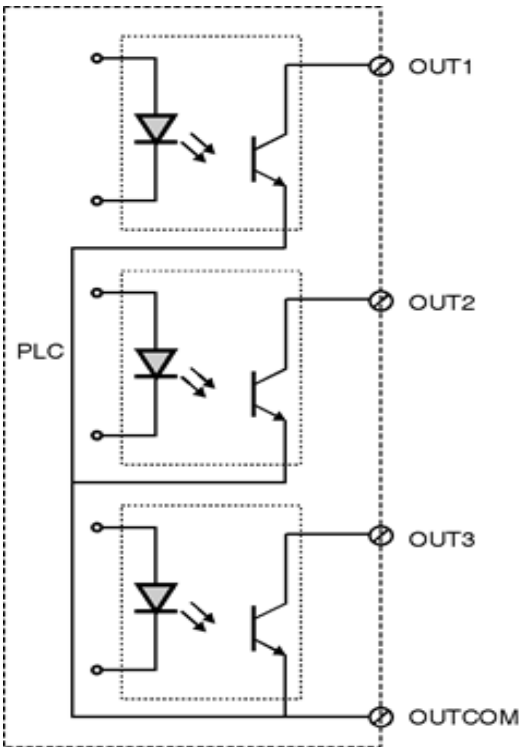




Important Instructions to examiners:

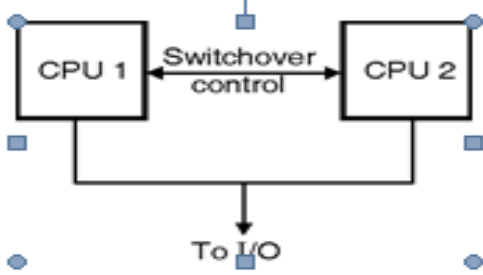
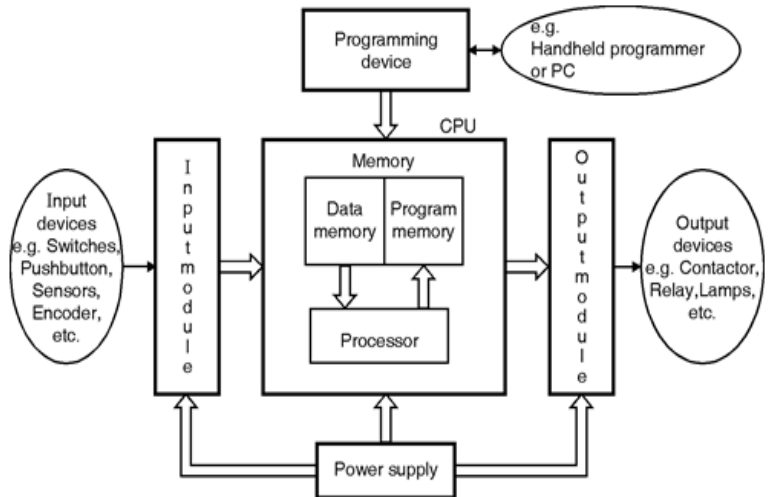
- 1) The answers should be examined by keywords and not as word-to-word as given in the model answer scheme.
- 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
- 3) The language errors such as grammatical, spelling errors should not be given more Importance. (Not applicable for subject English and Communication Skills.)
- 4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
- 5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
- 6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
- 7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Question & its Answer	Remark	Total Marks
1. A	Attempt any Three		12
a)	What is the need of automation in Industries? State any two processes where industrial operation cannot be performed manually.		04
Answer	<p>Need of automation in Industries :</p> <ol style="list-style-type: none">1) To Increase productivity2) To Increase product quality3) To Increase flexibility and convertibility4) Reduces manpower5) Reduction of personal accident6) Reduces cost of product7) Better inventory control8) Increases profit <p>State any two processes where industrial operation cannot be performed manually.</p> <ol style="list-style-type: none">1. Electrical distribution2. Process industries3. Robotics4. Automobile5. Medical6. Aerospace7. Nuclear plant8. Oil and refineries9. Pharmaceuticals <p>Note: any other two relevant industrial operation/process name should be considered.</p>	<p>03 mark for any three point</p> <p>½ mark for any each name. any two for 1 mark</p>	

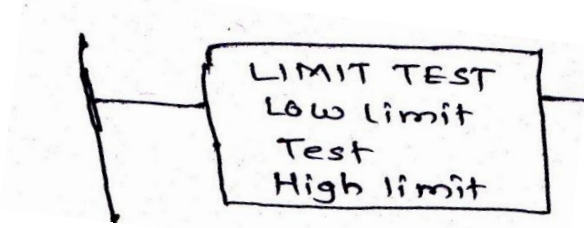
b)	State the classification of PLC based on its types and size		04
Answer	<p>Classification of PLC based on type and size:</p> <p>PLC : - A) Micro PLC (Fixed i/o)</p> <p>B) Modular PLC: - i) Small PLC ii) Medium iii) Large</p>	04 marks	
c)	Explain how PLC is interfaced with the field devices using TTL o/p Module	04	
Answer	<p>•</p>  <ul style="list-style-type: none"> The Fig shows interfacing of PLC with field devices using TTL o/p module. Transistor Transistor Logic (TTL) output modules switch 5 V_{DC} signals. A TTL output module allows for interfacing between the PLC and TTL comparable devices. An example of a TTL interface is interfacing a PLC to various 5 V_{DC} field devices including integrated circuits and seven segment LED display. TTL output are generally optically isolated. In some cases there may be direct and not optically isolated units provide better protection for PLC. 	<p>02 marks for Figure</p> <p>and</p> <p>02 Marks for Explanation</p>	



