CMR INSTITUTE OF TECHNOLOGY

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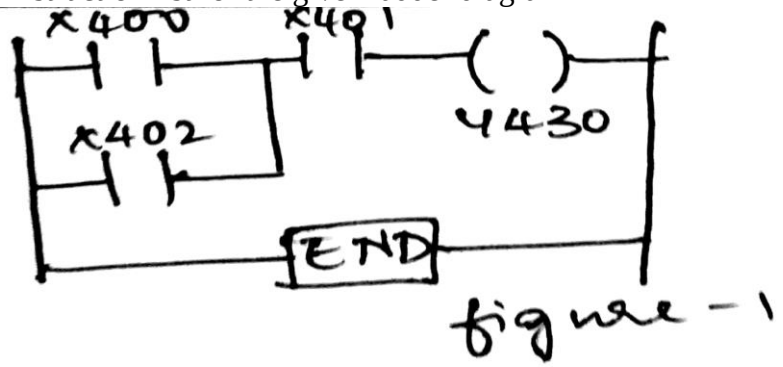
Internal Assesment Test - II

Sub:	Programmable Logic Conrtroller							Code:	15EE562
Date:	10/09/2018	Duration:	90 mins	Max Marks:	50	Sem:	5	Branch:	EEE

Answer Any FIVE FULL Questions

		Marks	OBE CO	OBE RBT
1	Define PLC. What are the advantages & disadvantages of PLC.	[10]	CO1	L1
2a.	Explain the operation of fixed type of PLC with a suitable neat diagram.	[6]	CO1	L5
2b.	Write a short note on RAM & ROM of a PLC	[4]	CO2	L1
3a	Write the instruction list for the given ladder diagram  figure - 1	[6]	CO2	L1
3b	Write a short note on sourcing and sinking of a PLC	[4]	CO2	L1
4	Draw the ladder diagram for the given expression i) $Q = (A \cdot B + C)\overline{D} \cdot E \cdot \overline{F}$ ii) $Y = AB + \overline{A}\,\overline{B}$	[10]	CO2	L3
5a	Differentiate between PLC and PC	[8]	CO1	L2
5b	Write a short explanation for each of the following analog I/O module specifications: a. Channels per module b. Input current/voltage range(s)	[2]		L1
6a	Write a ladder diagram to show how a system has to be no output when any one of four sensors gives an output and otherwise there is to be an output.	[4]	CO2	L3
6b	Briefly describe the different modes of operation of PLC.		CO1	L2
7a	Explain the memory organization of PLC	[6]	CO2	L5
7b	Write a short note on PLC size & PLC application	[6] [4]	CO1	L1

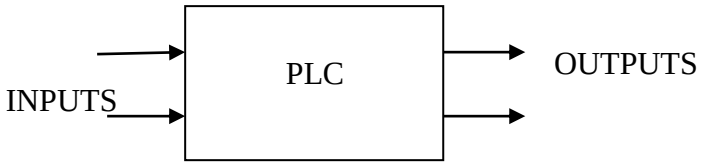
Course Outcomes		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Discuss history of PLC, its sequence of operation, advantages and disadvantages, main parts and their functions	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	Describe the hardware components of PLC: I/O modules, CPU, memory devices, other support devices, operating modes and PLC programming.	1	3	2	-	-	-	-	-	-	-	-	-	2	2	1
CO3	Describe field devices Relays, Contactors, Motor Starters, Switches, Sensors, Output Control Devices, Seal-In Circuits, and Latching Relays commonly used with I/O module.	1	-	3	2	-	-	-	-	-	-	-	-	2	2	1
CO4	Convert relay schematics and narrative descriptions into PLC ladder logic programs Analyze PLC timer and counter ladder logic programs. Describe the operation of different program control instructions	1	2	1	-	-	-	-	-	-	-	-	-	2	2	1
CO5	Describe the operation of mechanical sequencers, bit and word shift registers, processes and structure of control systems and communication between the processes	1	3	2	-	-	-	-	-	-	-	-	-	2	2	1
CO6	Discuss the execution of data transfer instructions, data compare instructions and the basic operation of PLC closed-loop control system	1	2	1	2	-	-	-	-	-	-	-	-	2	2	1

Cognitive level	KEYWORDS
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.

