MODEL ANSWER

WINTER– 18 EXAMINATION

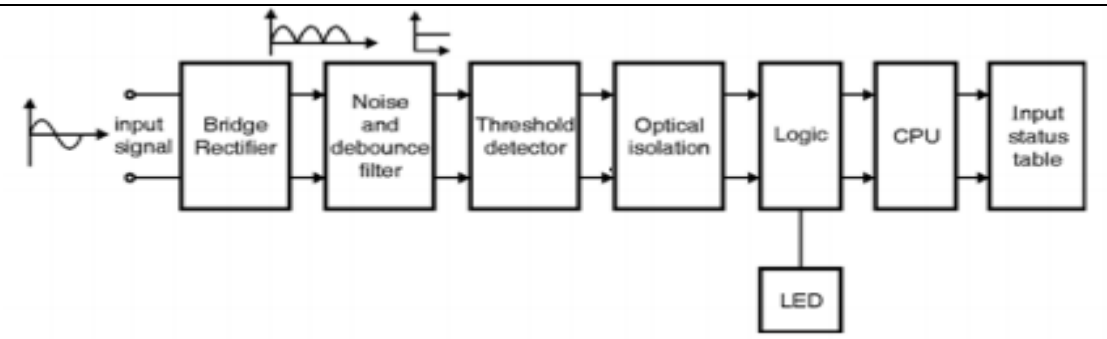
Subject Title: Industrial Automation

Subject Code: 17664

Important Instructions to examiners:

1) The answers should be examined by key words 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 anyequivalent 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.	Sub Q.N.	Answer	Marking Scheme
Q.1	**(A)**	**Attempt any Three:**	**12- Total Marks**
	a)	**State the benefits of automation.(four points)**	**4M**
	Ans:	**Benefits of Automation:** 1. Increases productivity. 2. Increases product quality. 3. Increases flexibility and convertibility. 4. Reduces manpower. 5. Reduction of personal accident/ Increase Safety. 6. Reduces cost of product. 7. Better inventory control. 8. Increases profit. 9. Reduce Manual Intervention. 11. Reduce plant Shutdown & breakdown Time. 12. Reduce plant startup time.	**1M for any 4 point**
	b)	**Draw block diagram of AC input module of PLC and explain.**	**4M**
	Ans:		**2M**



In the AC input module alternating current enters the input module and then given to rectifier and filter circuit.

2M

Rectifier and filter circuit**:**

- 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.

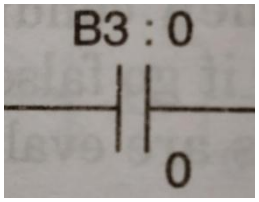
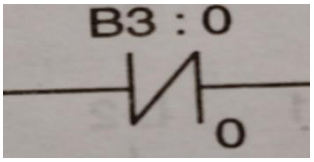
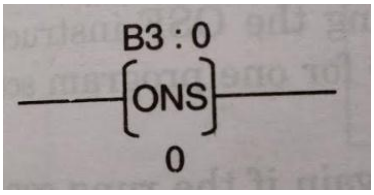
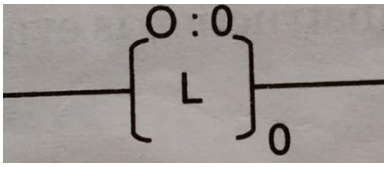
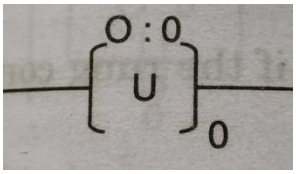
Threshold detection:

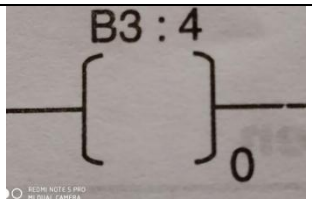
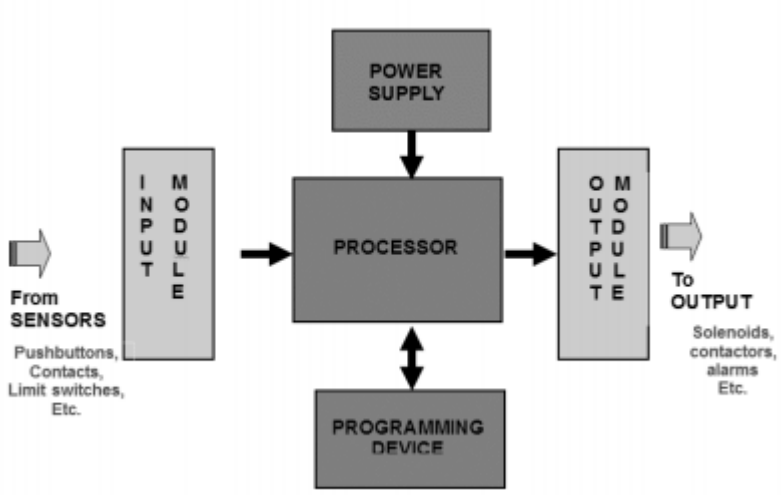
- Threshold detection circuitry detects whether the incoming signal has reached or exceeded a predetermined voltage level for a predetermined time and whether it should be classified as a valid ON or OFF signal.
- A typical valid OFF state is below 0 and 20 or 30 VAC depending on the module's manufacture and a valid ON state is between 80 and 132 VAC again depending on the module's manufacturer.

