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 **Friday, 06th November 2015 p.m.**

Instructions

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

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

   Resistivity of copper may be taken as 0.0173 μΩ.mm.

   Specific heat capacity of water is 4.2 kJ/kg°K.

   Temperature coefficient of copper is 0.004 Ω per °C.

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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) The reactance offered by a capacitor to alternating current of frequency 50 Hz is 10 Ω. If frequency is increased to 100 Hz, reactance becomes

A 20 Ω B 5 Ω C 25 Ω D 40 Ω E 15 Ω.

(ii) Which of the following material has a negative temperature coefficient of resistance?

A Brass. B Tungsten. C Aluminum.
D Carbon. E Gold.

(iii) The ratio of ampere - hour efficiency to watt-hour efficiency of lead acid cell is always

A less than one B just one C greater than one
D undefined E extremely high.

(iv) Which type of focusing is used by a CRO?

A Electromagnetic. B Electrostatic. C Deflection.
D Electrodynamic. E Thermostatic.

(v) What is the basic requirement of a d.c armature winding?

A It must be a closed one. B It must be a lap winding.
C It must be a single layer winding. D It must be a wave winding.
E It must be back pitched winding.

(vi) D.C potentiometer is an instrument which measure

A unknown e.m.f B large voltage C large power
D direct resistance E variable reluctance

(vii) Conductors are stranded in order to

A make cable more rigid B make cable more flexible
C increase the diameter D reduce losses
E reduce weight.

(viii) The efficiency of a nickel iron cell is less compared to lead acid cell, due to its

A lower e.m.f B higher e.m.f
C higher internal resistance D higher temperature of electrolyte used
E smaller quantity of electrolyte used.

(ix) Which one of the following statement is TRUE for both series and parallel d.c circuits?

A Power are additive. B Voltages are additive.
C Current are additive. D Elements have individual currents.
E Voltage and current are additive.

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(x) The term luminance is defined as
A the amount of light in lumens falling on unit area (squire meter).
B the capacity of radiated energy to produce light
C the property of a body producing a magnetic field when carrying current
D the transportation of electric charges along a path or around a circuit
E the causes of mechanical displacement or motion.

SECTION B (30 Marks)

Answer **all** questions in this section.

2. (a) What is the transformer?
   (b) Briefly explain the working principle of a transformer.

3. (a) What is the meaning of the term ''Mutual inductance'' as used in electrical technology?
   (b) Two coils, A and B have self-inductances of 120 μH and 300 μH respectively. If a current of 1A flowing through coil A produces flux linkages of 100 μWb turns in coil B. Calculate mutual inductance between the two coils.

4. (a) State three factors which influences the force on current carrying conductor.
   (b) A sample of copper has a resistance of 10 Ω at a temperature of 0°C. What will be its resistance at 50°C?

5. A moving coil instrument gives a full scale deflection when the current is 40 mA and its resistance is 25 Ω. Calculate the value of the shunt to be connected in parallel with the meter to enable it to be used as an ammeter for measuring currents up to 50 A.

6. An electric motor draws 18 A of current from a 240 V source. A wattmeter connected to the circuit indicates 3024 W. What is the power factor of the circuit?

7. Estimate the total luminous flux required to provide a services value of 120 lux in a room of 5 m by 7 m. Utilization factor and light loss factors are 0.6 and 0.8 respectively.

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

9. Mention three conditions to be fulfilled when connecting the transformers in parallel.

10. (a) List two losses that occur in induction motors.
    (b) A 3-phase induction motor running at a slip of 0.05 per unit has an input power to its rotor of 10 kW. Calculate the power dissipated in the rotor.

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11. (a) Define the term ''breakdown voltage of a material''.

(b) A cloud is at a potential of 8×10^6 V relative to the ground. A charge of 40 C is transferred in lightning stroke between the cloud and the ground. Calculate the energy dissipated.

SECTION C (60 Marks)

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

12. (a) Describe four conditions under which a self-excited d.c generator can fail to build up voltage. **(08 marks)**

(b) A long shunt compound generator delivers a load current of 60 A at 450 V and has armature series field and shunt field resistances of 0.06 Ω, 0.04 Ω and 240 Ω respectively. Calculate the generated voltage and the armature current. Allow 0.5V per brush for contact drop. **(12 marks)**

13. (a) Give six properties of a good heating element. **(06 marks)**

(b) A ply-wood board of 0.5 x 0.25 x 0.02 meter is to be heated from 25°C to 125°C in 10 minutes by dielectric heating employing a frequency of 30 MHz. Determine the power required in this heating process. Assume specific heat of wood is 1500 J/kg/°C, weight of wood 600 kg/m^3 and efficiency of process is 50%. **(08 marks)**

(c) The output of diesel engine was found to be 4.9 kW and a dynamometer used to check the output contained 30 kg of water. How much did the temperature of water rise during a 30 minutes running period? Neglect losses. **(04 marks)**

14. (a) Define the following terms as used in illumination: **(04 marks)**
(i) Coefficient of utilization.
(ii) Maintenance factor.
(iii) Coefficient of reflection.
(iv) Depreciation factor.

(b) A room 25 m long by 6 m wide is to be lighted to a level of 20 lux, while the average lumen of lamps is 25 lm/W, maintenance factor of 0.8 and coefficient of utilization 0.5. Calculate
(i) Total lumen.
(ii) Total power.
(iii) Number of lamps, if power rate of one lamp is 30 W. **(06 marks)**

(c) It is required to provide an illumination on 100 lux in a factory hall 30 m by 15 m. Assume that the depreciation factor is 0.8, coefficient of utilization is 0.4 and efficiency is 141 lm/W; suggests the number of lamps and their ratings. The size of lamps available is 100 W, 250 W, 400 W and 500 W. **(10 marks)**

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15. (a) (i) Define the term "rectification" as applied in electrical circuits.
(ii) Draw the circuit diagram of a full wave rectifier using a center tape transformer.
(iii) Draw the input and output wave form of the rectifier in 15 (a) (ii) for one period. **(10 marks)**

(b) (i) Give two advantages of half wave rectifier.
(ii) A half wave rectifier is connected in series with a load of 16 Ω to a.c supply of 25 volts r.m.s value. The rectifier has a constant resistance of 2 Ω in the forward direction while the reverse current is zero. Calculate the average and peak values of the currents in the load. **(10 marks)**

16. (a) Mention three disadvantages of the electric system to be operated at a low power factor and hence enumerate three methods in which this case can be improved or minimized. **(06 marks)**

(b) Three equal star-connected inductors take 8 kW at a power factor of 0.8 when connected across a 460 V, 3 phase wire supply. Calculate the
(i) line current
(ii) phase voltage
(iii) impedance per phase
(iv) resistance per phase
(v) inductance reactance per phase. **(14 marks)**

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