PO1 - *Engineering knowledge*; PO2 - *Problem analysis*; PO3 - *Design/development of solutions*; PO4 - *Conduct investigations of complex problems*; PO5 - *Modern tool usage*; PO6 - *The Engineer and society*; PO7- *Environment and sustainability*; PO8 – *Ethics*; PO9 - *Individual and team work*; PO10 - *Communication*; PO11 - *Project management and finance*; PO12 - *Life-long learning*

Solutions for IAT-1
Programmable Logic Conrtroller
Subject Code-15EE562

1. PLC is a special form of microprocessor which is used to store instructions, logic, counting & timing in order to control the process without the knowledge of computer.



ADVANTAGES:

- Small physical size & shorter project time.
- Cost effective for controlling complex system.
- Reliability.
- Less and simple wiring.
- Faster response.
- Remote control capability.
- More flexibility.
- Ease of maintenance / troubleshooting.

DISADVANTAGES:

- Fixed circuit operation.
- PLCs manufacturers offer only closed loop architecture.
- PLCs are propitiatory, which means software and parts one manufacturer can't be easily used in combination with part of another manufacturer.
- Number of optional modules must be added to maximize flexibility and performance.

2. Plc OPERATION –EXPLANATION
SCHEMATIC DIAGRAM

2 b. Read Only Memory (ROM)

- stores programs, and data cannot be changed after the memory chip has been manufactured.
- ROM is normally used to store the programs and data that defi ne the capabilities of the PLC. ROM memory is nonvolatile, meaning that its contents will not be lost if power is lost. ROM is used by the PLC for the operating system.
- The operating system is burned into ROM by the PLC manufacturer and controls the system software that the user uses to program the PLC.

Random Access Memory (RAM)

- Referred to as *read-write (R/W) memory*
- Information can be written into or read from the memory.
- RAM is used as a temporary storage area of data that may need to be quickly changed.
- RAM is volatile.
- A battery backup is required to avoid losing data in the event of a power loss
- Most PLCs use CMOSRAM technology for user memory.
- CMOS-RAM chips have very low current draw and can maintain memory.

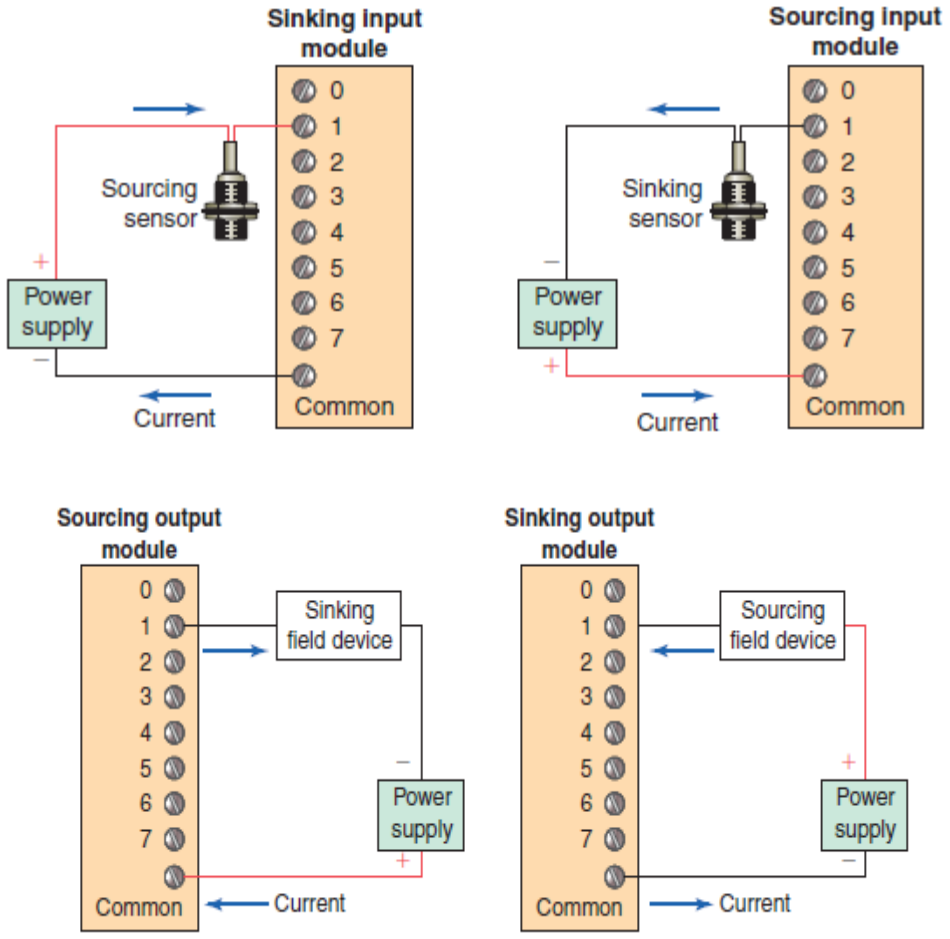
3a. Instruction List

```
start  x400
OR   X4302
AND X401
OUT  Y430
END
```