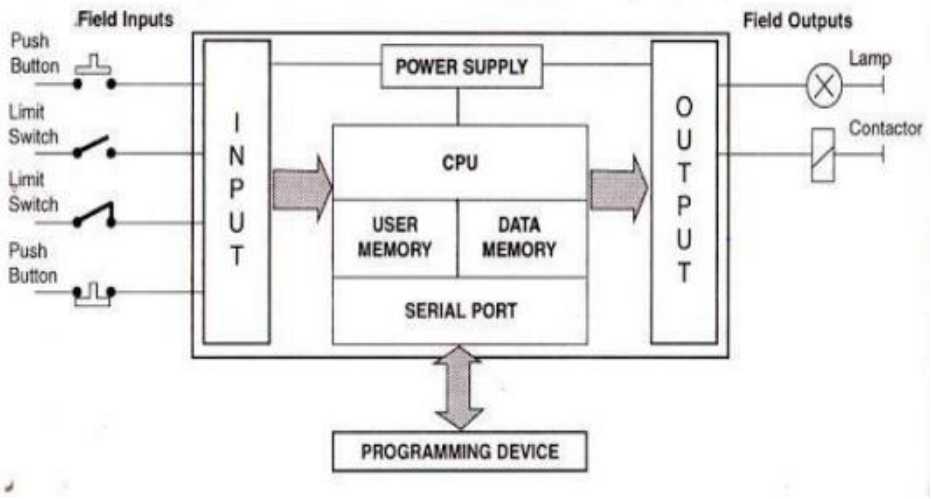
• The signal area between the upper voltage limit for a valid OFF state (20 VAC) and minimum voltage for a valid ON state (80 VAC) is called undefined zone or input state not guaranteed zone. The signals falling within this undefined zone may be ON or OFF making them unstable and unreliable.
• Filtering 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 VAC input module isolation separates the high-voltage, 110 VAC input signal from the CPU's low voltage control logic (typically 5 to 18 VDC) 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. **The logic section :** • 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.	
	c)	**List relay type instruction of PLC with symbols.**	**4M**
	Ans:	The relay type instructions are listed as , 1) NO  2) NC  3) One shot  4) Latch  5) Unlatch  6)Output Energize	**1M for each (any four)**

			
	d)	**List any four I/O module selection criteria.**	**4M**
	Ans:	**Following points must be considered while selecting I/O modules:** 1. System Requirement. 2. Application requirement. 3. What input /output capacity is required. 4. What types of input/output are required? 5. Electrical requirements. 6. Speed of operation. 7. Communication Requirements 8. Software Requirements. 9. Operator interface requirements. 10. Physical environment.	**1M for each (any four)**
	(B)	**Attempt any ONE:**	**6M**
	(a)	**Draw the block Diagram of PLC and give the function of each block.**	**6M**
	Ans:	**Diagram**  **OR**	**3M**



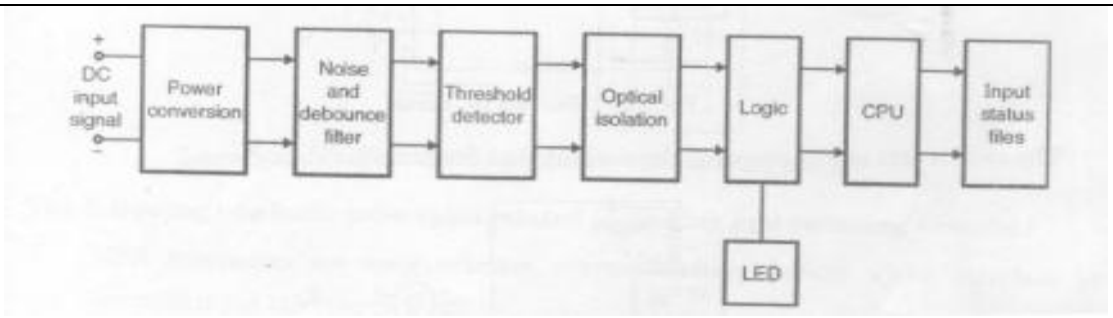
Explanation:

The Basic PLC structure consists of –

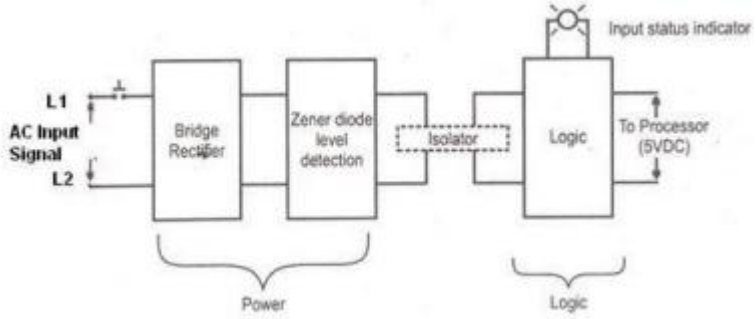
1) **Input Module:** Input Module works as an interface between the CPU and the real world input devices attached to input module .The devices connected to input module are called as input devices. It accepts the incoming signal and converts this signal in the form which is compatible with CPU.
2) **Output Module:** Output module works as an interface or link between the CPU and the real world devices attached to the output module. The main function of output module is to take control signal from CPU and based on signal received from CPU it changes the status of output devices.
3) **Central processing unit:** The CPU is the main part of any PLC .The CPU solves the user program logic, by using real time input status from input module and updates the status of outputs through output module.
4) **Power supply:** Power supply is the part of PLC which is used to supply required amount of power to CPU, input module and output module.
5) **Programming device:** The programming device is used for communication between user and PLC. The programming device helps the user to enter and modify the required program into the PLC memory and troubleshoot PLC ladder logic program.
6) **Memory:** PLC memory is divided in two part, Data memory and User memory. Data memory is used to store data associated with instruction address and user memory is used to store user's application program.

3M

(b)	**Draw the block Diagram of DC input module and explain the function of each block.**	**6M**
Ans:	**Diagram :**	**3M**



OR



3M

Working:

Power conversion: It consists of rectifier which converts the incoming AC signal to a pulsating dc level, which is passed through filter and other logic in order to deliver a clean and denounced dc signal.

Threshold detector: It detects if monitoring signal has reached or exceeded a predetermined value. A valid ON sate will be between 80- 132V ac. The upper voltage limit for a valid OFF state is below 20V. The voltage between 20V and 80V is called undefined zone.

Isolation: It is made up of an optical isolator which separate high voltage from CPUs low voltage control logic.

Logic section: It passes the input signal to the modules input address LED and the CPU.

