THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

FORM TWO NATIONAL ASSESSMENT

080 ELECTRICAL ENGINEERING

Time: 2:30 Hours **ANSWERS** **Year: 2022**

Instructions

1. This paper consists of Section **A, B** and **C** with a total of **ten (10)** questions
2. Answer **al**l questions.
3. Section **A** and **C** carry **fifteen (15)** marks each and section **B** carries **seventy (70)** marks
4. Cellular phones and unauthorized materials are not allowed in the assessment room
5. Write your **Assessment Number** at the top right-hand corner of every page.

FOR ASSESSOR'S USE ONLY

QUESTION NUMBER	SCORE	ASSESSOR'S INITIALS
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
TOTAL		
CHECKER'S INITIALS		

SECTION A (15 Marks)

Answer all questions in this section.

1. Choose the correct answer from the given alternatives by writing its letter in the box provided.

(i) Among other types, Juma decided to buy a lead-acid battery for his car. Why do you think he preferred a lead-acid battery and not an alkaline battery?

A. It is cheaper.

B. It has longer life.

C. It is very lighter.

D. It is mechanically strong.

Lead-acid batteries are preferred for cars because they are cheaper than alkaline batteries, making them cost-effective for automotive use.

Answer: A

(ii) You are provided with the following appliances to install in a house: heater, cooker, and washing machine. Why is it advised to connect the electrical appliances parallel in a circuit?

A. They depend on each other.

B. They draw less current.

C. They draw high current.

D. They operate independently.

In a parallel circuit, each appliance operates independently, so if one fails, others continue functioning, and each receives the full supply voltage.

Answer: D

(iii) A teacher ordered you to bring a first aid box after an accident occurred at the field. How would you identify the box?

A. A white cross on a green background.

B. A red cross on a white background.

C. A white cross on a black background.

D. A green cross on a white background.

A first aid box is typically identified by a white cross on a green background, as per international safety standards.

Answer: A

(iv) Suppose you are required to draw an object in its actual size. What is the appropriate name for the scale required to draw the object?

A. A double scale.

B. Magnified scale.

C. Enlarge scale.

D. Full scale.

Drawing an object in its actual size uses a full scale, where the drawing dimensions match the object's real dimensions (1:1 ratio).

Answer: D

(v) Suppose you got an electric shock when you touched the metallic part of an electric iron. What kind of electric shock is that?

A. Fuse blown.

B. Short circuit.

C. Earth leakage.

D. Open circuit.

An electric shock from touching a metallic part indicates earth leakage, where current flows to the ground through the user due to faulty insulation or grounding.

Answer: C

(vi) You are required to measure a very high frequency but small current. Which instrument will you use?

A. Thermocouple.

B. Electrodynamics ammeter.

C. Moving coil galvanometer.

D. Open circuit.

A moving coil galvanometer is sensitive and suitable for measuring small currents, including those at high frequencies, when calibrated appropriately.

Answer: C

(vii) How can you determine the presence of magnetic field in a material?

A. By detecting the lines of magnetic flux.

B. By noticing the deflection of a magnetic compass needle.

C. By heating the surrounding air.

D. By touching magnetically affected area.

The presence of a magnetic field is determined by the deflection of a magnetic compass needle, which aligns with the field lines.

Answer: B

(viii) Which of the following is the unit of inductance?

A. Ohm

B. Mho

C. Farad

D. Henry

The unit of inductance is the Henry, which measures the ability of a coil to store energy in a magnetic field.

Answer: D

(ix) A worker got a strain after lifting a load by using a ladder. What could be the possible cause of the strain?

A. The load was heavy.

B. The worker used a broken ladder.

C. The angle of the ladder was not reasonable.

D. The worker did not lift the load in a correct way.

The strain was likely caused by the worker not lifting the load correctly, as improper lifting techniques can lead to physical strain.

Answer: D

(x) A client is looking for a person who will produce specifications which will enable him to estimate the cost of the project. Who will you advise the client to call upon?

A. Cost engineer.

B. Design engineer.

C. Contract engineer.

D. Project engineer.

A design engineer produces specifications for a project, enabling cost estimation based on the design requirements.

Answer: B

2. Match the description of responsibilities in List A with the corresponding occupation in List B by writing the letter of the correct response below the item number in the table provided.

List A

(i) A person responsible for producing the design specifications which enable the cost estimate of the project.