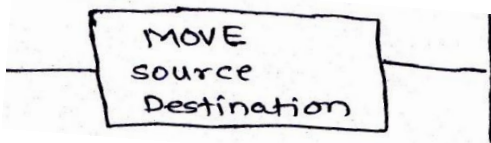
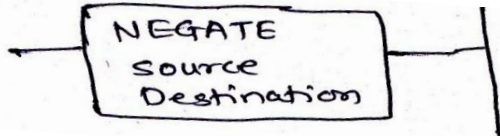
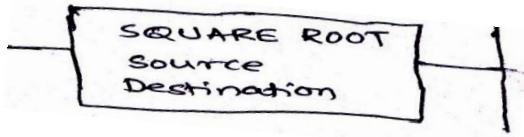
	<ul style="list-style-type: none">The outputs of the TTL unit have a common terminal which must be connected to the negative terminal of the power supply of the external TTL devices being driven by the output unit.Various PLC manufacturers specifying the outputs as positive or negative logic.																																																		
d)	Explain status bits CD, DN and OV of the counter. Draw the first word of counter memory that stores these status bits	04																																																	
Answer	<table border="1"><tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>09</td><td>08</td><td>07</td><td>06</td><td>05</td><td>04</td><td>03</td><td>02</td><td>01</td><td>00</td></tr><tr><td>C</td><td>C</td><td>D</td><td>O</td><td>U</td><td></td><td></td><td></td><td></td><td colspan="7">Internal use</td></tr><tr><td>U</td><td>D</td><td>N</td><td>V</td><td>N</td><td></td><td></td><td></td><td></td><td colspan="7"></td></tr></table> <p>FIG shows first word of Counter memory.</p> <p>Explanation :</p> <p>1)<u>CD :- Count down Enable bit:</u> This bit set to one or true when rung is true and down counter is enabled and set to zero or get false when rung goes false or down counter is reset.</p> <p>2)<u>DN: Done bit</u> This bit is set to one, when accumulated value is equal to or greater than preset value and reset to zero when accumulated value is less than preset value.</p> <p>3)<u>OV: Overflow bit</u> This bit is set to one when accumulated value exceeds the upper limit (+32767) value , when this limit is reached the count wraps around to -32768 value and counter decrements from this value.</p>	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00	C	C	D	O	U					Internal use							U	D	N	V	N												<p>01 marks for first word of counter</p> <p>01 mark for each bit of word counter</p>	
15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00																																				
C	C	D	O	U					Internal use																																										
U	D	N	V	N																																															
1. B	Attempt any one of following		06																																																
a)	Explain the following characteristics of PLC i) communication ii) Speed of execution ii) redundancy	06																																																	
Answer	<p>i) Communication : PLC have many built in communication ports. The PLC communicates with field devices through this port. These are generally 9 pin RS232 and optionally for RS485, ethernet, mod bus, Profibus, DF1 etc protocols available depending on manufacturer.</p> <p>ii) Speed of execution: “The amount of time it takes the PLC to get from one I/O update to next is referred as scan time: it is generally measured in milliseconds. This is related to speed of CPU. “The speed at which PLC scan memory and execute or the program is</p>	<p>02 marks for each characteristics of PLC</p>																																																	

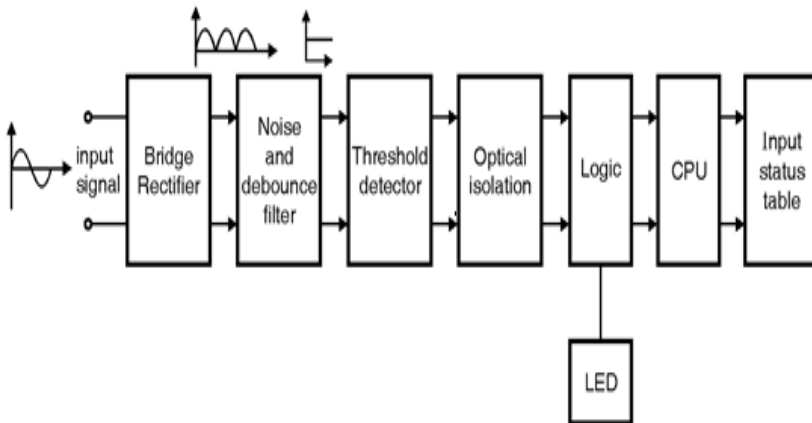
	<p>referred as speed of execution or scan rate”</p> <p>iii) Redundancy :</p> <ul style="list-style-type: none"> Redundancy means extra system components or mechanisms added to decrease the chance of total system failure. Different types of redundancy are available in PLC like redundancy for a CPU module, power module, bases and communication module is available. In case an error occurs in an active CPU module, a backup module is automatically converted to active one for continuous operation. In these cases two processors (CPUs) can be tied into one I/O system and switching control from the failure CPU to the backup CPU as in Fig. 		
b)	Draw the block diagram of PLC. Explain role of each block	06	
Answer	<p>Block diagram of PLC:</p>  <p>Explanation: It contains mainly following parts i) CPU ii) I/O module iv) Programming device v) Memory vi) Power supply The function of each block is as follows</p> <p>i) CPU:</p> <ul style="list-style-type: none"> It also performs arithmetic and logic functions 	<p>03 marks for dig,</p> <p>and</p> <p>03 marks for explanation of role of each block in brief</p>	



	<ul style="list-style-type: none">• It decodes and executes instructions• It executes operating system, manages memory, monitors inputs,• It evaluates the user logic, turns on the appropriate outputs,• It handles communication and interactions with other components of system <p>ii) I/O Module:</p> <ul style="list-style-type: none">• These transfers process information into digital values• I/p module interfaces i/p devices to CPU• o/p module interfaces CPU to O/P device <p>iii) Memory:</p> <ul style="list-style-type: none">• Stores data and programme instructions• There mainly two types of memory Ram , ROM• RAM is used to store user or temporary data.• ROM is used to store operating system and fixed data used by CPU <p>iv) Programming device:</p> <ul style="list-style-type: none">• Provides communication between user and PLC• It is used to enter or edit the programme of PLC <p>v) Power supply:</p> <p>It provides supply to all modules of PLC for their proper function.</p>		
Q 2)	Attempt any two of the following		16
a)	Explain the following instructions of PLC i) LIM ii) MOV iii) NEG iv) SQR	08	
Answer	<p>LIM:</p> <p>It is PLC instruction .</p> <p>If the test value is between high and low limit , then o/p is true otherwise o/p is false.</p> <p>shorthand notation is</p> <p>LIM (low limit,test value , High limit)</p> <p>Symbol :</p>  <p>i) MOV: Move</p> <p>It is move instruction of PLC .</p> <p>This instruction moves value from source to destination mentioned in the instruction.</p>	02 marks for each instruction	