Q 2		**Attempt any TWO:**	**16- Total Marks**
	a)	**(i)State types of PLC programming languages and explain.** **(ii) Give the types of miscellaneous instruction of PLC and explain.**	**8M**
	Ans:	**(i)State types of PLC programming languages and explain.** **PLC programming languages**: This standard specifies five languages divided into two parts namely-graphical languages and text-based languages. •**Graphical languages :** (i) Ladder Logic Diagram (LD) (ii) Function Block Diagram (FBD) (iii) Sequential Function Chart or Grafcet (SFC) •**Text-based languages :** (i) Instruction List (IL)	**1M types**

(ii) Structured Text (ST)

Explanation of PLC programming languages:

i) Ladder logic diagram (LD): It is a type of graphical language having the instructions in graphical symbol format. Ladder program is very similar to electrical wiring diagram, so it is easy to understand.

ii) Function Block Diagram (FBD): The primary concept behind FBD is data flow in this instructions are composed of operational blocks, Each block has one or more inputs and outputs.

iii) Sequential Function Chart or Grafcet (SFC): This language is used for performing simultaneously operations required for controller in complex machine process

iv) Instruction List (IL): It is similar to assembly language programming, in this low level computer language like mnemonic codes are used to specify the operation of each rung of ladder diagram.

v) Structured Text (ST): It is a high level computer type language like Basic or C. It is capable to perform calculations on values other than binary.

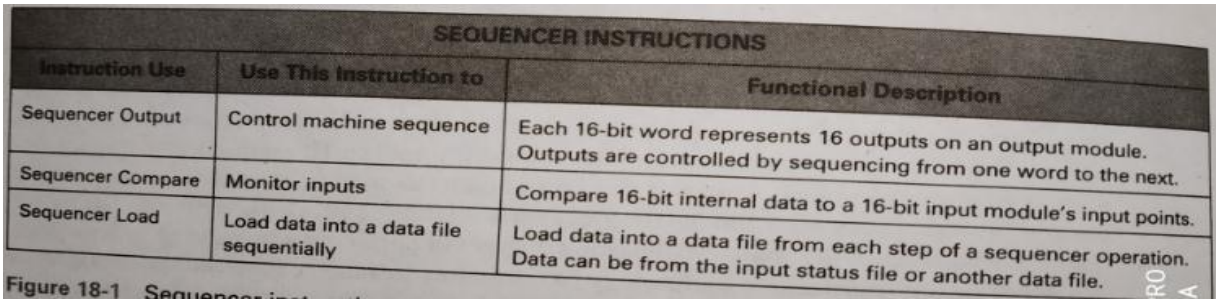
3M

(ii) Give the types of miscellaneous instruction of PLC and explain.

1M types

Types of miscellaneous (sequencer) instruction:

1.sequencer output
2. sequencer compare
3. Sequencer load.
4. Scale with parameter
5. Subroutine
6. PID

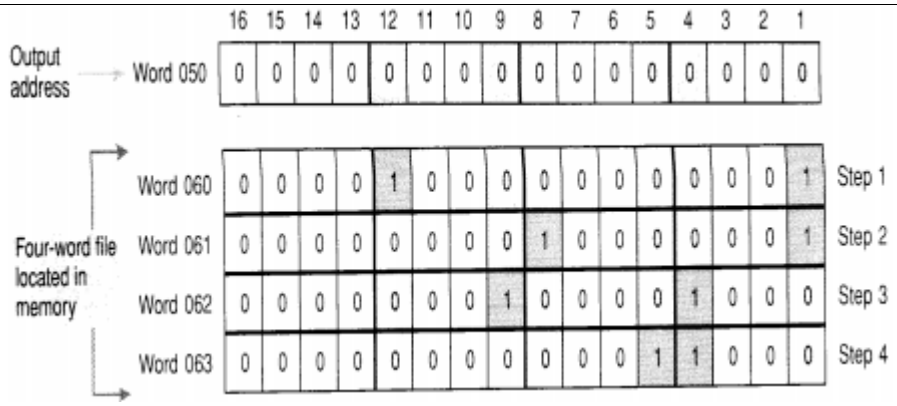


SEQUENCER INSTRUCTIONS		
Instruction Use	Use This Instruction to	Functional Description
Sequencer Output	Control machine sequence	Each 16-bit word represents 16 outputs on an output module. Outputs are controlled by sequencing from one word to the next.
Sequencer Compare	Monitor inputs	Compare 16-bit internal data to a 16-bit input module's input points.
Sequencer Load	Load data into a data file sequentially	Load data into a data file from each step of a sequencer operation. Data can be from the input status file or another data file.

Figure 18-1 Sequencer inst...

PLC sequencer replaces the mechanical drum sequence that was used to control the sequences of repeatable operations. It acts as pointer and points one of the word from block of data words stored in memory. It fetches the words one at a time from memory and transfer or move to another memory or to the output. When block of data is finished the PLC sequencer again point the first word from the block and process begins again. Traffic light controller is a simple example of sequencer which is controlled with electronics and PLC sequencer output.16 lights are used for output. Each light represent one bit address of output word 050.the lights are programmed in a four step sequence to simulate the operation of two way traffic light .Data are entered into word file for each sequencer step as shown fig.

3M



When sequencer is activated and advanced to step 1 the binary information in word 060 of file is transferred into word 050 of output as a result light 1 and 12 are switched ON and rest remains off. Advancing the sequencer to step 2 will transfer the data from 061 to word 050, as a result lamp 1 and 8 will be on and all the rest will be off and thus advancement in step 3 and step 4 is followed and finally when last step is reached, the sequencer is either automatically or manually reset to step 1.

b) **Draw a ladder daigram for two motor operation for following conditions:**

(i) Start pushbutton starts motor M1.

(ii) After 5sec. motor M1 is OFF and motor M2 is ON.

(iii) After 10sec. motor M2 is OFF.

(iv) Stop pushbutton stops both motors M1 and M2 if pressed any time during process.

