanical assembly diagram,
b) Use a single-line diagram,
c) Draw the components without connecting them,
d) Use a schematic wiring diagram

(ii) A student connects a contactor coil to a 3-phase power line directly, as per their understanding from a diagram.
What should the student verify in the drawing to correct this mistake?

a) The insulation thickness,
b) The type of enclosure,
c) The rated control voltage of the coil,
d) The wire size used for the motor.

(iii) You're assigned to prepare a wiring diagram for a 3-phase motor and overload relay.

What is the correct sequence of connection should be shown in the drawing?

a) Power → Contactor → Motor → Overload Relay.
b) Power → Contactor → Overload Relay → Motor.
c) Contactor → Overload Relay → Power → Motor.
d) Motor → Overload Relay → Contactor → Power.

(iv) A drawing shows a dashed line connecting several switches and sensors.

What does the dashed line most likely indicate?

a) Mechanical linkage or control connection
b) Electrical grounding
c) Optional wiring
d) Overhead cable tray

Section B: Attempt any three (3) questions **(30 marks)**

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15. Draw the control and power circuits of 3 phases induction motor of 6 kw started in Star-Delta with one lamp for Star and the other for Delta. **(10marks)**

16. Draw the connection diagrams of the following transformer winding configuration:

a) Delta-Wye (**Δ-Wye**) Connection,
b) Wye-Delta (**Wye-Δ**) Connection,
c) Delta-Delta (**Δ-Δ)** Connection,
d) Wye-Wye (**Y-Y**) Connection,
e) Open-Delta (**V-V**) Connection.

17. (i) What are the three (3) methods, which are used to improve power factor in three phase power systems? **(10marks)**

(ii) A 415 V, 3-phase a.c. motor has a power output of 12.75 kW and operates at a power factor of 0.77 lagging and with an efficiency of 85%. If the motor is delta-connected, determine

a) The power input
b) The line current and
c) The phase current.

18. A 5 kVA single-phase transformer has the turns ratio of 10:1 and is fed from a 2.5 kV supply. Neglecting losses, determine **(10marks)**

a) the full-load secondary current,
b) the minimum load resistance which can be connected across the secondary winding to give full load kVA,
c) the primary current at full load kVA.

19. The power input to a 500V,50Hz,6pole,3phase induction motor running at 975RPM is 40Kw. The stator losses are 1Kw, the friction and windage losses total are 2Kw. Calculate: **(10marks)**

a) The slip,
b) The rotor cu losses,
c) Shaft power,
d) The efficiency.

Section C: Attempt only one (1) question **(15 marks)**

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20. A single layer 3-phase motor has 36 slots, 4 poles and single pitched coil. Calculate: **(15marks)**

a) Number of slots per phase,
b) Number of slots per phase per pole,
c) Coil span,
d) Number of groups per phase,
e) If phase 1 enters by the first slot, by which slots enter phase 2 and phase 3?
f) Design that diagram in lap winding "group type".

21. The HEC Ldt needs to install a milling machine driven by three phase induction motor of 2.5kw to be controlled in the following ways: **(15marks)**

if start pushbutton(S1) is pressed, the motor starts to drive milling machine; when the milling process is ended, the stop push button (SO) will be used to stop the electrical motor.

Draw the control and power circuits of the system.

Note that the motor is protected against over current and heating.

END

RESERVED SPACE FOR SECTION B AND C ANSWERS

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