3B. Sourcing **& Sinking:**

Field devices connected to the positive (1) side of the field power supply are classified as sourcing field devices.

Field devices connected to the negative (2) side or DC common of the field power supply are sinking field devices.



5 b. **CHANNELS PER MODULE**

- individual circuits on discrete I/O modules are referred to as points,
- circuits on analog I/O modules are often referred to as channels.
- These modules normally have 4, 8, or 16 channels.
- Analog modules may allow for either single-ended or differential connections.
- *Single-ended* connections use a single ground terminal for all channels or for groups of channels.
- *Differential* connections use a separate positive and negative terminal for each channel.
- If the module normally allows 16 single-ended connections, it will generally allow only 8 differential connections.
- Single-ended connections are more susceptible to electrical noise.

INPUT CURRENT/VOLTAGE RANGE(S)

- These are the voltage or current signal ranges that an analog input module is designed to accept. The input ranges must be matched accordingly to the varying current or voltage signals generated by the analog sensors.

7b. Memory organization takes into account the way a PLC divides the available memory into different sections.

- The memory space can be divided into two broad categories:
  1. Program files .
  2. Data files.

Program Files

Program files are the areas of processor memory where ladder logic programming is stored. They may include:

• **System functions (file 0)** —this file is always included and contains various system-related information and user-programmed information such as processor type, I/O configuration, processor file Name and password.

• **Reserved (file 1)** —this file is reserved by the processor and is not accessible to the user.

• **Main ladder program (file 2)** —this file is always included and contains user-programmed instructions that define how the controller is to operate.

• **Subroutine ladder program (files 3–255)** —these files are user-created and are activated according to subroutine instructions residing in the main ladder program file.

Data Files

The data file portion of the processor's memory stores input and output status, processor status, the status of various bits, and numerical data. All this information is accessed via the ladder logic program. These files are organized by the type of data they contain and may include:

• **Output (file 0)** —This fi le stores the state of the output terminals for the controller.

• **Input (file 1)** —This fi le stores the status of the input terminals for the controller.

• **Status (file 2)** —This fi le stores controller operation information and is useful for troubleshooting controller and program operation.

• **Bit (file 3)** —This file is used for internal relay logic storage.

• **Timer (file 4)** —This file stores the timer accumulated and preset values and status bits.

Counter (file 5) —This file stores the counter accumulated and preset values and status bits.

• **Control (file 6)** —This file stores the length, pointer position, and status bit for specifi c instructions such as shift registers and sequencers.

• **Integer (file 7)** —This file is used to store numerical values or bit information.

• **Reserved (file 8)** —This file is not accessible to the user.

• **Network communications (file 9)** —this file is used for network communications if installed or used like files 10–255.

• **User-defined (files 10–255)** —These files are user defined as bit, timer, counter, control, and/or integer data storage.

6 b. When the PLC is switched into the program mode, all outputs from the PLC are forced off regardless of their rung logic status, and the ladder I/O scan sequence is halted.