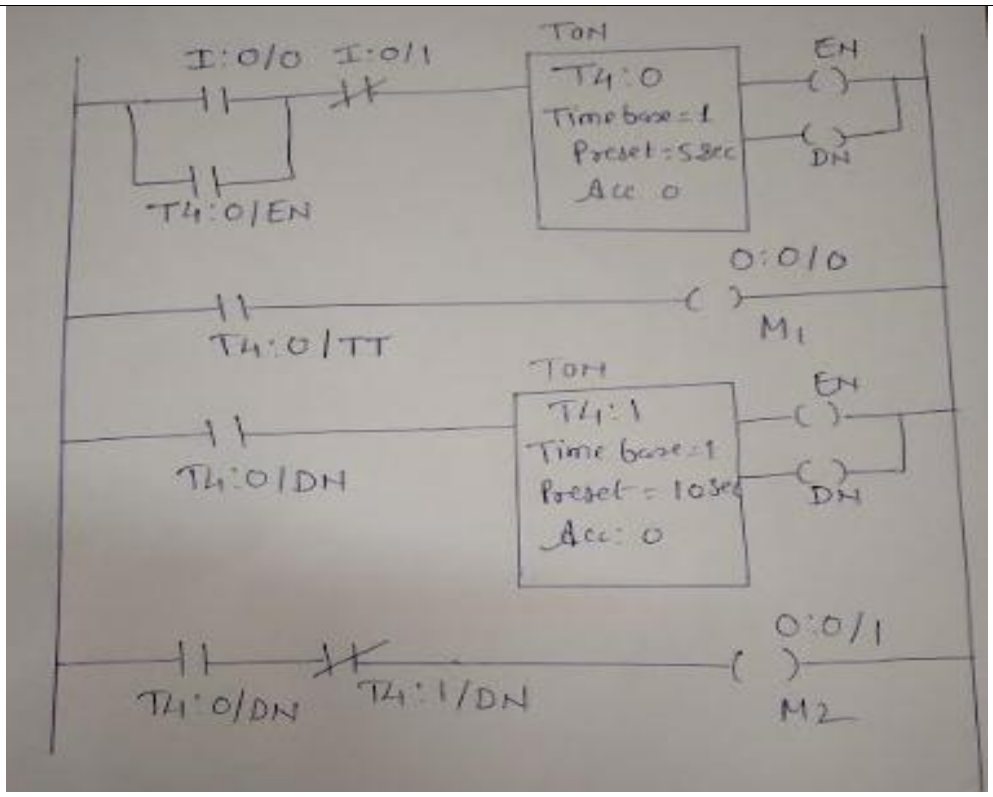
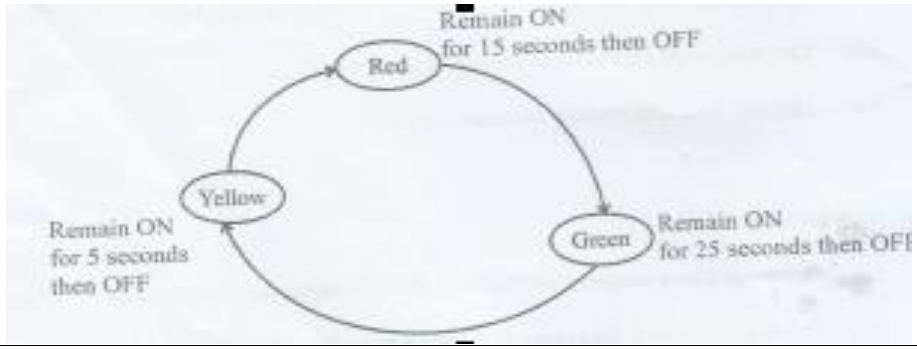
8M

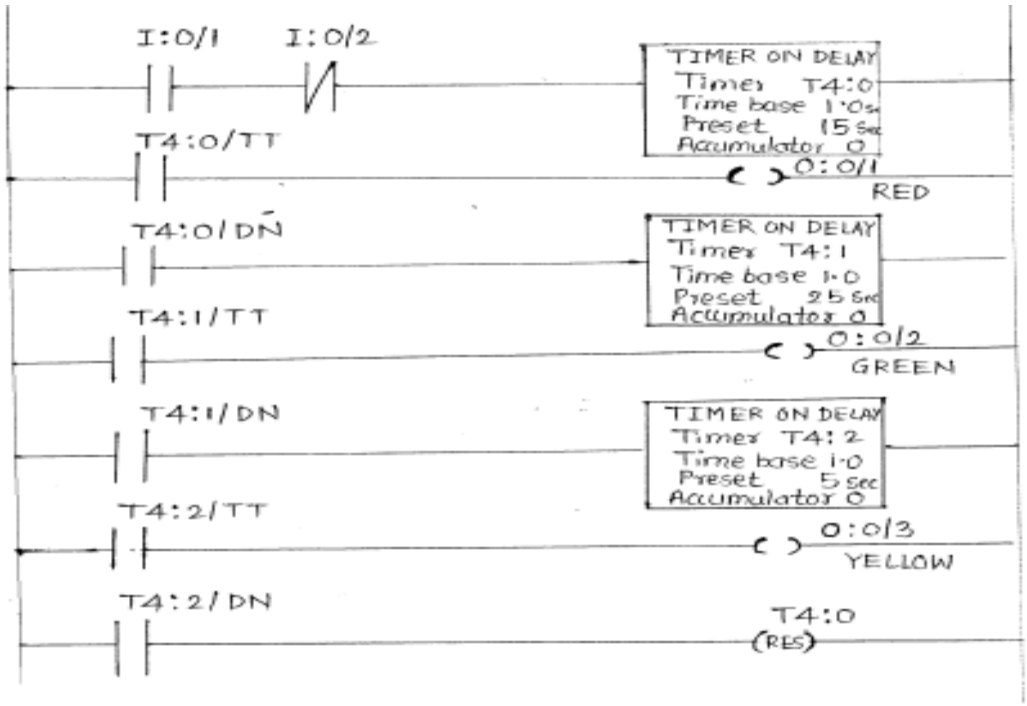
Ans:

No of Inputs : Start Pushbutton - I:0/0
Stop Pushbutton- I:0/1

No of Outputs:
MOTOR1 (M1) - O:0/0
MOTOR2 (M2) - O:0/1

2M Inputs and outputs with addresses

		 **(Note: any other correct logic can also be considered for the program, explanation is optional.)**	**6M for ladder diagram**
c)		**Design traffic light control program with following conditions:** **(i) Two inputs START and STOP (Both pushbutton)** **(ii) Three outputs-Red,Green and Yellow lamps.** **(iii) Repeat the given cycle until, STOP button is pressed.** 	**8M**
Ans:		**(Inputs and outputs with addresses = 2 mark)** **No of Inputs** : Start Pushbutton - I:0/0 Stop Pushbutton- I:0/1 **No of Outputs:** RED Lamp - O:0/0 GREEN Lamp - O:0/1 YELLOW Lamp - O:0/2	**2M Inputs and outputs with addresses**