	<p>MOV(source, destination) Symbol:</p> 		
	<p>ii) NEG: negative It has one source. It reverses the sign of source. NEG(value, destination) Symbol:</p> 		
	<p>iii) SQR: Square root instruction It is taking square root of source and result is stored destination SQR(source, destination) Symbol:</p> 		
b)	State any eight characteristics of HMI	08	
Answer	<p>Characteristics of HMI :</p> <ol style="list-style-type: none">1. Openness2. Flexibility to work in network environment3. User-friendly display4. Robust constructions5. Internet /Intranet support6. Data compatibility7. Multilingual support8. Authentication for user <p>Or any relevant 8 characteristics should be considered</p>	<p>01 mark for each characteristic</p>	

c)	Draw the block diagram of discrete AC input module. Explain the various blocks.	08	
Answer	<p>Block Diagram of Discrete A/c i/p module</p>  <p>In the AC input module alternating current enters the input module and then given to rectifier and filter ckt.</p> <p>Rectifier and filter ckt :</p> <ul style="list-style-type: none"> • This section consists of resistors and a bridge rectifier to convert the incoming AC signal to a pulsating DC signal. • The pulsating DC signal is then passed through filter and other logic circuitry in order to get clean, denounced DC input signal to the threshold detection. <p>Threshold detection:</p> <ul style="list-style-type: none"> • Threshold detection circuitry detects whether the incoming signal has reached or exceeded a predetermined voltage level for a predetermined time and whether it should be classified as a valid ON or OFF signal. • A typical valid OFF state is below 0 and 20 or 30 V_{AC} depending on the module's manufacture and a valid ON state is between 80 and 132 V_{AC} again depending on the module's manufacturer. • The signal area between the upper voltage limit for a valid OFF state (20 V_{AC}) and minimum voltage for a valid ON state (80 V_{AC}) is called undefined zone or input state not guaranteed zone. The signals 	<p>04 marks for block diagram</p> <p>And</p> <p>04 marks for explanation</p>	

falling within this undefined zone may be ON or OFF making them unstable and unreliable.

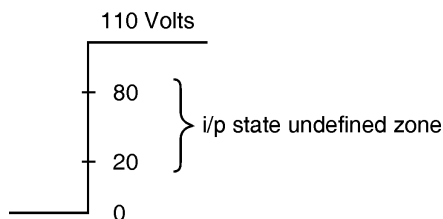
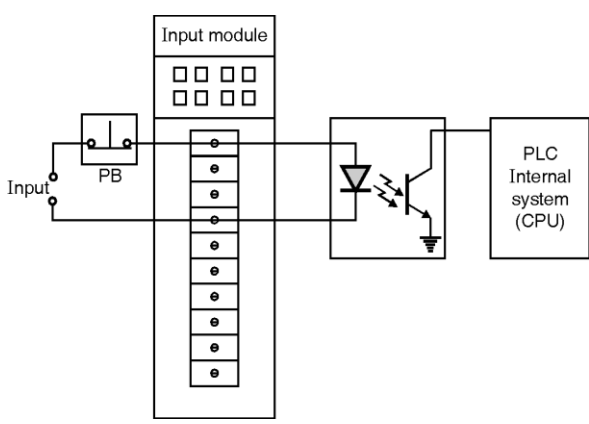


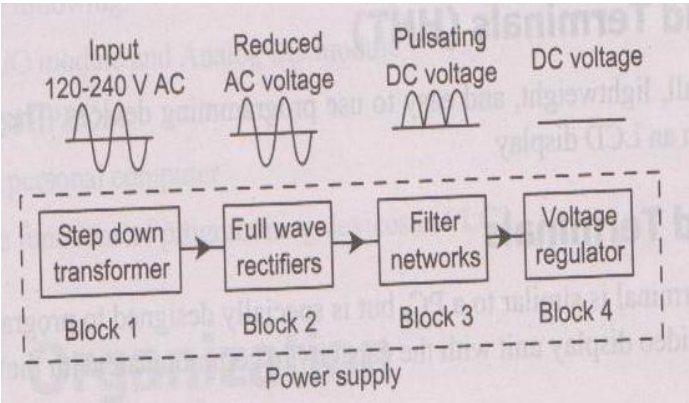
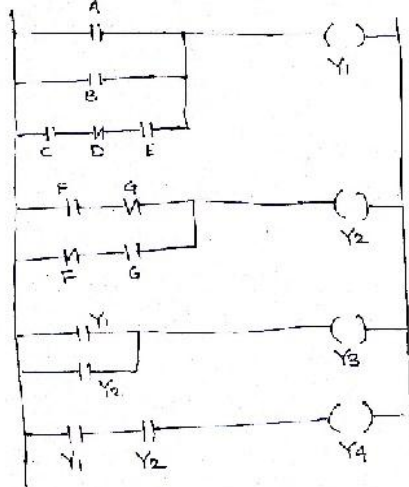
Fig. Input pulse with valid signal area defined

- Filtering and time delays are used to filter out electrical noise that may be interrupted as a false input pulse.
- To eliminate the possibility a faulty operation due to electrical noise, a valid AC input signal must not only be a specific value, but must be present for a specific amount of time before the input module allows the valid signal to pass to the isolation section.

Isolation :

- The isolation section of the input circuit is usually made up of an opto-isolator or it may called as opto-coupler. Where a light source (e.g. LED) and a photo detector (e.g. photo diode, photo transistor, photo voltaic cell etc.) are placed in signal package.
- In a 115 V_{AC} input module isolation separates the high-voltage, 110 V_{AC} input signal from the CPU's low voltage control logic (typically 5 to 18 V_{DC}) depending on the module manufacturer and the type of logic employed.
- Isolation is accomplished by the input signal energizing a light-emitting diode (LED), which transmits a signal of light energy to a receiver in the form of photo conductive diode. Here LED converts the electrical signal to an optical signal and receiver usually a photo-transistor, converts the optical signal back to the electrical signal.
- There is no actual physical or electrical coupling between the sending LED, it's associated input circuitry and the optical receiver and it's low-voltage associated logic circuitry. The signal is transferred by light (photon particles) from the LED.

