

**ELC – Electrical Technology  
and Automation**

**T031**

**Wednesday, 06/11/2013**

**8:30 – 11:30 AM**

**WORKFORCE DEVELOPMENT AUTHORITY**



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**ADVANCED LEVEL NATIONAL EXAMINATIONS, 2013;  
TECHNICAL AND PROFESSIONAL TRADES**

**EXAM TITLE: Electrical Technology and Automation**

**OPTION: Electricity - ELC -**

**DURATION: 3hours**

**INSTRUCTIONS:**

The paper contains **Three (3)** Sections:

Section **I**: Fourteen (**14**) questions, all **Compulsory**. **55marks**

Section **II**: Five (**5**) questions, **Choose any Three (3)**. **30marks**

Section **III**: Three (**3**) questions, **Choose any one (1)**. **15marks**

**Section I. All the 14 questions are compulsory. 55marks**

**01.** Fill in the blank space. Write in full the answer with the questionnaire included. **5marks**

- a. 1bar = .....KPa
- b. 1psi = .....KPa
- c. 1kgf/cm<sup>2</sup> = .....KPa
- d. 1atm = .....bar
- e. 1atm = .....kgf/cm<sup>2</sup>

**02.** Fill in the blank space. Write in full the answer with the questionnaire included. **7marks**

- a. 1joule = .....Kwh
- b. 1joule = .....ft lbf
- c. 1joule = .....calories
- d. 1joule = .....BTu
- e. 1joule = .....ergs
- f. 1joule = .....Nm
- g. 1joule = .....m<sup>2</sup>kgs<sup>-2</sup>

**03.** What are the requirements (qualities) of a pole? **4marks**

**04.** What is the relationship between electricity and magnetism? **2marks**

**05.** What is the SI unit of pressure? What is its equivalent? **2marks**

**06.** Two lamps A and B of 200 candela and 400 candela respectively are situated 100 m apart. The height of A above the ground level is 10 m and that of B is 20 m. If a photometer is placed at the centre of the line joining the two lamp posts, calculate its reading. **5marks**

**07.** Differentiate "Direct lighting" from "Indirect lighting". **2marks**

**08.** Name the essential parts of a DC generator, and the role of each of them. **7marks**

**09.** An 8-pole d.c. generator has 500 armature conductors, and a useful flux of 0.05 Wb per pole. What will be the e.m.f. generated if it is lap-connected and runs at 1200 rpm? What must be the speed at which it is to be driven to produce the same e.m.f. if it is wave-wound? **3marks**

10. Give the essential components of a pneumatic system. **6marks**
11. How do pneumatic actuators differ from hydraulic actuators? **3marks**
12. Explain briefly the pumping principal. **3marks**
13. A flow with a velocity of 0.5m/s follows through a pipeline with a nominal width of 8mm. The kinematic viscosity amounts to  $100 \text{ mm}^2/\text{s}$  at 150C. The density of the liquid is 850Kg/m<sup>3</sup>. Calculate the pressure loss for 10m length. **3marks**
14. A steel piston rod of 50mm of diameter has two ends firmly clamped. It has 120mm of the length and safety factor is 2.5. Calculate: **3marks**
- The area moment
  - The free buckling length
  - The permissible buckling force

**Section II. Choose and answer any Three (3) questions. 30marks**

15. What are the properties of a good insulator? **10marks**
16. Using a sketch describe the method for laying the cable. What are the properties of a buried cable? **10marks**
17. A 4-pole, 3-phase induction motor operates from a supply whose frequency is 50Hz. Calculate:
- The speed at which the magnetic field of the stator is rotating. **4marks**
  - The speed of the rotor when the slip is 0.04. **2marks**
  - The frequency of the rotor currents when the slip is 0.03. **2marks**
  - The frequency of the rotor currents at standstill. **2marks**
18. a) Name three types of hydraulic motors. **3marks**
- b) A hydraulic motor has a displacement of 10 in<sup>3</sup>, and operates with a pressure of 1000 psi and a speed of 2000 rpm. If the actual flow rate consumed by the motor is 95 gpm and the actual torque delivered by the motor is 1500 in lb, find:
- Volumetric efficiency
  - Mechanical efficiency
  - Overall efficiency
  - The actual horsepower delivered by the motor. **7marks**
19. a) Convert the following into decimal:  $(1001.0101)_2$  **3marks**
- b) Starting with the Boolean expression for a two-input OR gate, apply Boolean laws and theorems to modify it in such a way as to facilitate the implementation of a two-input OR gate by using two-input NAND gates only. **7marks**

**Section III. Choose and answer any One (1) question. 15marks**

- 20.** A hydro-electric station is supplied from a catchment area of 150square km with an annual rainfall of 150cm and effective head of 300m. Assume a yield factor of 50<sup>0</sup>/<sub>0</sub>, overall efficiency of 80<sup>0</sup>/<sub>0</sub> and a load factor of 40<sup>0</sup>/<sub>0</sub>, calculate the available continuous power and the rating of the generator installed. **15marks**
- 21. a)** Make a comparison between a series and a shunt motors. **4marks**
- b)** A 500 V d.c. shunt motor takes a current of 5 A on no-load. The resistances of the armature and field circuit are 0.22 ohm and 250 ohm respectively. Find:
- i)** The efficiency when loaded and taking a current of 100 A; **9marks**
- ii)** The percentage change of speed. **2marks**
- 22.** Draw a hydraulic diagram circuit with the following components:
- a hydraulic power supply with a filling level indicator.
- a.** a pressure line filter.
- b.** a pressure relief valve 50 bar.
- c.** a 4/3 way valve mid-position By-pass (P→A→B,T) actuated electrically in both directions.
- d.** a flow control speed in forward motion of double acting cylinder.
- e.** a double acting cylinder used to move a load of 1000Kg. **15marks**