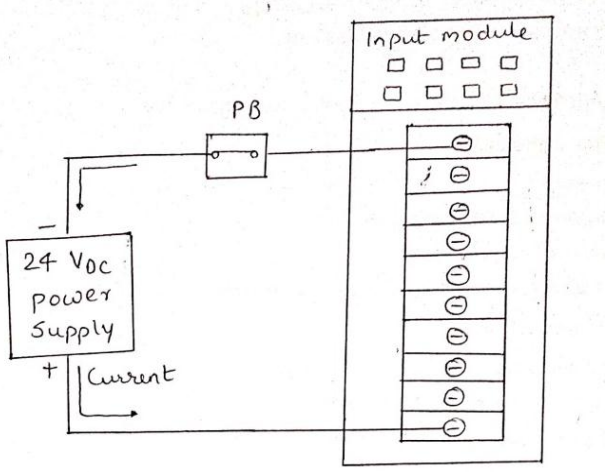


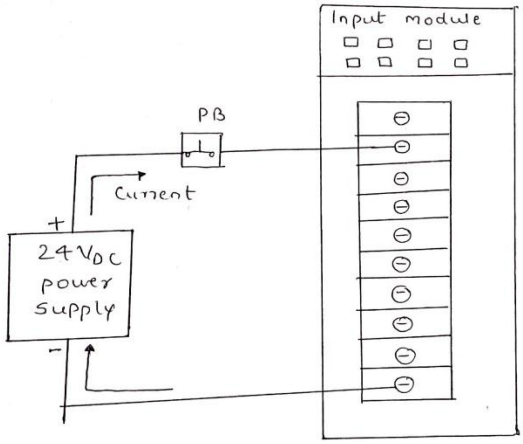
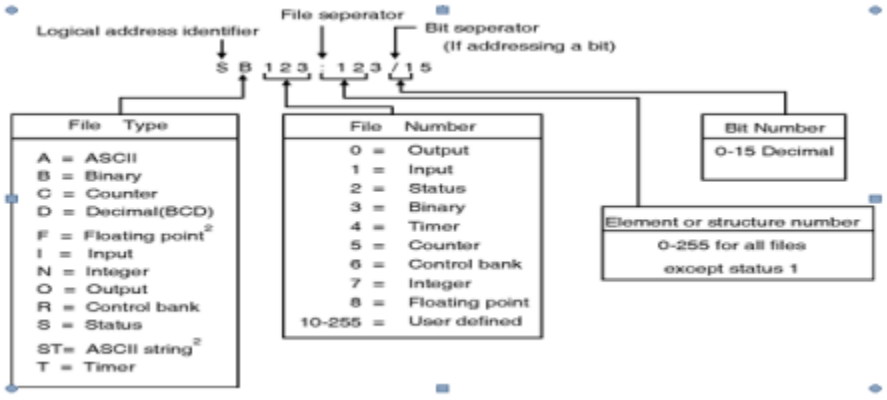
6M

1.When start pushbutton is pressed Timer T4:0 will start.
2. Timer T4:0/TT bit will enable for 15 seconds ,it will turned ON RED light for 15 second.
3. After 15 seconds ,T4:0/DN bit will set , Timer T4:1 will start.
4. Timer T4:1/TT bit will enable for 25 seconds , it will turned ON GREEN light for 25 second.
5. After 25 seconds , T4:1/DN bit will set, Timer T4:2 will start.
6. Timer T4:1/TT bit will enable for 5 seconds ,it will turned ON YELLOW light for 5 second.
5. After 5 seconds ,T4:1/DN bit will set , Timer T4:0 will reset and procedure repeats again and again.

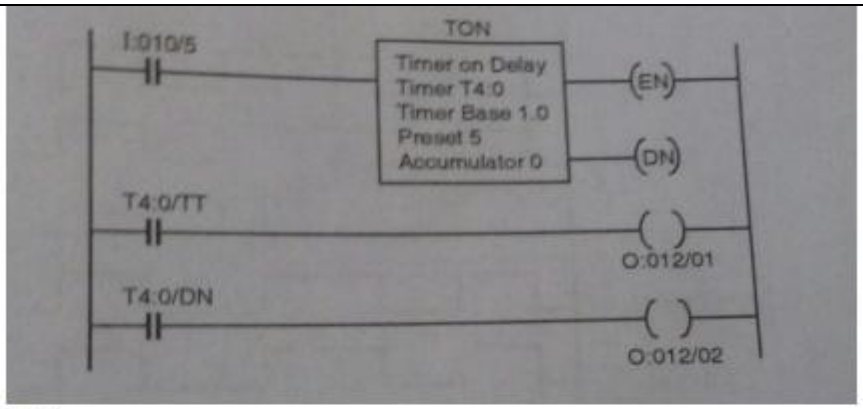
(Note: any other correct logic can also be considered for the program, explanation is optional)

Q.3		**Attempt any Four:**	**16- Total Marks**
	a)	**State classification of PLC based on type and size.**	**4M**
	Ans:	Classification of PLC based on type and size:: - **A) Micro PLC (Fixed I/O)** It is also called fixed PLC It is micro PLC because of its size It has fixed I/O's, brick design All components are in a single package. Effective use on smaller and stand alone application **B) Modular PLC: -** It is in modular in structure, its components are separate.Modules are installed in I/O rack.It	**4M**

	has following types: **i) Small PLC** : It has limited expansion capabilities. Having 20 inputs and 12 outputs are mounted on rack. Additionally less than 100 I/O's can be added through remote I/O rack. **ii) Medium PLC**: In this components are separate, also include mathematical function, file function etc. It can have 4000 to 8000 I/o' **iii) Large PLC**: It can hold multilplecards, can connected together as per requirement. It flexible and easy to maintain. It has I/O's more than medium PLC	
b)	**State the need of automation.**	**4M**
Ans:	**Need of Automation in process :** • To fulfill the demand of product at right time. • To reduce the human errors and involvement of human being in the process. • For better productivity. • For better control of process. • For better quality. • For reducing man power. • For reducing cost of product. **OR** Any other relevant points shall be considered	**4M (1M each)**
c)	**Draw sinking type and sourcing type for DC input module. State the meaning of it.**	**4M**
Ans:	 **"Sourcing DC input module with sinking switch."** In this circuit DC power supply actsas a source of current. Current will flow from positive trminal of power supply to push button and from push button to negative terminal of power supply through lamp load. Here in this circuit, lamp will take the current from push button as a result push button acts as source of current for lamp means lamp sinks the current to negative terminal.	**2M**