	<ul style="list-style-type: none"> Fig. shows simplified optical isolator.  <p>The logic section :</p> <ul style="list-style-type: none"> DC signals from the opto-coupler are used by the logic section to pass the input signal to the module's input address LED and the CPU. 		
Q.3	Attempt any four of the following		16
a.	State any four applications of automation in electrical distribution system.	04	
Answer	<p>Applications of automation in electrical distribution system:-</p> <ol style="list-style-type: none"> 1) Used to remotely monitor, co-ordinate and operate distribution components in a real time. 2) To atomize feeder for demand side management and load check. 3) To safety check, fault location and isolation etc. 4) For remote metering and load control. 5) For load shedding, economic operation and trouble call. 6) To increase the efficiency of electrical distribution system. <p>Or any other relevant application should be considered</p>	01 mark for each	
b.	List any eight benefits of automation.	04	
Answer	<p>Benefits of automation:-</p> <ol style="list-style-type: none"> 1)Increases productivity 2) Increases product quality 3)Increases flexibility and convertibility 4) Reduces manpower 5)Reduction of personal accident 6) Reduces cost of product 7) Better inventory control 8) Increases profit 	½ mark for each	

c.	With the help of neat diagram explain the power supply of PLC.	04	
Answer	<p>Block diagram PLC DC power supply:-</p>  <p>Explanation:</p> <p>It consists UPS (optional) , rectifier , filter and regulator</p> <p>UPS:</p> <ul style="list-style-type: none"> • It is also called as line conditioner • In this ac power is allowed to pass with battery backup, which enhances reliability and reduces disturbances. • o/p from UPS is passed to the rectifier <p>Rectifier:</p> <ul style="list-style-type: none"> • It converts AC into pulsating DC voltage. • o/p of rectifier is given to filter <p>Filter:</p> <ul style="list-style-type: none"> • It removes pulsating AC present in the o/p of rectifier • It gives pure DC signal <p>Regulator:</p> <ul style="list-style-type: none"> • It produces regulated o/p voltage. 	<p>02 marks for diagram</p> <p>And 02 marks for explanation</p>	
d.	<p>Draw the ladder diagram for the following Boolean equations. $Y_1 = A + B + C\bar{D}E$, $Y_2 = F \oplus G$, $Y_3 = Y_1 + Y_2$, $Y_4 = Y_1.Y_2$</p>	04	
Answer		<p>04 marks for any relevant ladder diagram</p>	

5) Batch interface:

This is the non-interactive user interface, where the user specifies all the details of the batch in advance for batch processing and receives the output when all processing is done

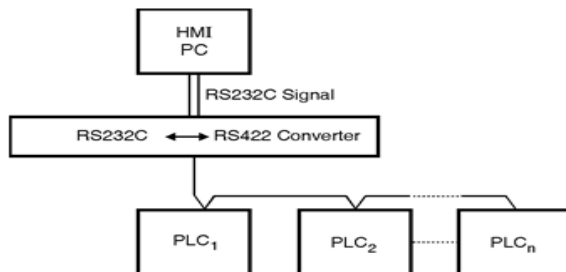
Or

The possible methods for this HMI and PLC interface are :

1. Using RS 422 multidrop interface.
2. Using Ethernet (10 MBPS) interface.
3. Using the factory LAN.
4. Using MODEM with remote PLCs.
5. Using internet or intranet for global interface.

1. RS 422 Multidrop Interface :

- This interface is implemented using the standard RS 422 used for multidrop communication.
- The HMI PC as usual works through serial port that uses RS 232C Standard for serial communication.
- To convert this RS 232 signal into RS 422 compatible signals we have to use the RS 232 to RS 485 converter.
- At the other end of this converter the multiple PLCs can be connected.

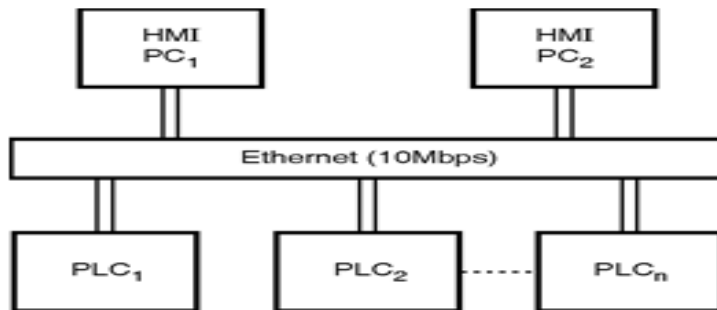


2.HMI and PLC Interface using Ethernet :

- In the interface using standard RS 422 we can interface one HMI screen to multiple PLCs.
- To communicate between more than one HMI screen with multiple PLCs at plant floor, the better option is Ethernet interface.
- In this interface the unique address called slave address is given to all

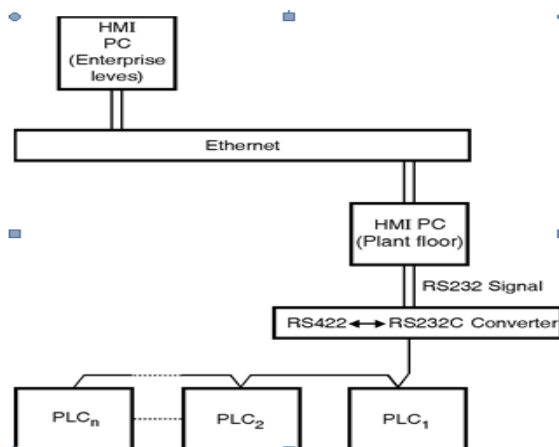
available PLCs.

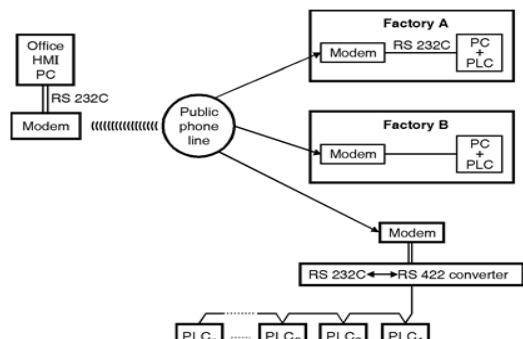
- The master also can be one or more with unique addresses.
- The HMI signals at the serial port of PC are RS 232 standard and require the conversion to Ethernet standards and it is done through Ethernet card.



3.HMI to PLC Interface using Factory LAN :

- In this application the HMI is at enterprise level, we can call it as the supervisory level.
- It is the combination of the first, two types i.e. RS 422 multidrop interface and the Ethernet interface.
- It covers the more wider area of plant floor.
- It uses the factory LAN(Local Area Network) i.e. Ethernet to connect the enterprise HMI to the plant floor HMI screens.
- The HMI signals are given to HMI screen through RS 422 and RS 232 converter.