(ii) The leader of a small team e.g., electricians and trainees.

(iii) A person responsible for carrying out testing, inspections, and commissioning of electrical installation survey drawings.

(iv) A person responsible for a number of large electrical jobs of different sites.

(v) An electrician who is responsible for the whole plant.

List B

A. Foreman

B. Skilled operator

C. Service manager

D. Project manager

E. Engineer

F. Technician

G. Craftsman

H. Contractor

(i) Producing design specifications → E (Engineer)

(ii) Leader of a small team → A (Foreman)

(iii) Testing, inspections, commissioning → F (Technician)

(iv) Responsible for large jobs across sites → D (Project manager)

(v) Electrician for whole plant → C (Service manager)

SECTION B (70 Marks)

Answer all questions from this section.

3. (a) You are supplied with three cells each with an e.m.f. of 1.5 V and an internal resistance of 1 Ω to light a torch. Draw a circuit diagram which shows the connection of the cells so that it can produce:

(i) A voltage more than 1.5 V.

To produce a voltage greater than 1.5 V, connect the cells in series.

Circuit Diagram (Description): Three cells in series, positive of one connected to negative of the next, with a torch bulb connected across the total voltage.

(ii) A total voltage of 1.5 V.

To produce a total voltage of 1.5 V, connect the cells in parallel.

Circuit Diagram (Text Description): Three cells in parallel, all positive terminals connected together and all negative terminals connected together, with a torch bulb across the terminals.

(b) Find a total internal resistance of the cell in part (a) (i) and (ii).

(i) Series Connection:

Total internal resistance = $R_1 + R_2 + R_3 = 1\ \Omega + 1\ \Omega + 1\ \Omega = 3\ \Omega$

Answer: Total internal resistance (series) = 3 Ω

(ii) Parallel Connection:

Total internal resistance = $1 / (1/R_1 + 1/R_2 + 1/R_3) = 1 / (1/1 + 1/1 + 1/1) = 1 / 3 = 0.333\ \Omega$

Answer: Total internal resistance (parallel) = 0.333 Ω

4. You are given a practical assignment which has two parts. The first part is to construct a circuit with capacitors C_1 and C_2 connected in series. The second part is to construct a circuit with inductors L_1 and L_2 connected in series.

(a) Draw the circuits to be used for the practical work.

Capacitors in Series (Text Description): Capacitors C_1 and C_2 connected end-to-end, with one terminal of C_1 connected to a voltage source, the other to C_2, and C_2's free terminal to the source's return.

Inductors in Series (Text Description): Inductors L_1 and L_2 connected end-to-end, with one terminal of L_1 connected to a circuit, the other to L_2, and L_2's free terminal completing the circuit.

Answer:

Capacitors: C_1 and C_2 in series (Diagram: C_1 connected to C_2 end-to-end).

Inductors: L_1 and L_2 in series (Diagram: L_1 connected to L_2 end-to-end).

(b) When C_1 and C_2 are 10 μF and 20 μF respectively, calculate the equivalent capacitance.

For capacitors in series: $1/C_eq = 1/C_1 + 1/C_2$

$1/C_eq = 1/10\ \mu F + 1/20\ \mu F = 0.1 + 0.05 = 0.15\ \mu F^{-1}$

$C_eq = 1/0.15 = 6.67\ \mu F$

Answer: Equivalent capacitance = 6.67 μF

(c) When L_1 and L_2 are 17.6 H and 13.4 H respectively, determine the equivalent inductance.

For inductors in series: $L_eq = L_1 + L_2$

$L_eq = 17.6\ H + 13.4\ H = 31\ H$

Answer: Equivalent inductance = 31 H

5. (a) Draw and give the applications of the following lines used in engineering field:

(i) Continuous thin line with zigzag.

(ii) Thin free hand continuous line.

(iii) Continuous thick line.

Description of Diagrams:

Continuous thin line with zigzag: A thin line with regular zigzag patterns.

Thin free hand continuous line: A thin, wavy line drawn freehand.

Continuous thick line: A bold, solid line.

(i) Continuous thin line with zigzag: Used to indicate a break in an object (e.g., a long pipe) to save space in drawings.

(ii) Thin free hand continuous line: Used for irregular boundaries or approximate shapes in sketches.

(iii) Continuous thick line: Used for visible outlines or edges of an object in technical drawings.