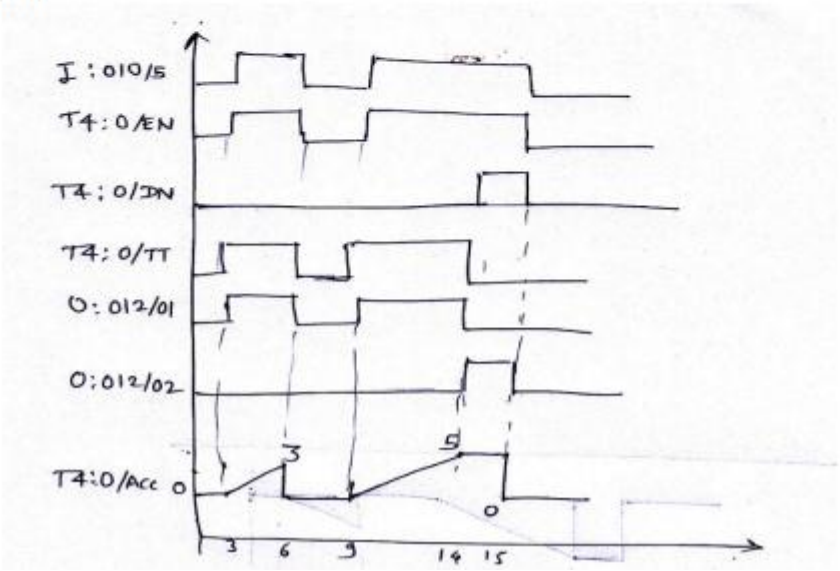
		So push button is a sourcing device and lamp is a sinking device. **"Sourcing DC input module with sourcing switch."**  Above fig. illustrates the current flow from the positive side of the battery to the lamp first. The lamp is then the source of the current as it passes it to the switch, which in turn sinks the current to ground The lamp acts as the source of the current that the switch sinks to ground .	**2M**
	d)	**Give I/O addressing format for a typical PLC with example.**	**4M**
	Ans:	 The addressing is necessary to deal with data files for their identification. It is identified by A letter called an identifier and a file number. The basic addressing elements include, type, slot, word and bit. Type: the type determine if an input or output being addressed Slot: the slot number is the physical location of the I/O module. This may be combination of rack number and slot number when using expansion of rack Word and bit: These are used to identify the actual terminal connection in a particular I/O module. **For example**:- I1:0/0, O0:2/5	**2M** **2M**
	(e)	**State four precaution when placing PLC in an enclosure.**	**4M**
	Ans:	**Precautions when placing PLC in an enclosure.(Any four)**	**1M each**

		1) Allow maximum convection cooling, all controller components should be mounted vertically, in some cases components mounted horizontally will obstruct air flow 2)The power supply has a higher heat dissipation, so power supply should be installed at the top of the enclosure above all other equipment, with adequate spacing between power supply and the top of the enclosure 3) The CPU should be located at a comfortable working level that is either to or below the power supply. If the CPU and power supply are contained in a single PLC unit, then the PLC unit should be placed toward the top of the enclosure with no other components directly above it, unless there is sufficient space 4) Do not install the control lines or communication cables together with the main circuit lines or power cables. Keep a distance of 150mm or more between them. Failure to do so may result in malfunction due to noise 5) At power-on or power-off, a voltage or current may flow between output terminals momentarily. In this case, start the control after analog outputs become stable. 6)Periodically check the earthing of panel where PLC is enclosed **Note: Any other relevant precaution**	
Q.4	**(A)**	**Attempt any THREE:**	**12- Total Marks**
	a)	**Draw the format of ON delay timer and explain with timing waveforms.**	**4M**
	Ans:	**Format of ON Delay timer:**	



1M

Waveform:



2M

Explanation of Bits:

1) T4:0 : This bit indicates timer file4,timer 0 ,it stores timer information

2) Time base 1.0: This bit indicates processor increments accumulated values in 1 second intervals.

3) Preset: It indicates delay for timer

4) Accumulator value gives current value of the timer as 0 which increases up to the preset value

5) I:010/5 : It is the input to the timer

6) EN : This bit is set ,when input is true

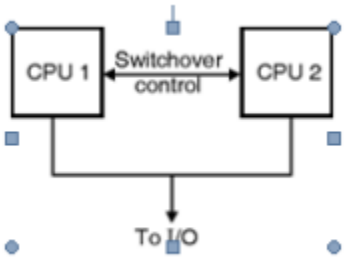
7) TT: This bit is set when timer is running other is reset

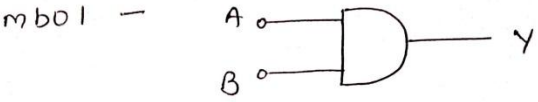
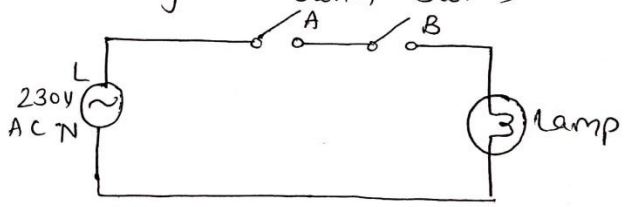
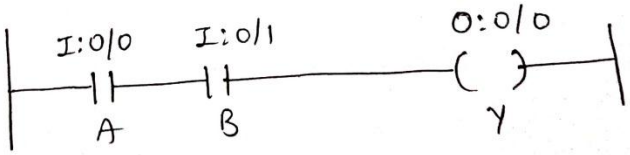
8) DN : This bit is set when accumulator value becomes equal to preset value and then respective output becomes ON