	<p>4.HMI Interface for Local and Remote PLCs using Modem :</p> <ul style="list-style-type: none"> This interface allows to access the PLCs at local plant floor as well as the PLCs located at remote place. It utilizes the standard public phone line and the modems for the information and data access. The central information Centre can get connected to remote plants at different locations. The modem used at both ends of telephone line converts the data signal levels to the standard telephone signal levels. 		
b)	Define SCADA. State its two applications.	04	
Answer	<p>Definition of SCADA:-</p> <p>SCADA is an acronym for supervisory control and data acquisition, a computer system for gathering and analyzing real time data. SCADA systems are used to monitor and control a plant or equipment in industries.</p> <p>Applications of SCADA:</p> <ul style="list-style-type: none"> Electric power generation, transmission and distribution Water sewage Building, facilities , environment Manufacturing industry Traffic signaling Mass transit City Water supply and distribution Automobile industries Process industries Oil refineries Steel and cement plant 	<p>01 mark definition</p> <p>03 marks for application</p>	
c)	List the various objects used in programming HMI. Explain any three of them.	04	

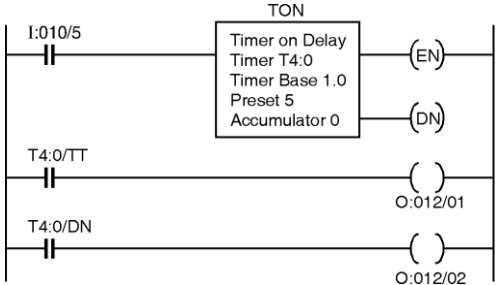


Answer	<p>Objects used in programming HMI:-</p> <ol style="list-style-type: none">1. Tag dictionary or tag editor.2. Dual driver communication (Two intelligent devices communicating to single HMI).3. Pixel positioning of screen objects (numeric fields, touch cells, etc.)4. Import capability of .bmp, .jpg, .tif, and .psgraphic images and5. Vector graphics. <p>1. Tag dictionary or tag editor :</p> <p>Tag editor or Tag Configuration Editor (TCE) is an application development utility used to create and edit tag configuration files that are used in machine control applications. It is an executable applications and it can be accessed from the tool menu of the HMI software. The tag configuration files created by TCE, describes the list of tags used in HMI controller of the control panel.</p> <ul style="list-style-type: none">• It is used to initialize the components used in the application.• The tag configuration files are used to define tags in the Touch Panel Alarm Engine (TAE), Current Value Table (CVT) and the CVT client communication.• The machine control architecture uses two separate tag configuration files, one for HMI and other for the controller. <p>For the machine control architecture, the TCE supports specific I/O interface that allows binding of tags to external data sources.</p> <p>2. Dual driver communication :</p> <ul style="list-style-type: none">• The dual driver communication means the two intelligent devices communicating to single HMI.• These intelligent devices referred as slaves and it has unique specified address to communicate.• It uses the standard communication protocol such as MODBUS.• These intelligent devices can be PLCs or PACs i.e. programmable automation controllers. <p>3. Pixel positioning of screen object :</p> <ul style="list-style-type: none">• The pixel positioning of screen objects mean the planning of the positions of the different objects used in the design of HMI screen.<ul style="list-style-type: none">• It includes the determination of proper size of object on screen.• The possible animation of the object, if required in process	<p>01 mark for list</p> <p>And</p> <p>01 mark for each object explanation</p>	
---------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------	--

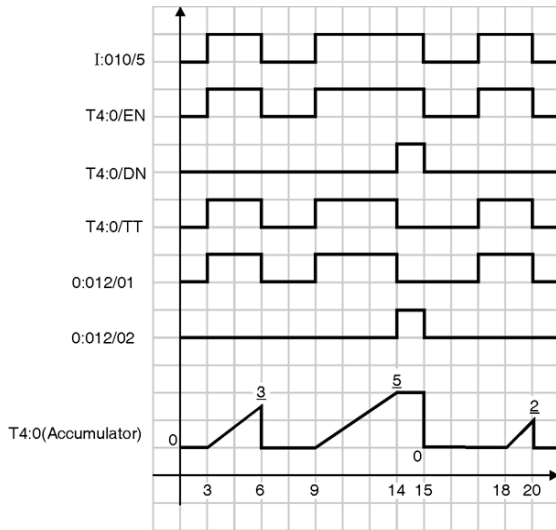


	<p>visualizaion.</p> <ul style="list-style-type: none">The different objects like I/O display, alarms and trends should be properly positioned for convenient visualization. <p>4. Import capability of different graphics files :</p> <ul style="list-style-type: none">The local operator panel programming should include the different drivers that will be capable of handling the different graphic files such as .bmp, .tif, .jpg and psgraphic formats.This increases the versatility of the HMI software. <p>5. Vector graphics :</p> <ul style="list-style-type: none">The vector graphics includes the mapping of the objects used in HMI screen. <p>It includes the display of different trends to understand the on-line updates of the plant operations.</p>		
d)	Draw the functional block diagram of SCADA.	04	
Answer	<p>Fig. Functional block diagram of SCADA</p>	04 mark	
4. B)	Attempt any one of the following		06
a)	List any six specialty modules. Explain any one of them.	06	
	<p>List of specialty modules:-</p> <ol style="list-style-type: none">BASIC moduleCommunication ModulesHigh-speed encoder input modulesRemote I/O Sub scannersResistance Temperature Detector (RTD) input moduleStepper motor control moduleThermocouple / Millivolt input module <p>Remote I/O Sub scanner :</p>	<p>03 marks for list</p> <p>And</p> <p>03 marks for explanation</p>	



