HATAHA

University of Jordan
Faculty of Engineering and Technology
Electrical Engineering Department
Measurements and Control Lab
Final Exam (40 marks)

40

Student Name (in arabic):
Student #:

Q1. Choose the correct answer of all the following questions.

1. The resistance between the earth electrodes must be:
   a. Less than 100 Ohms.
   b. Less than 1000 Ohms.
   c. Less than 10 Ohms
   d. Less than 60 Ohms.
   e. None of the above

2. Data Acquisition (DAQ) is for:
   a. Acquiring and measuring analogue or digital electrical signal from sensors,
   b. Acquisition transducers
   c. Test probes or fixtures or generating analogue or digital electrical signals
   d. All of the above
   e. None of the above

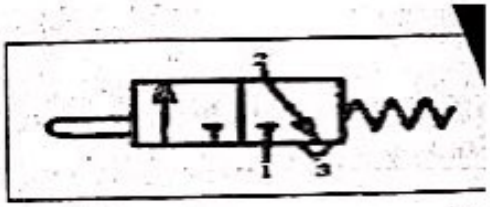
3. For small different temperature:
   a. The relation between voltage and temperature is linear
   b. The relation between voltage and temperature is nonlinear
   c. The voltage is zero
   d. The voltage could not be measured
   e. None of the above

4. A galvanometer is to be used as an Ammeter with Full scale deflection (FSD) 0-1 mA and internal resistance 75 ohms. To measure a 2mA current, the required parallel resistance is equal:
   a. 75 Ohms
   b. 37.5 Ohms
   c. 150 Ohms
   d. 100 Ohms
   e. None of the above

5. "the voltmeter is placed directly in parallel with the unknown resistor while in case II the ammeter is placed directly in series with the unknown resistor". It is a good method to measure:
   a. High values of resistances
   b. Low values of resistances
   c. Medium values of resistances
   d. All of the above
   e. None of the above

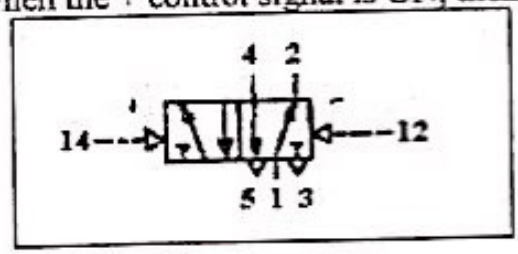
6. An advantage of using the operational amplifier applications as DC electronic milli-Voltmeter using a permanent magnet moving coil meter (PMMCM) is to minimize the error because of:
   a. The high input resistance and low output resistance of the op-amp
   b. The low input resistance and high output resistance of the op-amp
   c. The high input and output resistances of the op-amp
   d. The low input and output resistances of the op-amp
   e. None of the above

7. The following valve is:



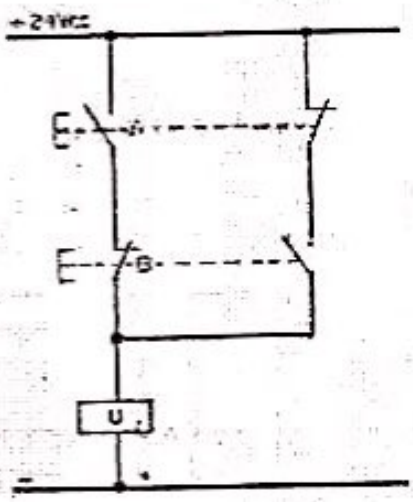
a. 3 2 directional roller valve with spring
b. 3 2 directional plunger valve with spring
c. 5 2 directional plunger valve
d. 5 2 directional plunger valve with spring
e. None of the above

8. For the following Bistable indirect controller valve, when the + control signal is ON, then:



a. The air flows from 1 to 2
b. The air flows from 1 to 4
c. The air flows from 4 to 5
d. a and c
e. None of the above