(b) Explain the use of the following essential items in electrical draughting:

(i) Grid paper

(ii) Pencil

(iii) Tee square

(iv) Drawing board

(i) Grid paper: Provides a scaled grid for precise measurements and alignment of electrical symbols and lines.

(ii) Pencil: Allows for accurate, erasable sketching of diagrams and annotations.

(iii) Tee square: Ensures straight horizontal lines and aligns paper for consistent drafting.

(iv) Drawing board: Provides a flat, stable surface to secure paper and support precise drafting.

6. (a) A 100 V with a resistance of 250 Ω is used to illuminate girls' dormitory. The lamp is working for 24 hours a day. Determine:

(i) The current taken by the lamp.

$I = V / R = 100\ V / 250\ \Omega = 0.4\ A$

Answer: Current = 0.4 A

(ii) The related power of the lamp.

$P = V \times I = 100\ V \times 0.4\ A = 40\ W$

Answer: Power = 40 W

(iii) The daily electrical energy consumed.

$Energy = P \times t = 40\ W \times 24\ h = 960\ Wh = 0.96\ kWh$

Answer: Daily energy = 0.96 kWh

(b) Differentiate between electrical quantities in (a)(ii) and (a)(iii).

Power (a)(ii) is the rate of energy consumption (Watts), while energy (a)(iii) is the total energy consumed over time (Watt-hours or kWh).

Answer: Power: Rate of energy use (W); Energy: Total energy consumed over time (kWh).

7. (a) Explain the principles used in the operation of the following instruments:

(i) Moving iron instruments

(ii) Moving coil instruments

(i) Moving iron instruments: Operate on the principle of magnetic attraction or repulsion between a fixed and a movable iron piece, caused by current in a coil, deflecting a pointer proportional to the current or voltage.

(ii) Moving coil instruments: Operate on the principle of a current-carrying coil in a magnetic field experiencing a torque, causing the coil and attached pointer to deflect proportional to the current.

(b) Examine six advantages of permanent magnet moving coil instruments.

(i) High accuracy due to linear deflection.

(ii) High sensitivity for small currents.

(iii) Low power consumption.

(iv) Uniform scale for consistent readings.

(v) Reliable due to simple, robust design.

(vi) Insensitive to external magnetic fields due to strong permanent magnet.

8. (a) Analyze three relationships between magnetic effect and electric current.

(i) Current produces a magnetic field (e.g., around a conductor, as in electromagnets).

(ii) A changing magnetic field induces an electric current (electromagnetic induction, as in generators).

(iii) A current-carrying conductor in a magnetic field experiences a force (motor effect, as in electric motors).

(b) You are provided with two coils P and Q which are mutually coupled. The mutual inductance between two coils is 0.24 H and the current in the primary winding increases from 0.2 A to 0.6 A in 10 msec. If the secondary coil Q is wound with 400 turns; determine:

(i) The average value of e.m.f in the secondary winding.

$EMF = M \times (\Delta I / \Delta t)$

$\Delta I = 0.6\ A - 0.2\ A = 0.4\ A$

$\Delta t = 10\ ms = 0.01\ s$

$EMF = 0.24\ H \times (0.4\ A / 0.01\ s) = 0.24 \times 40 = 9.6\ V$

Answer: Average EMF = 9.6 V

(ii) Change in flux.

$EMF = N \times (\Delta \Phi / \Delta t)$

$9.6\ V = 400 \times (\Delta \Phi / 0.01\ s)$

$\Delta \Phi = (9.6 \times 0.01) / 400 = 0.00024\ Wb$

Answer: Change in flux = 0.00024 Wb

9. Suppose you are required to do wiring and you are provided with electrical drawings. Identify the following symbols found in electrical drawings provided and give the purpose of each symbol.

(i) Light bulb symbol (circle with cross): Represents a lighting fixture; indicates where a lamp is installed.

(ii) Switch symbol (line with break): Represents a switch; controls the circuit's on/off state.

(iii) Socket symbol (semi-circle with lines): Represents a power outlet; provides a connection point for appliances.

(iv) Wire symbol (solid line): Represents an electrical conductor; shows current path.

(v) Earth symbol (lines of decreasing length): Represents grounding; ensures safety by diverting fault currents.

SECTION C (15 Marks)

Answer all questions from this section.

10. Construct the views drawing of the object in full size from the given views. All dimensions were in mm, construction lines were not to be erased, and all drawings were to be neatly shown.