	<p>When there is a need of an I/O chassis remotely mounted from the basic PLC, some PLC systems require a remote I/O sub scanner. For that simply put a subscanner resides in the base CPU chassis and relieves the CPU from the burden of scanning the I/O.</p> <p>A subscanner scan the remote I/O chassis and the respective I/O points. After the subscanner has scanned all remote I/O points, their I/O status is stored in a built-in buffer.</p> <p>At the appointed time in the CPU's scan, the CPU will read the I/O status of data stored in the sub scanner's buffer.</p>		
b)	Draw and explain the working of ON timer with waveform.	06	
Answer	<p>ON-Delay Timer (TON) :</p> <ul style="list-style-type: none">It can be used to turn a coil ON/OFF after a predefined time which is enabled by a true rung condition.An example of an Allen-Bradley TON timer is shown in Fig. a <p>Fig. a : An example of TON timer</p>  <ul style="list-style-type: none">In the above ladder programming, the timer block represent the format of TON timer.In this format T4: 0 indicates timer file 4, timer 0. This is the location in the PLC memory that will store the timer information.The time base is 1.0 indicating that processor increments accumulated value in 1 second intervals. Other time bases are also available in fractions and multiples of seconds.In this example, the preset value is 5 it indicates the delay for timer which is equal to the multiplication of time base and preset value.In this case delay for timer = $5 * 1.0 \text{ S} = 5.0 \text{ S}$The accumulator value gives the current value of the timer as 0 which increases until it reaches to the preset value.The timing diagram in Fig. b illustrates the operation of the above	<p>02 marks for Timer format</p> <p>And 03 marks for explanation</p> <p>And 01 mark for waveform</p>	

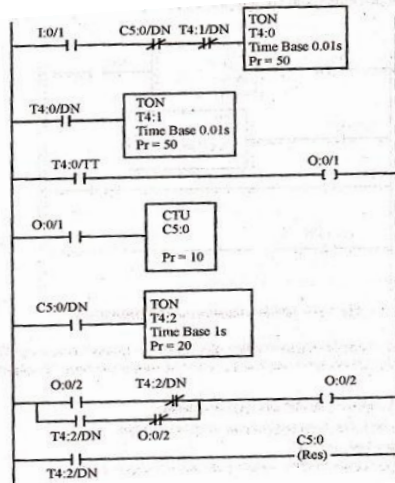


	<p>example.</p> <ul style="list-style-type: none">• In the diagram, I : 010/5 is the input and when input is true the EN bit that is enable bit of timer is true.• When timer is running TT bit will set and the accumulator value will begin increasing.• As TT bit sets, it turns ON the output O: 012/01.• From timing diagram in first condition input I : 010/5 is ON only for 3 sec. So accumulator value reaches upto 3.• After 3 sec. input is OFF. So accumulator resets to zero.• So to run the timer input rung condition must be true.• In second condition, input is true for more than 5 sec.• After 5 sec, accumulator value is 5 that is equal to preset value, which sets the DN bit and reset TT bit of timer.• Now DN bit turn ON the output O: 012/02. But when input I: 010/5 is released the accumulator resets to zero, and the DN bit is turned OFF.  <p style="text-align: center;">Fig. b) Timing Diagram</p>		
5	Attempt any two of the following		16
a)	Design a ladder diagram that will control a stepper motor so that it moves 10 steps forward, waits for 20 seconds and moves 10 steps in the reverse direction.	08	
Answer	The inputs and outputs can be arrayed as follows: Start Switch =I:0/1; For forward/reverse motion=O:0/2 For stepper pulse out=O:0/1 The stepper input pulse is 0.5 second ON and 0.5 second OFF. The rules can be written as shown in Table.	08 marks for ladder diagram	



T4:2/DN	O:0/2 _n	O:0/2 _{n+1}	Remarks
0	0	0	XOR Gate
	1	1	
1	0	1	
	1	0	

n is the number of program cycle



b) State and explain the functions of SCADA system.

08

Answer

Functions of SCADA system:-

1. System monitoring
2. System control
3. System management and
4. Demand side management

1. System monitoring :

- All SCADA systems provide real time monitoring of utility system status.
- Timely data on electrical faults and on other system abnormalities increases system reliability, decreases service time, and increases safety factor.
- In SCADA system even we call the data exchange in real time mode, at actual the data logging takes place with the process delay of about 10 msec. to one minute.
- The SCADA system can perform the remote metering operation if it has sufficient accuracy.
- Most of the SCADA systems have sufficient accuracy for metering.
- The SCADA system may accomplish remote metering by using either calculations from voltage current and power factor or by using analog or pulse outputs from electrical meters.

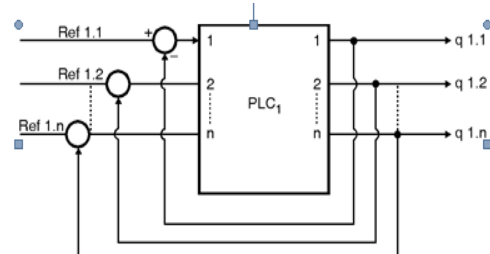
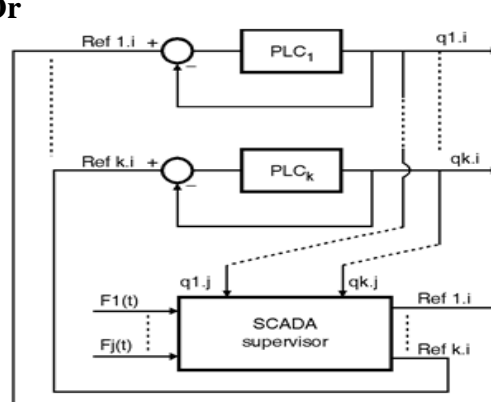
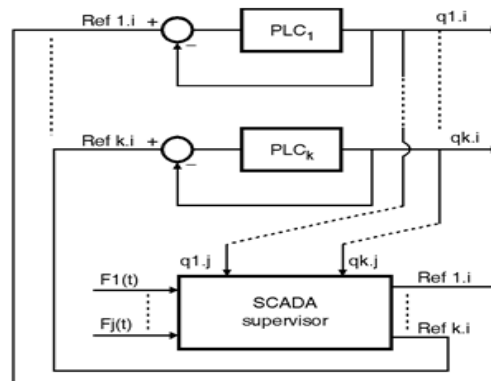
**02 marks
for state**