9. According to the following electrical diagram, when A=1 and B=1, then U is:

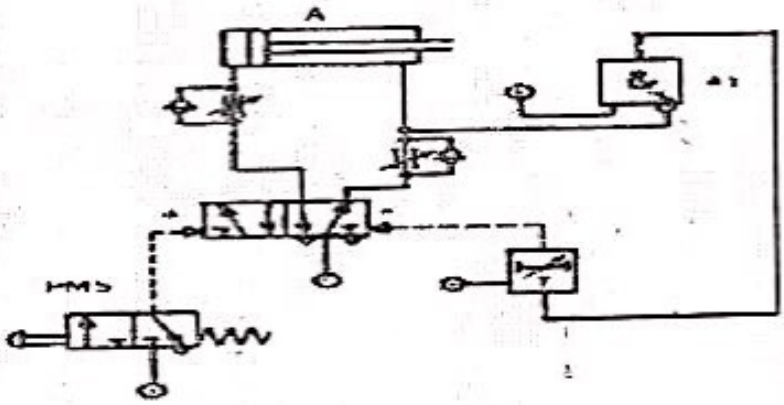


Electric diagram

a. 0
b. 1
c. 2
d. 3
e. None of the above

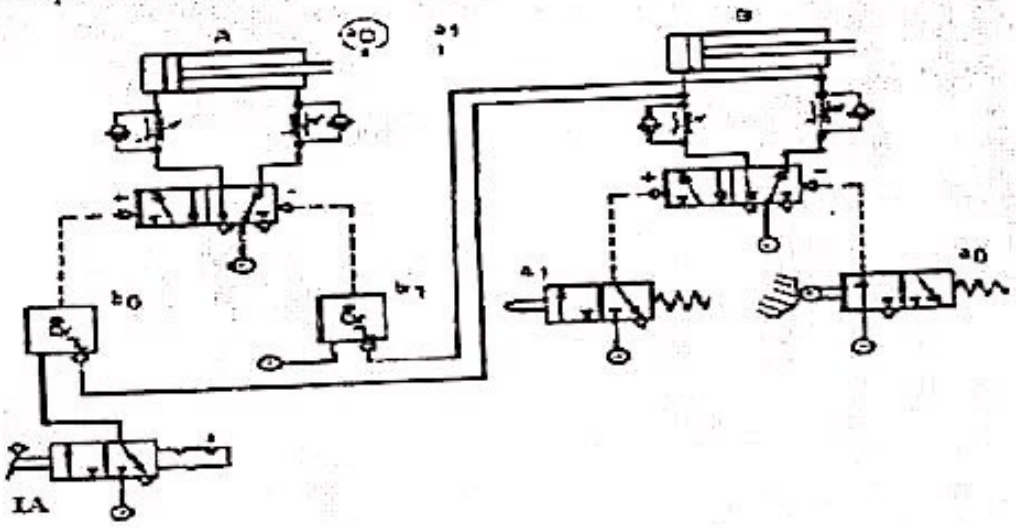
10. To build the electrical diagram of the relation $U = A\overline{B} + C$
a. Use NO contactor for A and C, and NC contactor for B
b. Use NC contactor for A and C, and NO contactor for B
c. Use NO contactor for A and B and C, but with latch for B
d. Use NO contactor for A and B and C, but with latch for A
e. None of the above

11. To get the sequence A+ , wait 10s then A-, the timer in the following system should be:



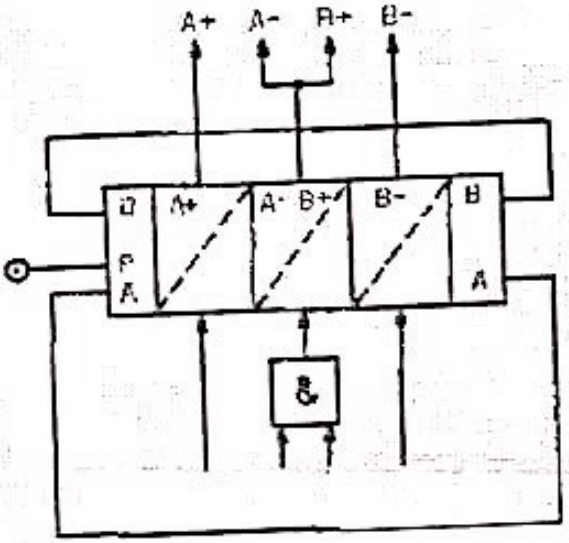
a. Pneumatically NO
b. Pneumatically NC
c. Eclectically NO
d. Electrically NC
e. None of the above

12. When push the IA in the following system, the sequence will be:



a. A+ → A- → B+ → B-
b. A+ → B+ → A- → B-
c. A+ → A- → B- → B+
d. A+ → B+→ A- & B-
e. None of the above

13. To get the required sequence in the following system, the control signals should be (from left to right):



a. b0, (a1, & b1), a1
b. b1, (a1, & b0), a0
c. a0, (a1 & b0), b1
d. a1, (a0 & b1), b0
e. None of the above

14. The equivalent gate of the following symbol is:

a. Yes
b. OR
c. AND
d. Comparator
e. None of the above

15. The red dot on the pneumatic devices represents:
a. Output terminal
b. Control signal terminal
c. Air source terminal
d. Exhaust termina'
e. None of the abo.

16. The TRMS is a nonlinear plant. To keep the identification simple the model can be treated as:
a. Two linear rotor models
b. Two linear couplings
c. One linear rotor model with one linear coupling in-between
d. Two linear rotor models with two linear couplings in-between
e. None of the above

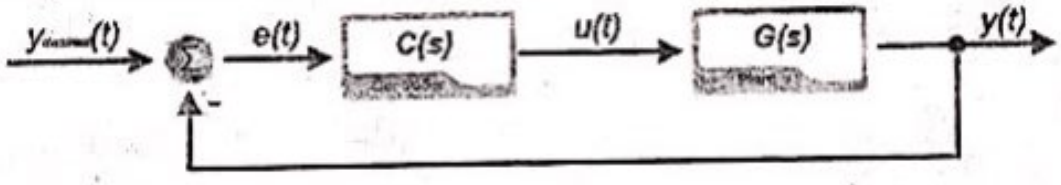
17. There are a few important things that the control system designer has to keep in mind when carrying out an identification experiment, which are:
a. The numerator and denominator order of the transfer function
b. The stability
c. The input signal
d. a and b
e. None of the above

