ELC - Automation

T003

Friday, 30/11/2018

08:30 – 11:30 AM

WORKFORCE DEVELOPMENT AUTHORITY

P.O. BOX 2707 Kigali, Rwanda Tel: (+250) 255113365

ADVANCED LEVEL NATIONAL EXAMINATIONS, 2018, TECHNICAL AND PROFESSIONAL STUDIES

EXAM TITLE: AUTOMATION

OPTION: Electricity (ELC)

DURATION: 3 hours

INSTRUCTIONS:

The paper is composed of **the following sections**:

Section I: Fourteen (14) compulsory questions. **55 marks**

Section II: Attempt **any three (3)** out of five questions. **30 marks**

Section III: Attempt **any one (1)** out of three questions. **15 marks**

The use of geometric material and scientific calculator is accepted

Note:

Every candidate is required to carefully comply with the above instructions. Penalty measures will be applied on their strict consideration

Section I. Fourteen (14) Compulsory questions — 55 marks

01. Give the meaning of the following terms by:

a) Hydraulic system,

b) Sequence valve. **(4 marks)**

02. State the Gay-Lussac's Law. **(3 marks)**

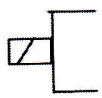
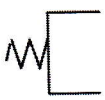
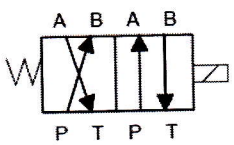
03. Make a summation of the following binary numbers:

0011.1010 and 0110.1000 **(3 marks)**

04. A cylinder is supplied with 80 bar pressure; its effective piston area is equal to 500 mm^2.

Find the maximum force which can be attained. **(3 marks)**

05. Give the names of the valves symbol shown below. **(4 marks)**

S/n	Valve actuation symbol	Name
1		Pressure Compensation
2		Push button
3		Spring
4		4/2 manuall operated

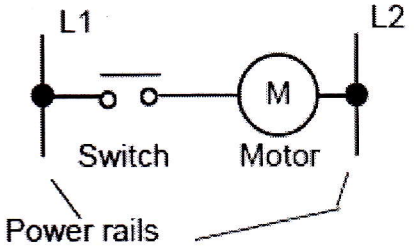
06. A single-vane rotary actuator has the following physical data:

Outer radius of rotor = 0.5 cm; Outer radius of vane = 1.5 cm

Width of vane = 1 cm

If the torque load is 1000 Ncm, what pressure must be developed to overcome the load? **(4 marks)**

07. Draw a wiring diagram circuit for switching on or off an electric motor using push buttons represented by a ladder diagram as shown below:



Ladder diagram

(4 marks)

08. State the role of flow control valve in Hydraulic system and then specify the types of speed control of a Hydraulic Cylinder. **(5 marks)**

09. Determine the force needed to apply to a piston of 2Cm radius to result a force of 4000N at the working piston of radius 4cm. Calculate also the hydraulic pressure. **(5 marks)**

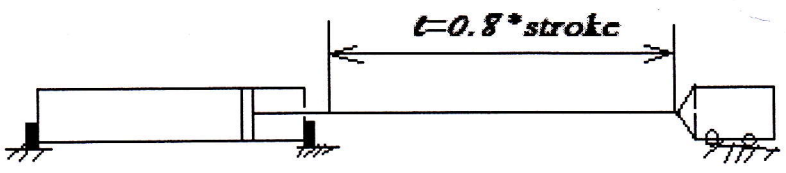
10. Prove that the expressions X= $A\overline{B}C+AB\overline{C}+ABC$ and X= $AB + AC$ are equivalent. **(4 marks)**

11. Explain why flammable cleaning solvents should not be used on pneumatic components. **(4 marks)**

12. Give the definition of a relay. **(3 marks)**

13. List at at least five (5) basic elements used in Electro pneumatic circuits. **(5 marks)**

14. What will be the maximum stroke of a cylinder with rod of 16mm diameter as shown in the figure below:



(4 marks)

