THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

082 **ELECTRICAL ENGINEERING SCIENCE**
(For Both School and Private Candidates)

Time: 3 Hours **Monday, 12th October 2012 p.m.**

Instructions

1. This paper consists of sections A, B and C.
2. Answer **all** the questions in sections A and B and **three (3)** questions from section C.
3. Calculators are **not** allowed in the examination room.
4. Cellular phones are **not** allowed in the examination room.
5. Write your **Examination Number** on every page of your answer booklet(s).

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SECTION A (10 Marks)

Answer **all** questions in this section.

1. For each of items (i) – (x) choose the most correct answer from among the given alternatives and write its letter beside the item number.

(i) Candela is the unit of
A light flux B luminous intensity C illumination
D luminous efficiency E luminous flux.

(ii) The atom which consists of one proton in the nucleus with an electron revolving around it is called
A hydrogen B berrylium C helium D lithium E oxygen.

(iii) The quality of a capacitor can be expressed in terms of
A power dissipation B cost C capacitance value
D material used E size.

(iv) The heat energy required to change 1 kg of a substance from a liquid to a gaseous state at the same temperature is called
A specific heat capacity B heat capacity of freezing C heat of the body
D specific latent heat of fusion E specific latent heat of vaporization.

(v) Transformer cores are laminated in order to
A reduce cost B reduce hysteresis loss C minimize eddy current loss
D increase voltage E simplify its construction.

(vi) The universal measuring instrument is the one which is used to measure
A only a.c quantities B both a.c and d.c quantities
C only d.c quantities D bigger and smaller electric quantities
E high and low power quantities.

(vii) The strands of a cable are mostly bunched together in order to
A reduce the heat generated in the cable B increase the diameter of the cable
C reduce the cross sectional area of the cable D increase the flexibility of the cable
E reduce the I^2R which normally occurred in the cable.

(viii) A rectifying component is said to be a half wave rectifier, if
A it produces pulsating waves B it contains one diode in the circuit connected
C it produces waves without ripples D it increases the flexibility of the cable
E it contains two diodes in the circuit connected.

(ix) Sulphation in a lead-acid battery occurs due to
A tricle charging B incomplete charging C constant charging
D fast charging E heavy discharging current.

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(x) Transfer of heat by conduction means heat is transmitted through

A solid material B liquid C heated particles
D air molecules E gaseous material.

SECTION B (30 Marks)

Answer **all** questions in this section.

2. A twin core copper cable has a resistance of 2.2 Ω per core, what is the length of a cable if the diameter of a cable is 1mm and resistivity of copper is 1.73×10^{-8} Ω-m.

3. (a) Define the cathode ray oscilloscope.
   (b) What is the importance of the electron gun in the oscilloscope?
   (c) Mention the importance of using oscilloscope in the electronic system.

4. (a) State Lens's law of electromagnetism.
   (b) A coil of 500 turns is limited by a flux of 0.4 mWb. If the flux is reversed in 0.01 second. Find the e.m.f induced in the coil.

5. When an electric heater of 50 watts is used to heat a metal block of mass 50 kg in 10 minutes, a temperature rise of 12^0C is produced.
   (a) How much heat energy is produced by the heater in 10 minutes?
   (b) Calculate the specific heat capacity of metal.

6. Calculate the brightness (or illuminance) of snow under illumination of (i) 44,000 lux (ii) 0.22 lux. Assume that snow behaves like a perfect diffuser having a reflection factor of 85%.

7. What do you understand by the following terms as used in a.c circuit?
   (a) Root mean square value
   (b) Frequency
   (c) Cycle

8. (a) Why is the modification of a simple primary cell done?
   (b) List down two materials used as positive and negative electrodes for a Leclanch'e cell (battery) and name the instrument used to measure specific gravity of the battery.

9. (a) How is conductor size indicated?
   (b) Mention four common materials used for cable insulation.

10. A four pole, lap connected d.c generator has 600 armature conductors and runs at 1200 r.p.m. If the flux per pole is 0.06 Wb;
   (a) calculate the e.m.f induced.
   (b) find the speed at which it should be driven to produce the same e.m.f when wave connected.

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11. In a common base configuration current amplification factor is 0.92. If the emitter current is 1.2 mA , determine the value of the base current.