18. The sampling time choice:
a. Is important both for identification and control.
b. Cannot be too short nor can it be too long
c. Is important for identification only and should be short
d. a and b
e. None of the above

19. the matlab function oe(3,4,1) is to identify the system transfer function of:
a. 3 poles and 4 zeros
b. 4 poles and 3 zeros
c. 2 poles and 4 zeros
d. 2 zeros and 4 poles
e. None of the above

20. The TRMS system consists of:
a. PC, A/D and D/A converters, sensors
b. A/D and D/A converters, sensors, the controlled process
c. PC, A/D and D/A converters, sensors, the controlled process
d. PC, A/D and D/A converters, sensors, equilibrium unit
e. None of the above

21. The closed loop TF of the following controlled system is:



a. $\frac{C(s)G(s)}{1-C(s)G(s)}$
b. $\frac{C(s)G(s)}{1+C(s)G(s)}$
c. $\frac{G(s)}{1-C(s)G(s)}$
d. $\frac{C(s)}{1+C(s)G(s)}$
e. None of these answers

ıe Laplace transformation of the PID controller is:

a. $\frac{s^2 + Is + D}{s}$

b. $\frac{Ds^2 + Is + P}{s}$

c. $\frac{Ds^2 + Ps + I}{s}$

d. $\frac{Ps^2 + Ds + I}{s}$

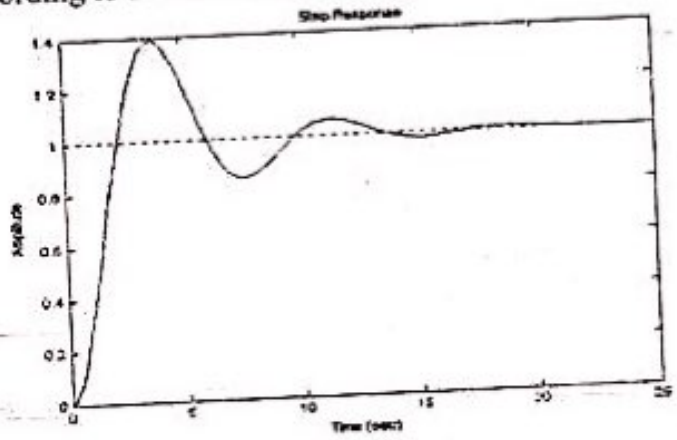
e. None of the above

23. The Integral part in the PID controller:
    a. Is very important and assures 0 error value in steady state
    b. Is to make the response faster
    c. Is responsible for the speed of the system reaction
    d. All of he above
    e. None of the above

24. The Derivative part in the PID controller:
    a. Is very important and assures 0 error value in steady state
    b. Is to make the response faster
    c. Is responsible for the speed of the system reaction
    d. All of he above
    e. None of the above

25. The Proportional part in the PID controller:
    a. Is very important and assures 0 error value in steady state
    b. Is to make the response faster
    c. Is responsible for the speed of the system reaction
    d. All of the above
    e. None of the above

26. The overshoot of a system according to its following step response is:



    a. 0.4%
    b. 4%
    c. 1.4%
    d. 28.6%
    e. None of the above

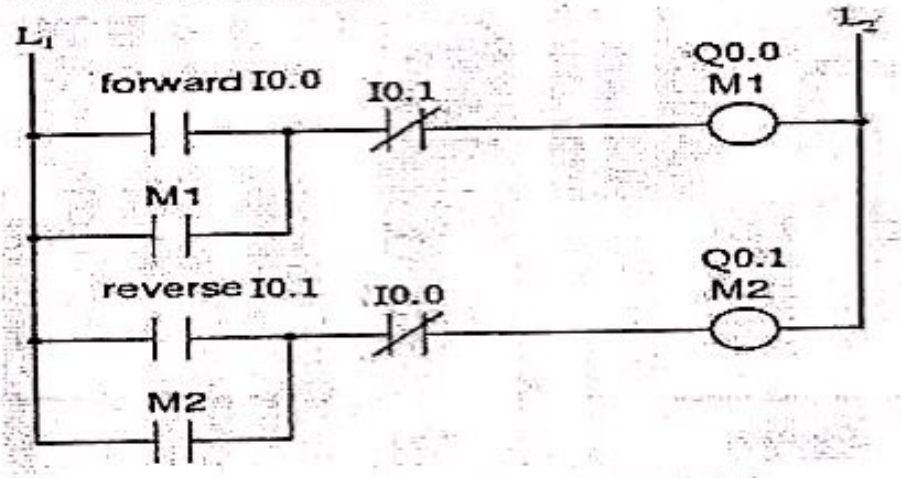
27. The possible value of ζ of the system in the previous question is:
    a. <1
    b. >1
    c. Between 0 and 1
    d. 1
    e. None of the above