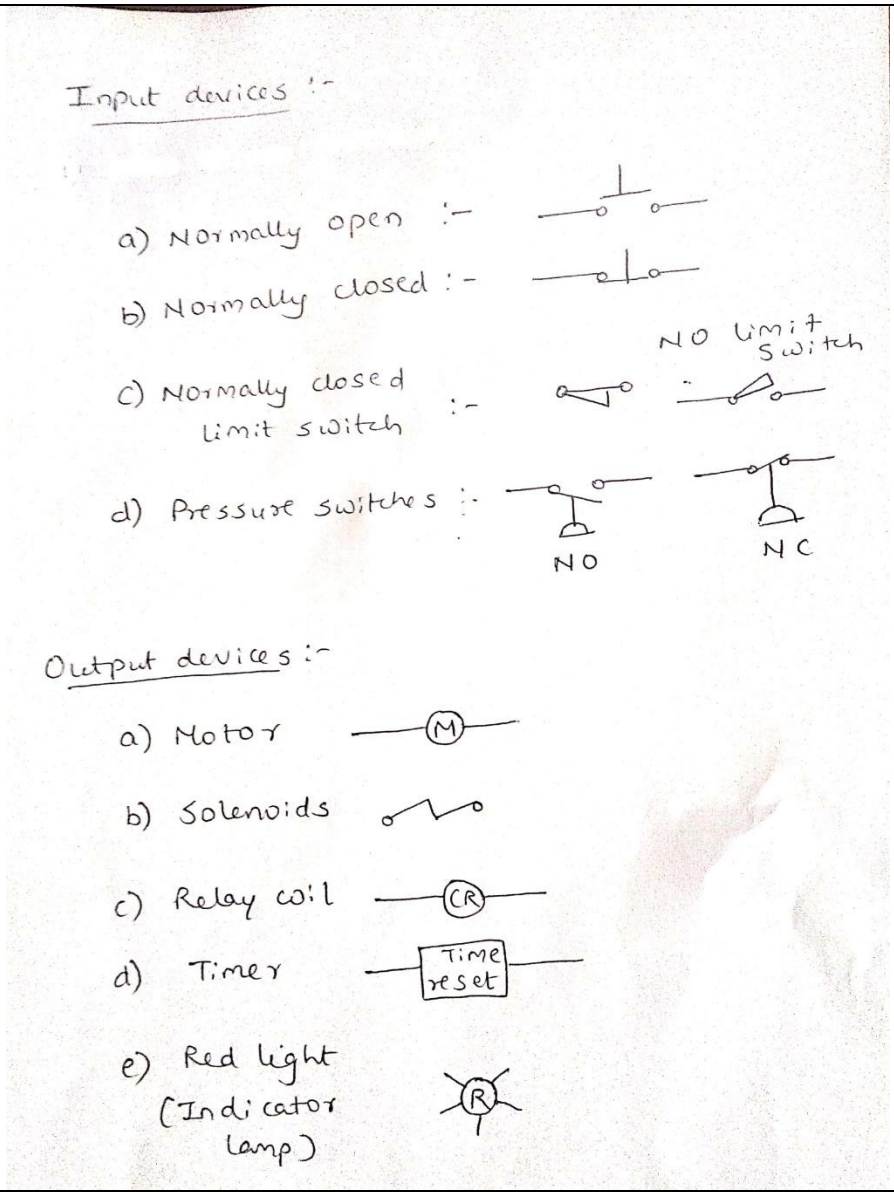
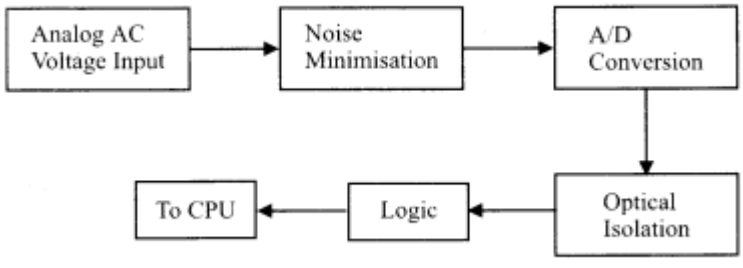
1M