And

**06 marks
for
explanation**



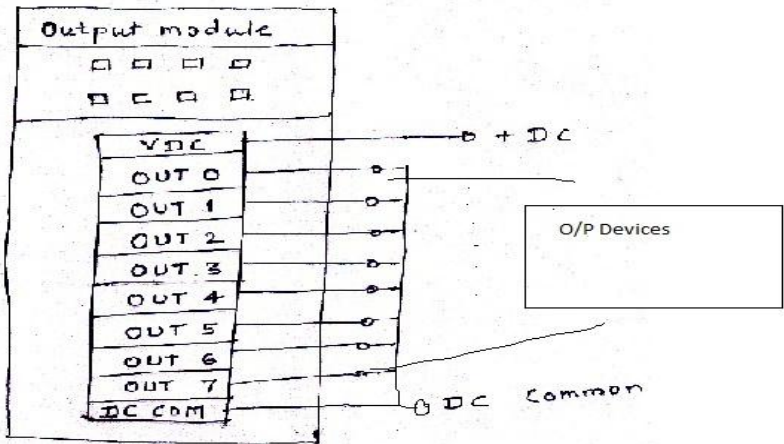
	<ul style="list-style-type: none">• The system monitoring broadly includes the detection of local and remote signal status, and the status of sequence of events.• The status of sequence of events caters to the control element for corrective or preventive action. <p>2. System control :</p> <ul style="list-style-type: none">• The system control is the second major function for which we use the SCADA system.• These controls include corrective control, preventive control and emergency control.• The corrective control activates when the system parameter crosses the set point values toward upper or lower levels.• The preventive control is actually sort of protection control which does not allow to accumulate the unexpected status of the system parameters to lead to worst levels.• The emergency control is the type of system control in which the normal operation of the system is suspended and the alert signals are generated to draw the attention of the operator or it is accomplished automatically. <p>3. System management :</p> <ul style="list-style-type: none">• The data provided by the SCADA system is critical in the management of process activities.• The SCADA system collects real time data for future use and analysis.• This data is then used for off-line system analysis of losses, load conditions and fault frequencies.• The recorded sequence of events data may be analyzed quickly to identify the origin of electrical faults.• The Sequence of Events (SOE) analysis allows pre and post disturbance analysis of the system parameters that we obtain at the system monitoring.• The accurately collected data can be used to evaluate the overall performance of the system.• Thus we can say that SCADA is centre of utility management system. <p>4. Demand-side management :</p> <ul style="list-style-type: none">• This feature or function of SCADA comes in picture for the applications of energy management and electrical supply scheduling.		
--	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--	--

	<ul style="list-style-type: none"> Using the remote and automatic control of circuit breakers, SCADA system can be used in load management to reduce peak hours of power consumption. Load management may be done by duty-cycling individual loads or by complete block (Feeder) isolation. Out of the above discussed functions SCADA, some of the functions may not be need and available in a typical SCADA system. If we take the function of SCADA as the purpose to use SCADA then we can enlist the function of SCADA system as : <ol style="list-style-type: none"> Display machine status Allow operator to start and stop operation cycle from control panel or enterprise SCADA screen. To monitor the process updates such as object counting, liquid filling, cutting, etc. To produce the reports of the trends and parameters. 		
c)	Explain communication of PLC and SCADA with the help of block diagram.	08	
Answer	<p>Communication of PLC and SCADA:</p> <div style="display: flex; align-items: center;"> <div style="border: 1px solid black; padding: 5px; margin-right: 20px;"> <p>Upper layer (SCADA PC) (Operator/Supervisor/Administrator)</p> <hr/> <p>Lower layer (inner layer) Master and slave PLCs. (operator/Supervisor)</p> </div> <div>  </div> </div> <p style="text-align: center;">or</p> <div style="display: flex; justify-content: space-around;"> <div> <p>Fig. two layer model layer model</p>  </div> <div> <p>Fig. Inner loop of the two</p> </div> </div> <p style="text-align: center;">Or</p>  <p style="text-align: center;">Fig. The upper level control loop of PLC and SCADA communication</p>	<p>04 marks for any one block diagram</p> <p>And 04 marks for explanation</p>	

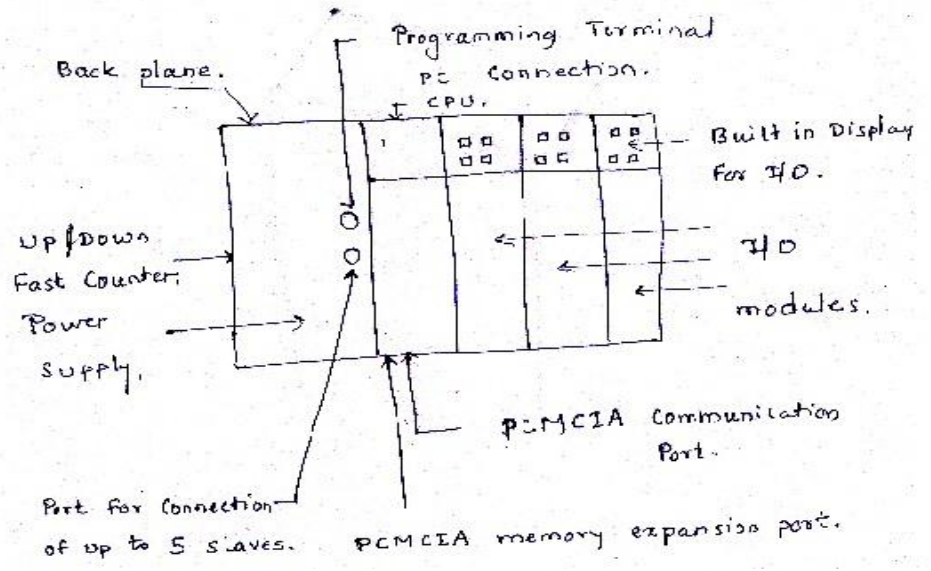


	<p>The communication between PLC and SCADA is described as follows</p> <ul style="list-style-type: none">• Interface between the SCADA and PLC can be described with respect to two layer model of PLC SCADA interface.• The model based approach reduces the development efforts of it's designer and enables the implementation of the system in a specified time.• According to this two layered mode used to build the process automation, the inner loops are cared or performed by PLC and the outer loop is managed by the centralized SCADA system. <p>The individual inner loop of PLC consists of the reference inputs applied to it.</p> <ul style="list-style-type: none">• The set of reference inputs for each local PLC is generated by the outer SCADA loop.• The error signal obtained from error detector drives the inputs of PLCs at master and slave levels. <p>The upper layer consists of SCADA PC.</p> <ul style="list-style-type: none">• The control and reference signals generated by that supervisory PC are transferred to the PLC using the serial communication port.• The standard industrial protocol like PROFIBUS are used to sent the information datagrams. <p>The input functions for upper loop control are mentioned as comfort laws, safety laws ($f_1(t)$, $f_2(t)$, ..., $f_j(t)$).</p>		
6.	Attempt any four of the following		16
a)	List the various programming languages of PLC	04	
Answer	<p>List of PLC programming languages:</p> <p>A) Graphical languages:</p> <ul style="list-style-type: none">i) Ladder Logic Diagram(LD)ii) Functional Block Diagram (FBD)iii) Sequential Function Chart or Grafcet (SFC) <p>B) Text-based languages:</p> <ul style="list-style-type: none">i) Instruction list (IL)ii) Structured Text (ST)	02 marks each types	
b)	Explain the sourcing O/P module with their wiring diagram	04	
Answer	<p>Explanation:</p> <p>In sourcing o/p module there are +DC and common terminal . All devices are connected to +dc through o/p module and another terminal of o/p device</p>		