28. It provides a voltage proportional to motor speed:
    a. Tachogenerator
    b. Brake disk
    c. Motor
    d. Power amplifier
    e. None of the above

29. The tachogenerator factor is:
    a. The change in speed for generated volts of 100 V
    b. The change in generated volts for a speed change of 1000 r/m
    c. The change in generated volts for a speed change of 100 r/m
    d. The change in speed for generated volts of 1 V
    e. None of the above

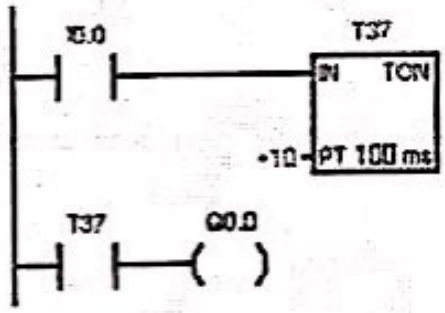
30. In control systems, dc motors are often used because:
    a. The speed are controlled by the magnitude of the applied voltage.
    b. The direction are controlled by the direction of the applied voltage
    c. The speed and direction are controlled by the magnitude and direction of the applied voltage
    d. All of the above
    e. None of the above

31. To switch the all network in the following figure:



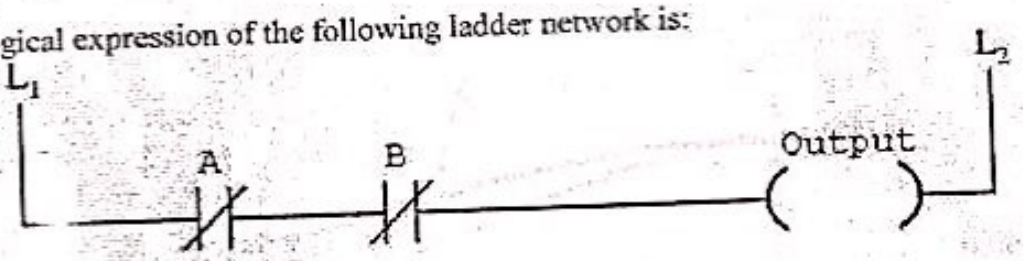
    a. Adding NC pushbutton contactor in parallel with the network
    b. Adding NO pushbutton contactor in parallel with the network
    c. Adding NC pushbutton contactor in series with the network
    d. Adding NO pushbutton contactor in series with the network
    e. None of the above

32. When push I0.0 for one time in the following network, then:



    a. Q0.0 will be ON after 100ms
    b. Q0.0 will be OFF after 100ms
    c. Q0.0 will be ON after 1s
    d. Q0.0 will be OFF after 1s
    e. None of the above

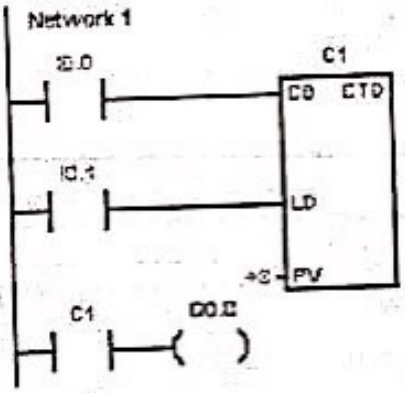
The logical expression of the following ladder network is:



a. $A+B$
b. $\overline{A}+\overline{B}$
c. AB
d. $\overline{AB}$
e. None of the above

34. One of the following is not acceptable as input with PLC:
    a. I1.2
    b. I0.9
    c. I0.0
    d. b and c
    e. None of the above

35. When push I0.0 three times, then push I0.1 once in the following network:



a. Q0.0 will turn ON
b. Q0.0 will turn OFF
c. Q0.0 still been ON
d. Q0.0 still been OFF
e. None of the above

Q2. Fill in the following blanks for the given statements:

1. In the Feedback Analogue Unit, the _____ is used to combine potentiometer signals to provide the error.
2. The machine that when rotated produces an emf proportional to speed which can be used as a measure of the rotation speed is _____.
3. To drive the DC motor, we use _____.
4. The _____ is an automatic electromechanical device that uses error-sensing feedback to correct the performance of a mechanism.
5. The type of the DC motor that was used in the laboratory is _____.
6. The system behavior when $0 \leq \zeta < 1$ is _____.

Q3. Figure 5 shows a plot that you got when you did the DC servo experiment.