Run Mode The run mode is used to execute the user program. Input devices are monitored and output devices are energized accordingly. After all instructions have been entered in a new program or all changes made to an existing program, the processor is put in the run mode.

Test Mode The test mode is used to operate or monitor the user program without energizing any outputs. The processor still reads inputs, executes the ladder program, and updates the output status table fi les, but without energizing the output circuits. This feature is often used after developing or editing a program to test the program execution before allowing the PLC to operate real-world outputs. Variations of the test mode can include the *single-step test mode,* which directs the processor to execute a selected single rung or group of rungs; the *single-scan test mode,* which executes a single processor operating scan or cycle; and the *continuous-scan test mode,* which directs the processor to continuously run the program for checking or troubleshooting.

Remote Mode Some processors have a three position switch to change the processor operating mode. In the Run position, all logic is solved and the I/O is enabled. In the Program position, all logic solving is stopped and the I/O is disabled. The Remote position allows the PLC to be remotely changed between program and run mode by a personal computer connected to the PLC processor. The remote mode may be beneficial when the controller is in a location that is not easily accessible.

7 b. PLC size

- nano is the smallest size with less than 15 I/O points.
- micro types (15 to 128 I/O points).
- medium types (128 to 512 I/O points).
- large types (over 512 I/O points).

Applications

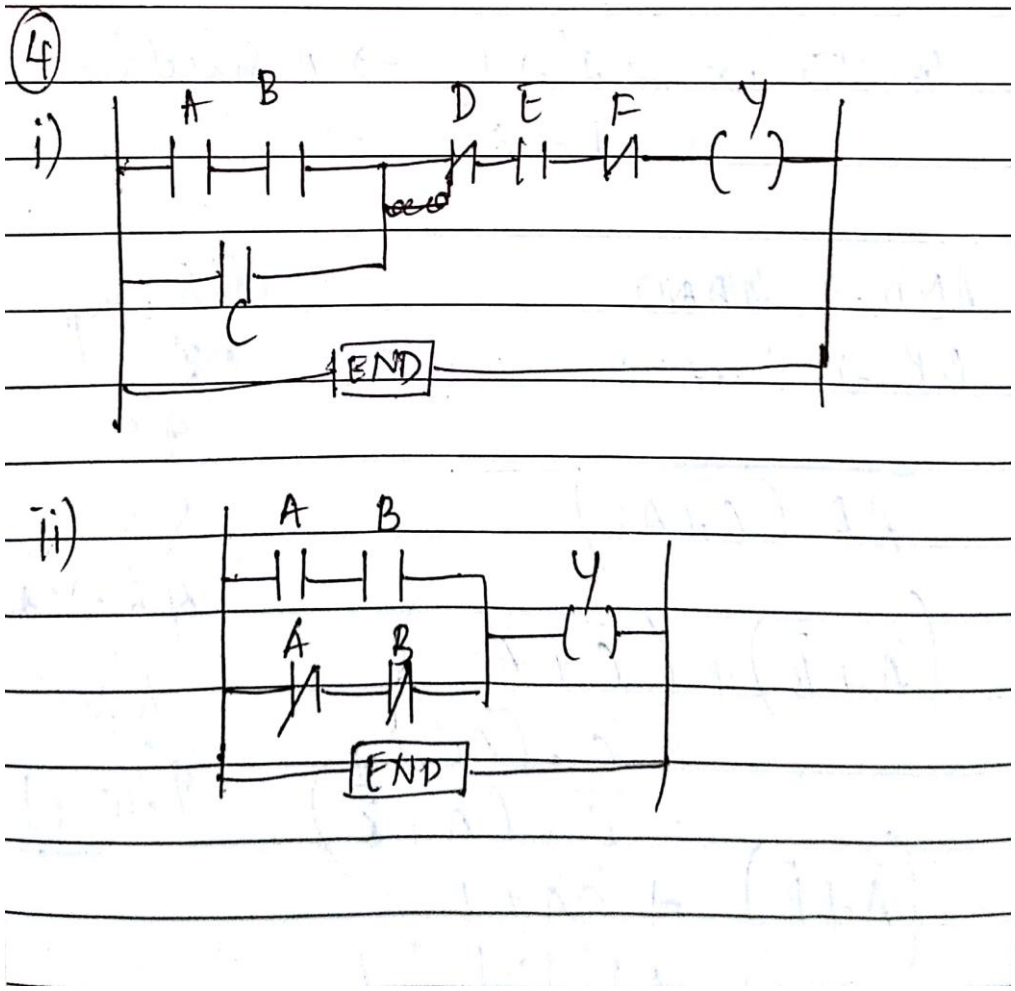
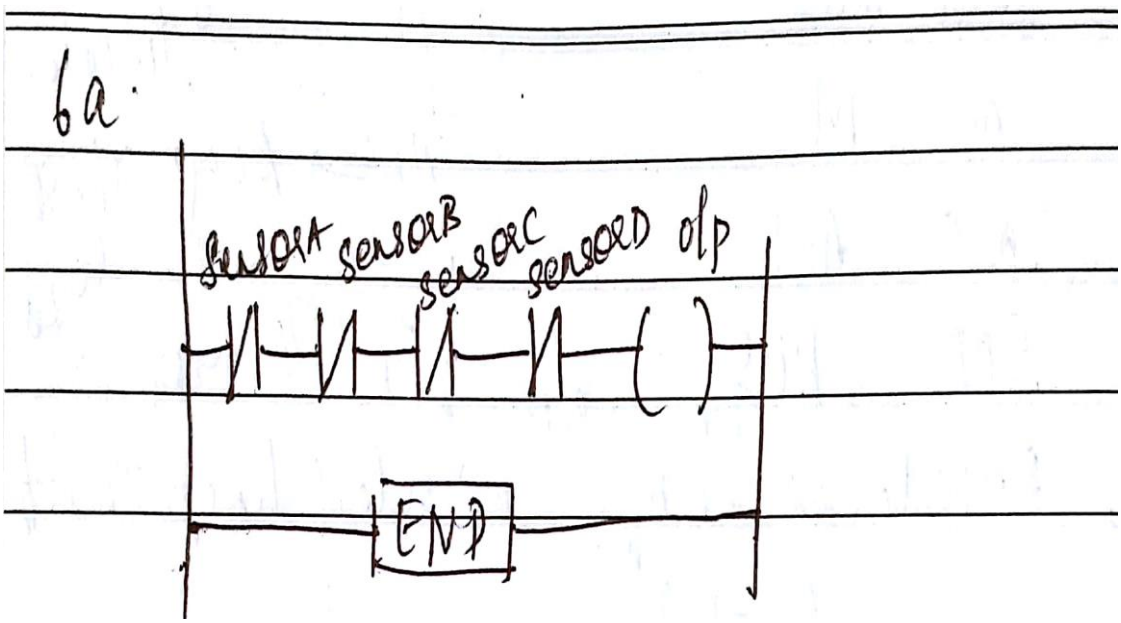
There are three major types of PLC application: single-ended, multitask, and control management. A *single-ended* or stand-alone PLC application involves one PLC controlling one process

- **stand-alone** unit and would not be used for communicating with other computers or PLCs. The size and sophistication of the process being controlled are obvious factors in determining which PLC to select.
- A *multitask* PLC application involves one PLC controlling several processes.
  Adequate I/O capacity is a significant factor in this type of installation. In addition, if the PLC would be a subsystem of a larger process and would have to communicate with a central PLC or computer, provisions for a data communications network are also required.
- A *control management* PLC application involves one PLC controlling several others .This kind of application requires a large PLC processor designed to communicate with other PLCs and possibly with a computer. The control management PLC supervises several PLCs by downloading programs that tell the other PLCs what has to be done.

5a. PLC:

- Operates in industrial enviroment
- PLC is programmed in relay ladder logic
- Has no keyboard, CD drive, monitor, or disk drive
- Has communication ports and terminals for input and output devices

PC:

- Capable of executing several programs simultaneously, in any order.
- Some manufacturer have software and interface card available so that a PC can do the work of a PLC.
- Speedy information processing
- Easy customization

- Straightforward data exchange with other systems