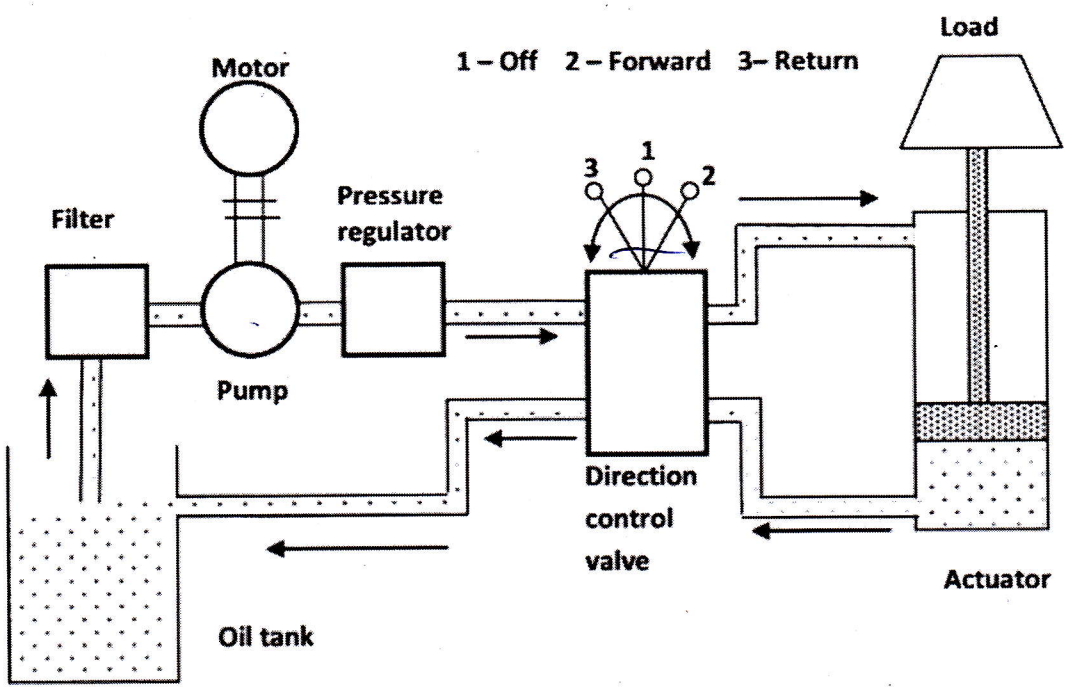
15. What are the Classifications of Hydropower Plants? **(10 marks)**

16. List the steps to troubleshooting a pneumatic system. **(10 marks)**

17. A double-acting cylinder is hooked up in the regenerative circuit of figure below. The cracking pressure for the relief valve is 1000psi. The piston area is $25in^2$ and the rod area is $7in^2$. The pump flow is 20gallons per minute.

Find, in metric system, the cylinder speed, the load-carrying capacity, and power delivered to the load (assuming the load equals the cylinder load-carrying capacity) during the: (a) extending stroke, and (b) retracting stroke. **(10 marks)**

18. State the functions of the hydraulic components shown in the following figure: **(10 marks)**



19. Sketch a block diagram showing how the following components should be fixed practically in a pneumatic circuit: an intake air filter-a compressor-a primer mover –a cooler –a separator – a receiver –a pressure switch –a secondary air treatment- a control valve –an actuator. **(10 marks)**

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

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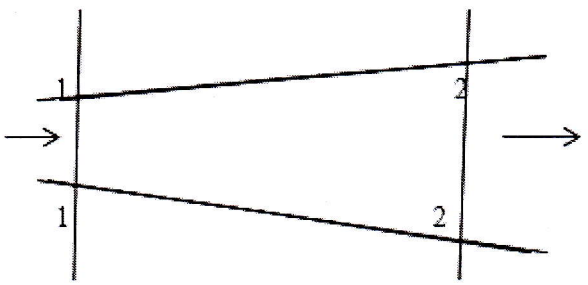
20. Explain the representation mode of a Sequential Flow Chart or Grafcet and give an example of this representation. **(15 marks)**

21. A. Oil (specific gravity Sg = 0.9, kinematic viscosity vc =75 centistokes) flows at a flow rate of 30gpm through a 0.75 inches diameter commercial steel pipe. What is the equivalent length, in metric system of 0.75 inches-wide open gate valve placed in the line? The constant factor K for a gate valve, wide open is equal to 0.19.

(10 marks)

B. The diameter of a pipe at the sections 1-1 and 2-2 are 100mm and 150mm respectively. If the velocity of the water flowing through the pipe at the 1-1 is 3.5 m/sec, find the discharge through the pipe and the velocity of water at section 2-2. **(5 marks)**



22. Construct a Series hydraulic motor circuit with bi-directional rotation, a hydraulic power supply unit. All hydraulic filters, a DC Valve 4/3 way center all ports opened, operated electro- hydraulically in directions, a high pressure gauge and a flow meter. **(15 marks)**