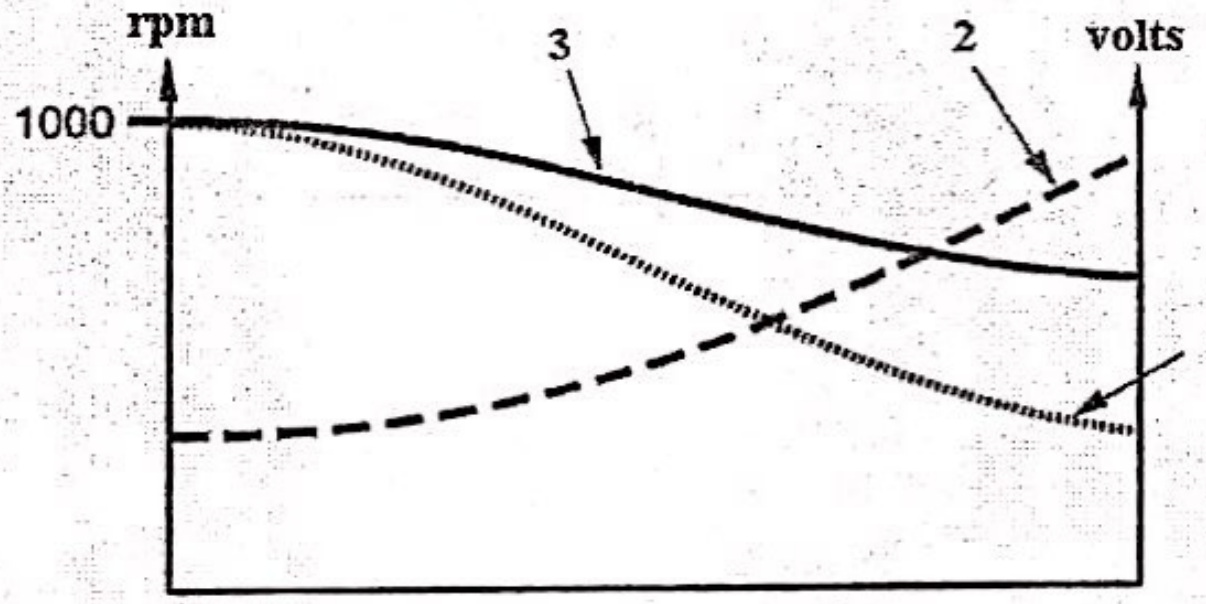
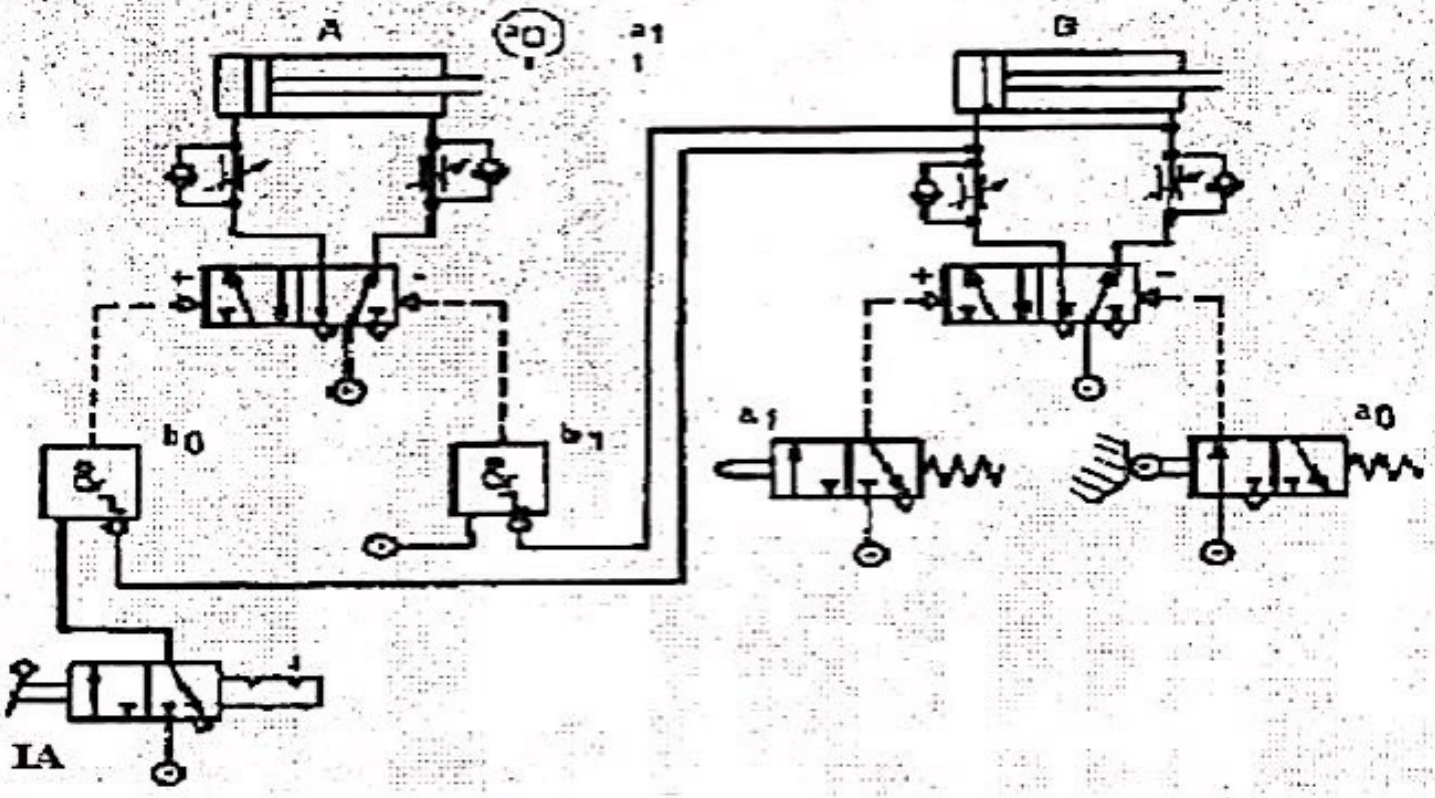


Figure 5.

