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

081

# ELECTRICAL INSTALLATION
(For Both School and Private Candidates)

*Time: 3 Hours* *Tuesday, 11th October 2011 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).
6. Whenever necessary use the following constants:
   - Resistivity of copper is 0.017 μΩ-m.
   - Resistivity of aluminium is 0.028 μΩ-m.
   - Specific heat capacity of water is 4190 J/kg°C.
   - Temperature coefficient of copper is 0.0039 per °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.

(i) If the excitation to the field of the d.c motor is constant, then the torque developed in the motor is proportional to
A armature current B field current C rotor speed
D magnetic flux E induced e.m.f.

(ii) A.C power is transmitted at high voltage in order to
A safeguard against losses B minimize transmission losses
C increase tensile strength D reduce cost of power generation
E make the system more reliable.

(iii) What is the current rate and the cable size of a domestic ring circuit?
A 120 A and 1.5 $mm^2$ B 30 A and 2.5 $mm^2$ C 15 A and 2.5 $mm^2$
D 20 A and 2.5 $mm^2$ E 5 A and 1.5 $mm^2$

(iv) PVC cannot be used in conditions where temperature exceeds
A 98°C B 60°C C 20°C D 45°C E 25°C

(v) The best instrument for the measurement of e.m.f of a cell is
A potentiometer B ammeter C voltmeter D ohmmeter E galvanometer

(vi) A circuit is protected by a fuse of rating 5 A. If it has a fusing factor of 1.45, what is the minimum fusing current?
A 3.45 A B 6.25 A C 7.25 A D 10.0 A E 100.0 A

(vii) Which of the following is the most likely source of harmonics in transformer?
A Poor insulation B Over load C Core saturation
D Loose connection E Mechanical stress.

(viii) The objective of carrying out a polarity test is to verify that
A lamp holders and switches are correctly earthed
B final circuits are correctly fused and earthed
C the circuit is continuous through the installation
D protective gears are connected to the neutral conductor
E a single pole switches are connected in the live conductor.

(ix) Which of the following shows the correct sequence of power connection to a consumer?
A Supply authority, meter, consumer unit, and cut out
B Supply authority, circuit breaker, meter and cut out
C Supply authority, cut out, meter, and consumer unit
D Supply authority, meter, cut out, and consumer unit
E Supply authority, consumer unit, cut out and meter.

(x) When 10 mA passes through a human body, it will cause
A mild sensation B muscle effects C rise in heart beats
D rise in body temperature E death.

## SECTION B (30 Marks)

Answer **all** questions in this section.

2. Explain three factors which determine the seriousness of electric shock. **(03 marks)**

3. Explain three reasons which make conduit wiring system be mostly recommended in electrical installation works. **(03 marks)**

4. A 4-pole wave connected generator has a useful flux of 0.02 Wb. If the induced e.m.f is 288 V at 1200 r.p.m. **(02 marks)**
(i) Find the number of conductors in the armature. **(01 mark)**
(ii) If each slot contains 10 conductors, find the number of slots in the armature.

5. A three-phase transformer is used to step down the supply voltage from 10,000 V to 433 V. The output of the transformer is 150 kVA. Find the secondary and primary currents of the transformer. **(03 marks)**

6. Explain three disadvantage of oil circuit breaker. **(03 marks)**

7. Suggest three precautions required to be taken to avoid electric shock to a worker. **(03 marks)**

8. A twin copper cable 100 m long has a resistance of 0.1 Ω. Calculate the minimum cross-sectional area of the required conductor. **(03 marks)**

9. Briefly explain the function of the transformer, filter and voltage regulator in a d.c power supply. **(03 marks)**

10. A resistance R is connected in series with a parallel circuit comprising 20 Ω and 48 Ω. The equivalent resistance of the circuit is 62.5 Ω. Calculate value of R. **(03 marks)**

11. Classify d.c motor according to the connections made to the field system. **(03 marks)**

## SECTION C (60 Marks)

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

12. (a) Three phase systems are more economical over single phase systems. Give four reasons to support this statement. **(04 marks)**

(b) Discuss four factors which make power plants prefer to have several smaller generators running in parallel rather than having large single unit. **(08 marks)**

(c) A shunt d.c machine connected to 250V supply has an armature resistance of 0.12 Ω and field resistance of 100 Ω. Find the ratio of the speed of the machine as a generator to the speed as a motor, the line current in each case being 80A. **(08 marks)**

13. (a) Explain methods of heat transfer from a hot to a cold body. **(06 marks)**

(b) Draw a sketch of a non pressure (free outlet) type water heater and label clearly its parts. **(08 marks)**

(c) A 4 kW immersion heater is fitted to a tank containing 223.5 litres of water. If the initial temperature of water was 27°C, how long it would take to heat the water and reach a temperature of 87°C? Assume no heat loss and an efficiency of 82 %. Take 1 kWh to be $3.6 \times 10^6$ Joules and a litre of water to weigh 1kg. **(06 marks)**

14. (a) Which types of switches will you need to control lights from three different doors? Explain their function. **(04 marks)**

(b) A bed room has got one lamp which is controlled by two switches. Make a neat circuit diagrams when the lamp is switched on and when it is off. **(04 marks)**

(c) Two metal filament lamps with intensities 150 cd and 300 cd respectively are fixed 10 m apart on a level bench. A double sided matt white screen is placed on the line between the lamps so that both sides of the screen are equally illuminated. Calculate the
(i) distance between the screen and the larger lamp; **(08 marks)**
(ii) illuminance on each side of the screen if it were positioned half way between the lamps. **(04 marks)**

15. (a) (i) Differentiate between fixed and running charges in the operation of a power company. **(02 marks)**
(ii) Give two expenses which are considered as fixed costs and two as running costs in the operation of a power company. **(02 marks)**

(b) A 100 MW power station delivers 100 MW for 2 hours, 50 MW for 6 hours and is shut down for the rest of each day. It is also shut down for maintenance for 45 days each year. Calculate its annual load factor. **(04 marks)**

(c) A 415 V 3-phase, 50Hz induction motor having an output of 74.6 kW runs on full load at a power factor of 0.7 lagging and with an efficiency of 85%. Find the capacitance per phase of a mesh-connected capacitor necessary to raise the power factor to unity. **(12 marks)**

16. (a) (i) Differentiate absolute instruments from secondary instruments. **(02 marks)**
(ii) A moving coil milliammeter has a resistance of 5 Ω and a full scale deflection of 20 mA. Determine the resistance of a shunt to be used so that the instrument could measure currents up to 500 mA at 20°C. What is the percentage error in the instrument operating at a temperature of 40°C? **(08 marks)**

(b) The steady readings of single-phase watt-meter in a 3-phase circuit are 35 kW and 14 kW respectively. Calculate the power factor; power consumed by the load in kVA and line current if the supply is at 415 V. **(10 marks)**