

**THE NATIONAL REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
CERTIFICATE OF SECONDARY EDUCATION EXAMINATIONS**

082

**ELECTRICAL ENGINEERING SCIENCE
(For Both school and Private Candidates)**

Time: 3 Hours

Friday, 03rd November 2017 p.m.

Instructions

1. This paper consists of sections A, B and C with a total of **sixteen (16)** questions.
2. Answer **all** question in sections A and B and **three (3)** questions from section C.
3. Non programmable calculators may be used.
4. Cellular phones and any unauthorized materials are **not** allowed in the examination room.
5. Write your **Examination Number** on every page of your answer booklet(s).
6. Whenever necessary use the following constants.

Permittivity of free space, $\mu_o = 4\pi \times 10^{-7} \left(\frac{H}{m} \right)$.

Resistivity of copper may be taken as $0.0173 \mu\Omega \cdot \text{mm}$.

Specific heat capacity of water = $4.20 \text{ kJ/kg}^\circ\text{K}$.

Temperature coefficient of copper is $0.004 \Omega \text{ per } ^\circ\text{C}$.



SECTION A (10 Marks)

Answer **all** questions in this section.

1. For each of items (i) – (x), choose the correct answer from among the given alternatives and write its letter beside the item number in the answer booklet provided.
- (i) Which one of the following is the other name for an alternating current generators?
A Silent pole generators B Shaded pole generators C Dynamometers
D Alternators E Dynamos.
- (ii) What is the term used to represent the difference between the synchronous speed and the actual speed of the rotor of a.c motor?
A Frequency B Slip C Motor speed
D Maximum speed E Angular speed
- (iii) The unit used to measure flux density is
A weber B kg/m^3 C weber/m
D tesla E weber/m^3 .
- (iv) Which of the following is the effect of electrical current?
A Electrical effect. B Mechanical effects. C Heating effect.
D Potential effect. E Current effect.
- (v) The main particles of an atom are
A Molecules, protons and electrons. B Protons, neutrons and electrons.
C Neutrons, electrons and molecules. D Electrons, molecules and charges.
E Charges, protons and neutrons.
- (vi) Which of the following electrical machines operates in most similar way to the principle of operation of a 3 phase induction motor?
A Synchronous motor B Repulsion start induction motor
C Transformer with a shorter secondary D Capacitor start induction run motor
E Series motor.
- (vii) The basic devices found in every electrical measuring instruments are
A integrating, recording and operating B controlling, damping and integrating
C operating, controlling and damping D operating, indicating and recording
E damping, recording and integrating.
- (viii) Which statement is the most correct among the following?
A The quantity of heat depends on mass only.
B The quantity of heat depends on mass, nature of material only.
C The quantity of heat depends on temperature, nature of material and mass.
D The quantity of heat depends on temperature only.
E The quantity of heat depends on its dielectric material.

- (ix) Which one of the following is the correct definition of a "neutral point" in relation to magnetic effect?
- A A place where there is no resultant magnetic field.
 - B A place where there is a resultant magnetic field.
 - C A place where the production of magnetic field is traced.
 - D A place where the magnetic field is constant.
 - E A place where the magnetic field cuts the flux.
- (x) The necessary condition for resonance to occur in an a.c circuit is
- A inductive reactance to be equal to capacitive reactance
 - B inductive reactance to be less than one
 - C capacitive reactance to be greater than inductive reactance
 - D supply frequency to be equal to capacitive reactance
 - E capacitance to be equal to inductance.

SECTION B (30 Marks)

Answer **all** questions in this section.

2. (a) State Ohm's law.
(b) What voltage should be applied across $2200\ \Omega$ resistor in order for a current of 10 mA to flow through it?
3. Briefly describe three methods of transferring heat from a body.
4. Define the following terms:
 - (a) Electromagnetic induction
 - (b) Reluctance
 - (c) Coefficient of coupling.
5. Briefly explain how you can extend the range of:
 - (a) an ammeter
 - (b) a voltmeter.
6. Briefly describe two common faults in leclanche cells.
7. A coil has a resistance of $18\ \Omega$ when its mean temperature is 20°C and $20\ \Omega$ when its mean temperature is 50°C . Find its temperature coefficient at 0°C .
8. (a) State the Lambert's cosine law of illuminations.
(b) A lamp giving a 95.5 candela in all directions is suspended 8 m above the working plane. Calculate the illumination directly under the lamp on the working plane.
9. Draw the circuit for a single phase half-wave rectifier.

10. Define the following terms as used in a.c current:
- (a) Frequency
 - (b) Amplitude
 - (c) Root mean square.
11. A three phase system supplies a line current of 72.16 A and line voltage of 250 V when it is delta connected. Calculate:
- (a) phase current
 - (b) phase voltage.

SECTION C (60 Marks)

Answer **three (3)** questions from this section.

12. Two similar coils have a coupling coefficient of 0.25 when they are connected in series with total inductance of 80 H. Calculate:
- (a) self inductance
 - (b) mutual inductance
 - (c) the total inductance when the coils are connected in series opposing.
13. (a) An ammeter has a full scale deflection of 15 mA and a resistance of 50 Ω . The instrument is to be converted to a voltmeter with a full scale deflection of 240 V. Calculate;
- (i) the value of multiplier required.
 - (ii) the total resistance of the voltmeter.
- (b) If a moving coil instrument has a full scale current of 20 mA and coil resistance of 10 Ω ; Calculate the value of shunt resistor to enable the instrument to measure up to 1 A.
14. (a) Define the following terms as applied in electrical conductors:
- (i) Electrical potential
 - (ii) Potential difference
 - (iii) One volt
 - (iv) Electric current.
- (b) Twelve cells each of e.m.f 1.5 volts and internal resistance of 0.2 Ω are arranged four in series per row, three rows in parallel. When the external resistance is 4 Ω , calculate;
- (i) circuit total resistance.
 - (ii) the circuit current.
 - (iii) the terminal potential difference.
 - (iv) power dissipated in external resistance.

15. (a) What is the effect of heat on pure metal or conductor?
- (b) (i) Mention four factors which determine the resistance of pure conductors.
(ii) Briefly describe the relationship between each factor and its resistance.
- (c) The resistance of copper wire coil at 0°C is $100\ \Omega$. Calculate:
(i) the resistance of the coil at 30°C .
(ii) the resistance of coil if temperature rises from 30°C to 50°C .
16. A two conductor distributor AB, 1400 meters long is fed at end A at 220 V. The loads are as follows; 60 A at 200 meters, 40 A at 700 meters and 80 A at 1000 meters from the feeding end point. The resistance of cable is $1.1\ \Omega/1000$ meters. With the aid of a simple sketch diagram, calculate:
(a) the total current fed in distributor.
(b) the current in each section of the cable.
(c) the total resistance in each section of the cable.