1. The name of the system that you should connect in order to get the results shown in Figure 5 is:_____.
2. Curve 1 is: _____.
3. Curve 2 is: _____.
4. Curve 3 is: _____.

Q4. Draw a ladder diagram that does the following sequence:
When activating the pushbutton I0.0 five times, the output Q0.0 turns ON.
When activating the pushbutton I0.1, Q0.0 turns OFF, pushing I0.1 one more time Q0.0 turns ON again.

Draw the equivalent electrical diagram of the following system.

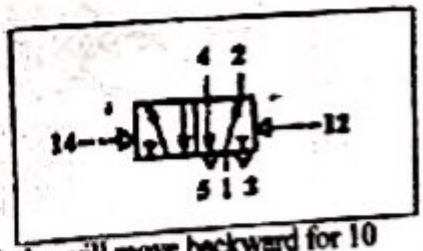


ame (in Arabic):_____

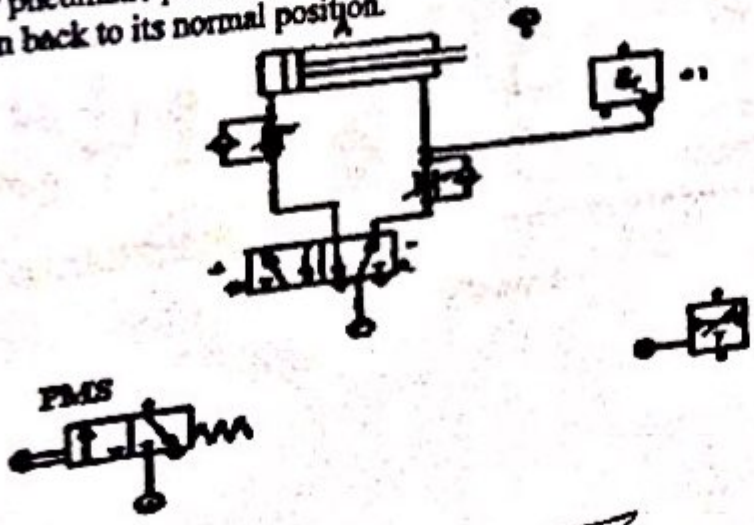
:_____

Q1. ***Fill in the following blanks for the given statement*** *(20 points)*

1. In the Feedback Analogue Unit, the _____ is used to combine potentiometer signals to provide the error.
2. The machine that when rotated produces an emf proportional to speed which can be used as a measure of the rotation speed is_____.
3. To drive the DC motor, we use _____.
4. The _____ is an automatic electromechanical device that uses error-sensing feedback to correct the performance of a mechanism.
5. The type of the DC motor that was used in the laboratory is _____.
6. In the tachogenerator, the change in the generated volts for a speed change of 1000 r/min is _____.
7. The system behavior when $0 \leq \zeta < 1$ is _____.
8. PLC brands (other than Siemens) are: 1-_____ 2-_____ 3-_____.
9. The range M0.0-M16.0 contains _____ internal relays.
10. In a Ladder Diagram, the horizontal rows called the _____, the vertical lines called _____.
11. For small different temperatures, the relation between voltage and temperature is.....
12. An advantage of using the operational amplifier applications as DC electronic milli-Voltmeter using a permanent magnet moving coil meter (PMMC) is to minimize the error because of the ..... input resistance and .....output resistance of the op-amp.
13. For the following Bistable indirect controller valve, when the + control signal is ON, then the air flows from ..... to .....



Q2. Connect the pneumatic parts shown in this figure so that the cylinder will move backward for 10 seconds then back to its normal position. *(4 points)*



Q3. Figure 3 shows the block diagram of a closed loop control circuit, which was part of the DC servo experiment: *(10 points)*