	<p>are connected directly to common terminal. In this configuration o/p module act as sourcing to o/p devices</p> <p>Fig showing sourcing O/P module with their wiring diagram</p> 	<p>02 Marks for explanation</p> <p>And</p> <p>02 Mark for diagram</p>	
c)	Explain the troubleshooting procedure of PLC	04	
Answer	<p>The troubleshooting of PLC system can be done in following manner.</p> <ul style="list-style-type: none">• Input devices e.g. switches can be manipulated to give the open and closed contact conditions and the corresponding LED on the input module observed.• It should be illuminated when the input is closed and not when it is open. Failure of LED to illuminate could be, because the input device is not correctly operating/ there is incorrect wiring connection to the input module/the input device is not correctly powered or LED or input module is faulty.• For output devices that can be safely started, Push button might have been installed so that each output can be tested.• Another method that can be used to test inputs and outputs is termed as forcing.• This involves software, rather than mechanical switching ON or OFF, being used with instructions from the programming panel to turn ON or OFF inputs/outputs.• In order to do this, a PLC has to be switched into the forcing or monitor mode by pressing a key marked FORCE or selecting that mode on a screen display.• A portion of the program may operate properly in the FORCE mode but not during actual operation. For example input IN 0045 may operate correctly in the FORCE mode but not in actual operation.	<p>04 marks for explanation</p>	



	<p>This would indicate that the input, IN0045, is malfunctioning because of internal or external reasons.</p> <ul style="list-style-type: none">• In addition to the CPU status screen display, many PLCs have available a fault indication register display. The fault display may appear automatically or may have to be called up.• Other displays with more specific information are available on some PLCs. A message on one of these PLCs might say, for example “OUTPUT 0024 IS SHORTED” or “REGISTER 043 IS NOT WORKING.”• More sophisticated PLC System have messages that also tell which external devices are not working and why? For example “MOTOR NUMBER 45 IS OVERHEATING”. <p>Most PLCs contain some software checking program. This checks through the installed program for incorrect device addresses, and provides a list on a screen or as a printout of all input/output points used, counter and timer settings etc. with any errors detected.</p>		
d)	Explain in detail the PLC hardware configuration	04	
Answer	<p>PLC contain different modules like input , output module , CPU Module , Power supply module , Racks, communication ports etc are connected together to form PLC.</p> <p>The number of module of each may differ from manufacture to manufacture.</p> <p>The diagram of general configuration of PLC as follows</p>  <p style="text-align: center;">Or</p> <p>Any other relevant diagram should be considered</p>	<p>02 marks for explanation</p> <p>And</p> <p>02 marks for diagram</p>	



e)	Explain the addressing of I/O of PLC	04																	
Answer	<div><ul style="list-style-type: none">• The file in output image elements is file 0 of the data table. This file accommodate up to 256 output image elements.• The file for input image elements is file 1 of the data table. This file accommodates up to 256 input image elements.<p>Each I/O image element consists of one 16- bit word. You can address an I/O image element in it’s entirety (whole) or you can address any particular input or output bit of an element individually.</p><div><p>Word separator**</p><p>File separator</p><p>Logical address identifier</p><p>Bit seperator*</p><p>\$ I : 1 2 . 1 / 1 2</p><table><tr><td>File type</td><td>I/O slot number</td><td>Word number</td><td>Bit number</td></tr><tr><td>O = Output I = Input</td><td>0-30 decimal</td><td>0-255 decimal</td><td>0-15 decimal</td></tr></table><p>* Required only when addressing to the bit level ** Required only when addressing 24 and 32 bit I/O</p></div><p>Or</p><div><p>Logical address identifier</p><p>File separator</p><p>Bit seperator (If addressing a bit)</p><p>\$ B 1 2 3 : 1 2 3 / 1 5</p><table><tr><td>File Type</td><td>File Number</td><td>Bit Number</td></tr><tr><td>A = ASCII B = Binary C = Counter D = Decimal(BCD) F = Floating point² I = Input N = Integer O = Output R = Control bank S = Status ST= ASCII string² T = Timer</td><td>0 = Output 1 = Input 2 = Status 3 = Binary 4 = Timer 5 = Counter 6 = Control bank 7 = Integer 8 = Floating point 10-255 = User defined</td><td>0-15 Decimal</td></tr></table><table><tr><td>Element or structure number</td></tr><tr><td>0-255 for all files except status 1</td></tr></table></div></div>	File type	I/O slot number	Word number	Bit number	O = Output I = Input	0-30 decimal	0-255 decimal	0-15 decimal	File Type	File Number	Bit Number	A = ASCII B = Binary C = Counter D = Decimal(BCD) F = Floating point ² I = Input N = Integer O = Output R = Control bank S = Status ST= ASCII string ² T = Timer	0 = Output 1 = Input 2 = Status 3 = Binary 4 = Timer 5 = Counter 6 = Control bank 7 = Integer 8 = Floating point 10-255 = User defined	0-15 Decimal	Element or structure number	0-255 for all files except status 1	02 marks for explanation And 02 marks for diagram	
File type	I/O slot number	Word number	Bit number																
O = Output I = Input	0-30 decimal	0-255 decimal	0-15 decimal																
File Type	File Number	Bit Number																	
A = ASCII B = Binary C = Counter D = Decimal(BCD) F = Floating point ² I = Input N = Integer O = Output R = Control bank S = Status ST= ASCII string ² T = Timer	0 = Output 1 = Input 2 = Status 3 = Binary 4 = Timer 5 = Counter 6 = Control bank 7 = Integer 8 = Floating point 10-255 = User defined	0-15 Decimal																	
Element or structure number																			
0-255 for all files except status 1																			