SECTION C (60 Marks)

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

12. (a) With the help of a simple diagram, explain how an ammeter and voltmeter instruments are connected to the load circuit. **(02 marks)**

(b) A moving coil instrument has a resistance of 10 Ω and gives a full scale deflection when carrying a current of 50 mA. Find the resistance to be connected in shunt as an ammeter to measure current up to 100 A and in series to measure voltage up to 700 V. **(11 marks)**

(c) The input power to a three-phase motor was measured by two wattmeter method. The readings were 5.2 kW and -1.7 kW and the line voltage was 400 V. Calculate
(i) the total power
(ii) the power factor
(iii) the line current
(07 marks)

13. (a) (i) Differentiate between auto-transformer and double wound transformer basing on their constructions.
(ii) State laws which are adopted by transformer to accomplish its working principle and then explain how transformer works. **(08 marks)**

(b) A 120 kVA, 6000/400V, 3-phase 50 Hz transformer has iron loss of 1600 W. The maximum efficiency occurs at 3/4 full load. Find the efficiency of the transformer at
(i) full load and 0.8 power factor
(ii) half load and unity power factor
(iii) maximum efficiency
(12 marks)

14. (a) A three phase induction motor has four wound poles, and supplied from 50 Hz system. Calculate the
(i) synchronous speed
(ii) rotor speed when slip is 4%
(iii) rotor frequency when the motor runs at 660 r.p.m. **(06 marks)**

(b) A 415 V, 3-phase, 50 Hz induction motor having an output of 74.6 kW runs on full load at a power factor 0.7 lagging and with an efficiency of 85 percent. Find the capacitance per phase of mesh connected capacitor necessary to raise the power factor to
(i) a unit
(ii) 0.9 lagging
(14 marks)

15. (a) (i) Define Q-factor of a resonance series circuit.
(ii) An alternating quantity may have any shape of waveform such as sinusoidal, rectangular or saw tooth. Explain four advantages of alternating voltages and current which have sinusoidal waveforms. **(05 marks)**

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(b) A 20 Ω resistor is connected in series with an inductor, a capacitor and an ammeter across a 25V variable frequency supply. When the frequency is 400 Hz, the current is at its maximum value of 0.5 A and the potential difference across the capacitor is 150 V. Calculate the

(i) capacitance of the capacitor.

(ii) resistance and inductance of the inductor. **(07 marks)**

(c) An R-L-C series circuit consist of a resistance of 1000 Ω, an inductance of 100 mH and capacitance of 10 μF. If a voltage of 100 V is applied across the combination, find

(i) the resonance frequency

(ii) Q-factor of the circuit

(iii) the half power point. **(08 marks)**

16. (a) (i) State Kirchhoff's laws.

(ii) Use Kirchhoff's law; calculate the current in each branch of the circuit shown in Figure 1. **(09 marks)**

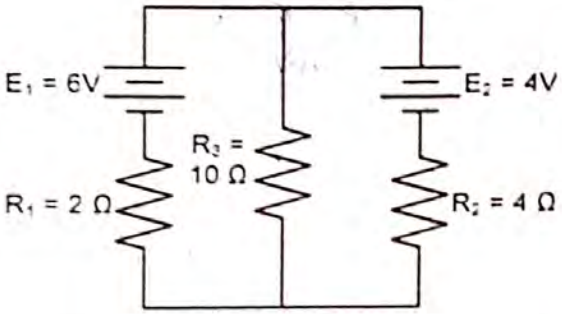


Figure 1

(b) Three similar primary coils are connected in series to form a closed circuit as shown in Figure 2. Each coil has an e.m.f of 1.5 V and an internal resistance of 30 Ω. Calculate the currents and show that points A, B and C are at the same potential. **(05 marks)**

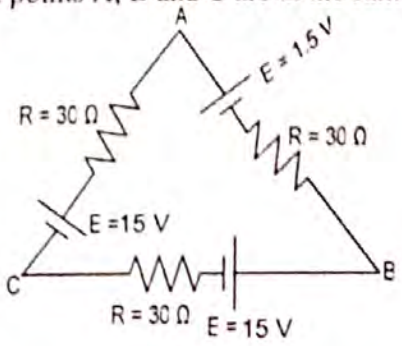


Figure 2

(c) Study Figure 3 and then calculate total resistance and total current of the circuit. **(06 marks)**

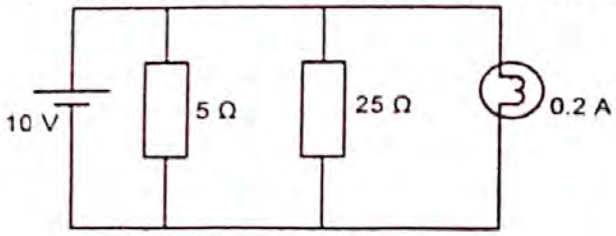


Figure 3

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