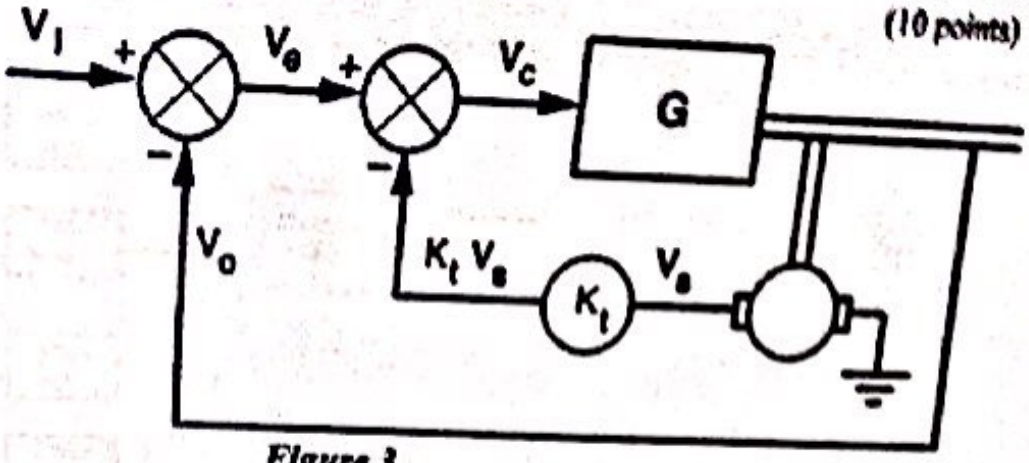


Figure 3.

1. The name of the system that can be obtained when you connect the control circuit shown in Figure. 3 is _____.

2. Connect the Analogue Unit shown in Figure 4 in order to have the same control system that is shown in Figure 3.

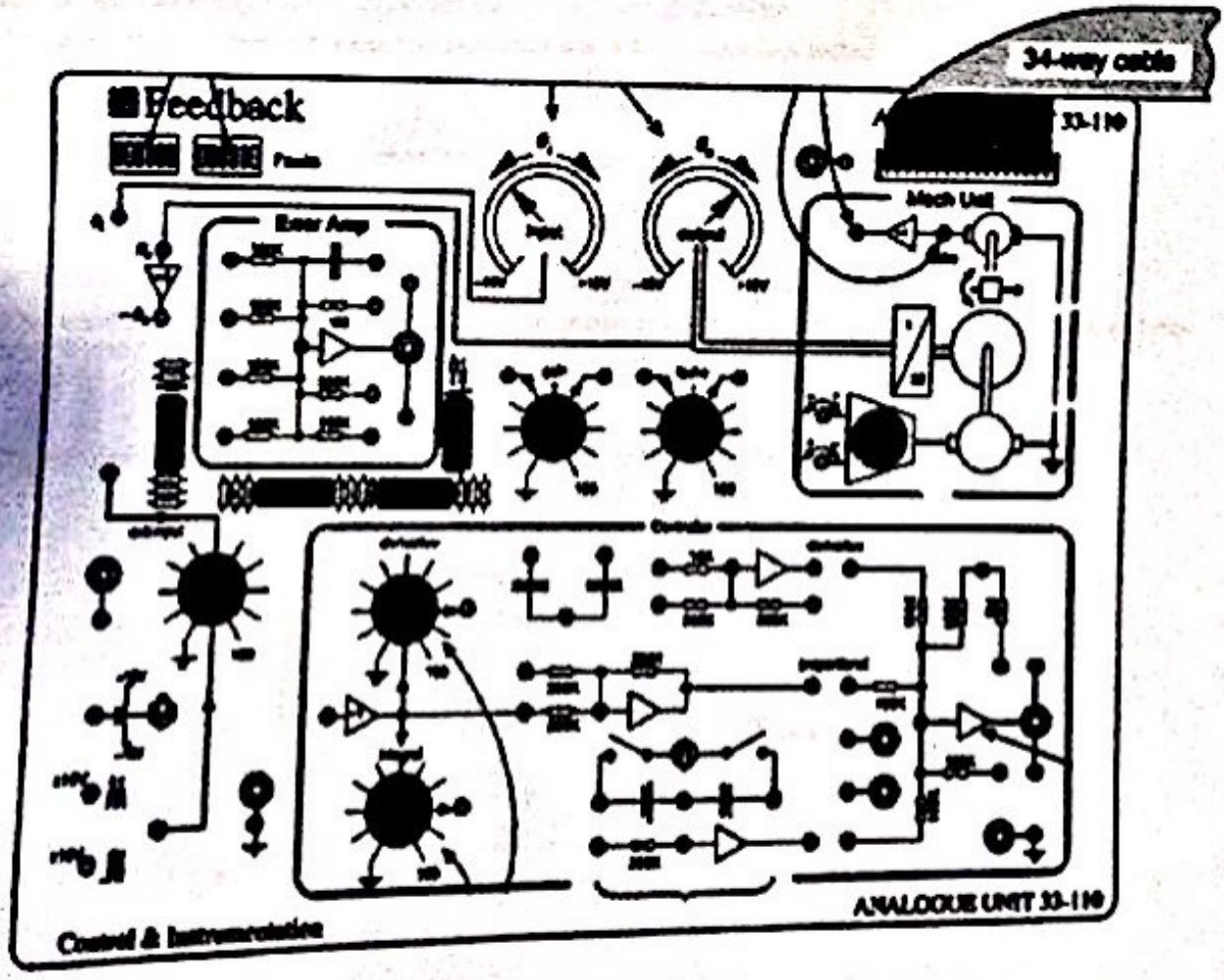
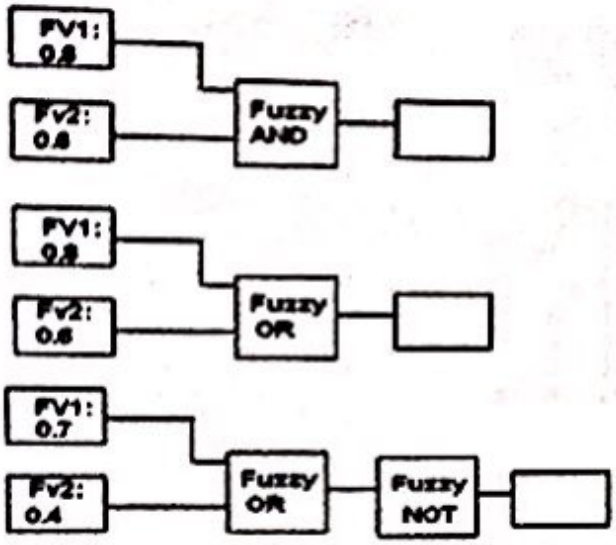


