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

082 **ELECTRICAL ENGINEERING SCIENCE**
(For Private Candidates Only)

Time: 3 Hours **Friday, 28th November 2014 a.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. Non programmable calculators may be used.
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 correct answer from among the given alternatives and write its letter beside the item number in the answer booklet provided.

(i) The magnitude of the induced e.m.f in a conductor depends on the
A amount of the flux cut
B amount of the flux linkage
C rate of change of flux linkage
D magnetic field strength
E flux density of the magnetic field.

(ii) The SI unit of illuminance is
A lumen B cd/m^2 C $lumen/m^2$ D candela E lumen/watt.

(iii) If 0.0006 microfarad is converted to pico farads, the result will be
A $0.0006x10^{-6}pF$ B $0.0006x10^{-13}pF$ C $0.0006x10^{-12}pF$
D $0.0006x10^{-9}pF$ E $0.0006x10^{6}pF$.

(iv) Which is the lightest atom particle when compared to others?
A electrons B nucleus C molecule D protons E neutrons.

(v) What will happen if an ammeter is used as a voltmeter?
A It will indicate higher reading
B It will indicate no reading
C It will indicate medium reading
D It will burn out
E It will give extremely low reading.

(vi) The frequency of rotor current in a 6-pole, 50 Hz, 3-phase induction motor running at 950 r.p.m. is
A 2.5 Hz B 1.5 Hz C 5 Hz D 0.05 Hz E 95 Hz.

(vii) Digital instruments are those which
A have numerical readout
B use LED or LCD displays
C have a circuitry of digital design
D contain electronic device
E use deflection type meter movement.

(viii) The deflection sensitivity of a cathode ray tube depends inversely on the
A deflecting voltage
B length of the vertical deflection plates
C separation between Y-plates
D distance between screen and deflecting plates
E separation between X-plates.

(ix) Which of the following frequencies has got longest period?
A 1 Hz B 10 Hz C 1 kHz D 10 kHz E 100 kHz.

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(x) The voltage of the electric system connected in delta is given by

A $\sqrt{V_L} = 3\,V_{PH}$ B $V_L = V_{PH}$ C $V_P = \sqrt{V_L}$

D $V_L = \sqrt{3}\,V_{PH}$ E $V_P = 3\,V_L$.

SECTION B (30 Marks)

Answer **all** questions in this section.

2. The equation for an alternating current is given by $i = 28.28\,\text{Sin}\,(314t + 30^0)$A. Find its r.m.s value and frequency.

3. Figure 1 shows an electric circuit in which some of the quantities are represented by numbers, others by letters. Calculate the value of X and R.

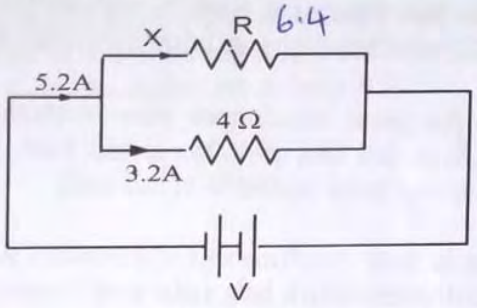


Figure 1

4. An eight pole lap connected armature has 96 slots with 6 conductors per slot and is driven at 25/3 rev/sec. The useful flux per pole is 0.09 Wb. Calculate the generated e.m.f.

5. Find the heat energy required to raise the temperature of 0.068 m^3 of water from 18^0C to 80^0C. The mass of 1 m^3 of water is 10^3 kg and the specific heat capacity of water is 4187J per kg^0C.

6. An electronic beam has a velocity of 10^7 m/s when enters a magnetic field perpendicular to the direction of the flux. If the axial length of the magnetic field is 2 cm. Calculate the
   (a) radius of the curvature of the electron path in the magnetic field.
   (b) angle through which the electron is deflected. Assume $e/m = 1.76 \times 10^{11}$ C/kg.

7. Mention six methods of identifying conductors.

8. Briefly, explain three advantages of three phase system over a single phase system.

9. (a) What modifications would be necessary if a motor is required to operate on voltage which is different from that originally designed?
   (b) A motor stops after starting i.e. it fails to carry load. Give four possible causes of the problem.

10. Give three practical applications of chemical effect of electric current.

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11. (a) Define the term inverter as used in power supply.
(b) The main components which are really required for conversion from a.c to d.c is a transformer and a rectifier. Briefly explain the function of each in power supply.

SECTION C (60 Marks)

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

12. (a) (i) Why are transformers used in electrical transmission and distribution system?
(ii) A step down transformer has a turn's ratio of 6:1. The input to the transformer is 3 kW at 3 kV; calculate the value of the secondary current. Neglect losses. **(06 marks)**

(b) A 600 kVA, single phase transformer when working at unity power factor has an efficiency of 92 % at full load and also at half load. Determine its efficiency when it operates at unity power factor and 60 % of full load. **(14 marks)**

13. (a) Mention and explain three classifications of secondary instruments. In each case give one example of the instrument which falls under that category. **(06 marks)**

(b) A moving coil instrument has a resistance of 5 Ω between terminals and full scale deflection is obtained with a current of 0.015 A. The instrument is to be used with a manganim shunt to measure 100 A full scale. Calculate the error caused by a 20 ^{0}C rise in temperature when
(i) the internal resistance is 5Ω due to copper only.
(ii) a 4 Ω manganim swamping resistor is used in series with a copper resistor of 1Ω.
Given $\alpha_{copper} = 0.4\%$ per ^{0}C and $\alpha_{manganim} = 0.015\%$ per ^{0}C **(14 marks)**

14. (a) Differentiate line voltage from phase voltage. **(02 marks)**

(b) A 15 kW, 440V three phase a.c. motor has an efficiency of 80% and a power factor of 0.6 when delivering its rated output. Calculate the
(i) output power in (kW)
(ii) phase current and phase voltage, if the windings are in star and delta connection. **(09 marks)**

(c) A 400 V (line to line) is applied to three phase star-connected identical impedances each consisted of 4 Ω resistances in series with 3 Ω inductive reactance. Find the
(i) line current and
(ii) total power supplied. **(09 marks)**

15. (a) (i) State major application for current Kirchhoff's law.
(ii) Explain six precautions to be taken in the maintenance of a lead acid battery. **(07 marks)**

(b) Two cells L and M are connected in parallel to a battery charger. The open circuit voltages of the two cells are 12 V and 12.5 V respectively and their respective internal resistances are 0.06Ω and 0.05Ω. If the battery charger has the open – circuit voltage of

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15 V and an internal resistance of 0.15Ω, calculate the initial charging currents of batteries L and M. **(13 marks)**

16. (a) (i) State two laws mostly applied in the calculations of the illumination values.
(ii) Why the inert gases, like argon and neon filled in the fluorescent tubes or bulbs? **(03 marks)**

(b) (i) What do you understand by the term 'stroboscopic effect' as applied in the lighting system?
(ii) Enumerate three factors which used to reduce the stroboscopic effect at the fluorescent lamps.
(iii) What is the main function of a photo meter as far as the lighting system is concerned? **(05 marks)**

(c) A hall 15 m by 20 m is to be illuminated to a level of 70 lux, luminaire having an efficiency of 12 lm/W and spacing height ratio 1.2 is to be suspended 4m above the floor. Estimate the number of luminous required and the power of each luminaire. Assume a utilization factor 0.5 and the maintenance factor 0.8. **(12 marks)**

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