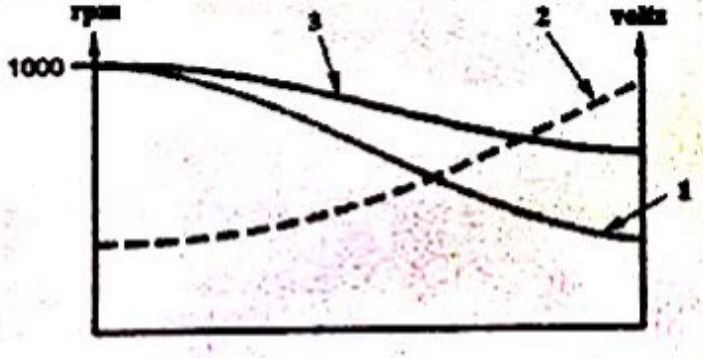
Figure 4.

Q4- Specify the output values for each of the following operations: **(16 points)**



1. *Fuzzy variables are converted back into real signals by:*
   a) Fuzzifier b) Fuzzy NOT c) Defuzzifier d) Classifier
2. *The process of converting a measured signal value to a fuzzy variable is called:*
   a) Fuzzification b) Fuzzy Rule
   c) Defuzzification d) Classification
3. *The membership function shape used in the fuzzy control experiment was:*
   a) Exponential b) Trapezoidal c) Triangular d) Cosine bell
4. *The process of assigning degrees of membership is called:*
   a) Fuzzification b) Fuzzy Rule c) Defuzzification d) Classification
5. *The membership function is a variable which tells us how true the fuzzy proposition associated with each fuzzy level is and it has a value between:*
   a) 0-1 b) 0-10 c) 1-10 d) 0-100

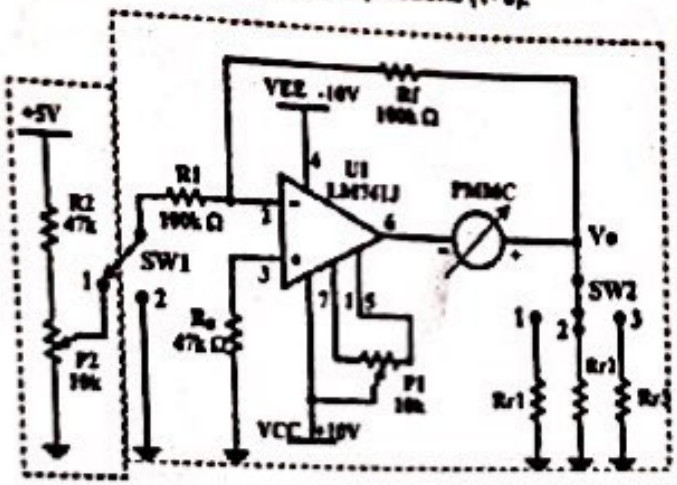
Q5. This figure shows a plot that you got when you did the DC servo experiment. (12 points)



The name of the system that you should connect in order to get the results shown in the figure is: _____.

1. **Curve 1 is:** _____.
2. **Curve 2 is:** _____.
3. **Curve 3 is:** _____.

26- The schematic diagram shown is for an electronic milli-Voltmeter which was used in Exp.2 Study the circuit carefully, then answer the questions (1- 6). (18 points)



Note: PMMC Specifications: I_{fsd} = 1mA, R_{coil} = 75Ω

1- Describe the function of the element(s) in the following table:

Element	Function
P2	Potentiometer (voltage devider)
SW1	
SW2	decade resistance boxes (for range)
R_s	
R1	input resistance and to have very high input impedance like voltmeter

2- What is the purpose of using OP amp to design DC milli- voltmeter?

because this op-amp is an excellent amplifier that result in medium gain (20-100) for signals in the mV range

3- What is the purpose of using potentiometer "P1" in the above schematic?

4- Calculate the value of Rr2 provided that the milli-voltmeter range is (0-1000) mV)?

6- What is the maximum voltage that can be read by the PMMC based on the above schematic?