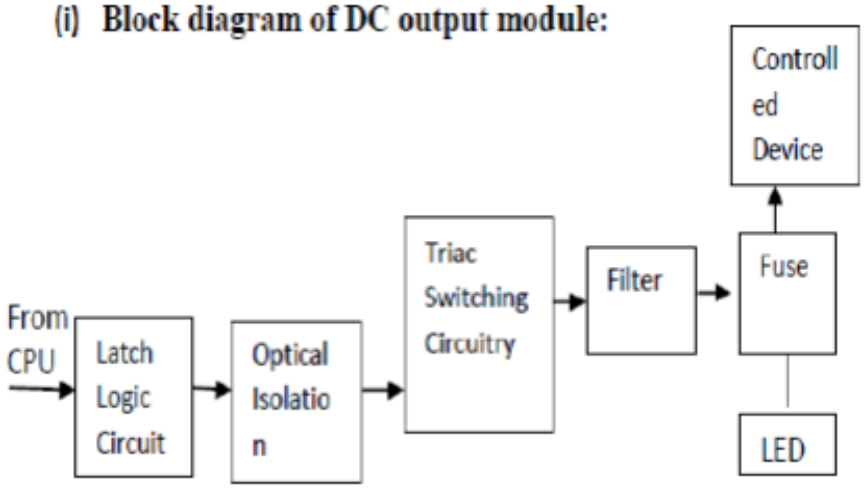
Or

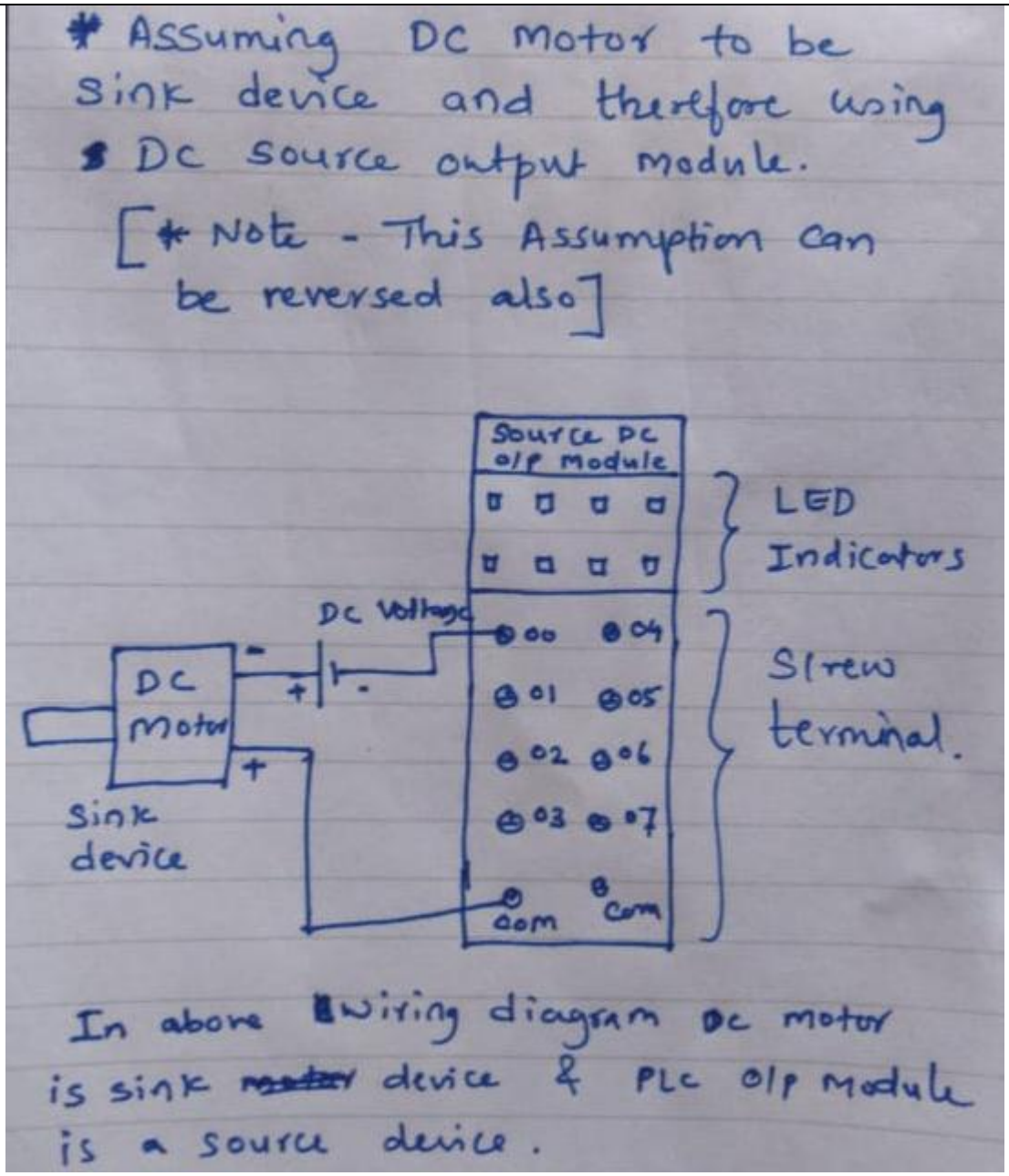
(Any other relevant example with waveform should be considered)

	b)	**State the concept of redundancy in PLC with a suitable diagram.**	**4M**
	Ans:	**Redundancy :** • 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. • CPU redundancy system is composed of separate bases for idea redundancy structure. • 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 can be tied into one I/O system and some means is provided that switches control from the failure CPU to the backup when a failure occurs as shown in Fig. 	**2M** **2M**
	c)	**Draw symbol, Boolean equation, electrical and ladder diagram for AND gate.**	**4M**

	Ans:	AND Gate :- Symbol –  Boolean Equation – $Y = A \cdot B$ Electrical Diagram –  Ladder Diagram :-  	**1M** **1M** **1M** **1M**
	d)	**State the guidelines to maintain PLC in good running condition.**	**4M**
	Ans:	**Guidelines for maintenance of PLC** • Periodically check the tightness of I/O Module terminal screws. They can become loose over period. • Periodically check for corrosion of connecting terminals. Moisture & corrosion atmospheres can cause poor electrical connections. • Make sure that components are free of dust. • Stock commonly needed spare parts. • Keep duplicate record of operating programs being used. • Replace the PLC batteries used for backup in time. • Have a written check list , control list for each PLC • Keep additional check list for each PLC with records of what , who ,when should be kept. • Periodically Check earthing of PLC panel. • Always keep the PLC in dry, cool place under AC environment.	**1M each (any four)**
	(B)	**Attempt any ONE:**	**6M**
	(a)	**List three input and three output devices with their symbols used with PLC.**	**6M**

	Ans:		**3M** **3M**
	(b)	**Explain analog input module with the help of block diagram.**	**6M**
	Ans:	**Block Diagram of Analog Input Module**  **Explanation:-** Analog input modules interface a PLC to analog input signals. It gives ability to PLC to monitor a continuously changing input signals such as pressure, temperature, flow etc. The	**3M** **3M**

		module converts analog input signals to 16 bit binary values storage in the processor's input status table. Analog modules are designed to accept current and voltage signals such as 0-10 Vdc,-10-10 Vdc,0-5Vdc and 0-20mA,4-20mA,-20 -20mA etc. When signal reaches an input module, it is rich in different noise signals. The signal is freed from noise through noise Minimization circuits. The signal is then digitized and sent to logic section through an isolation circuit. The logic section allows the digitized signal to go to the CPU following the predetermined logic.	
Q.5		**Attempt any Two:**	**16- Total Marks**
	a)	**(i) Draw a neat diagram of DC output module and give the function of each block. (ii) Draw wiring diagram to connect DC motor to PLC and specify type of output module can be used.**	**8M**
	Ans:	**(i) Draw a neat diagram of DC output module and give the function of each block** **Diagram:-** **(i) Block diagram of DC output module:**  DC output modules simply act as a switch to control output field device to control output field device. Each output point contains switching devices, which is located inside the output module it is seen that the module consists of some potential free contacts operated by signals from the CPU. Once this signal appears at the output terminals of the module, the indicating LED glows. This signal is again isolated from the output power circuit by an optoisolator, amplified by the amplifier and interfaced with the real world power circuit. Field output devices like coils, relays etc., powered by a power supply external to the PLC receive the signal to operate for final control action. **(ii) Draw wiring diagram to connect DC motor to PLC and specify type of output module can be used.**	**2M** **2M**

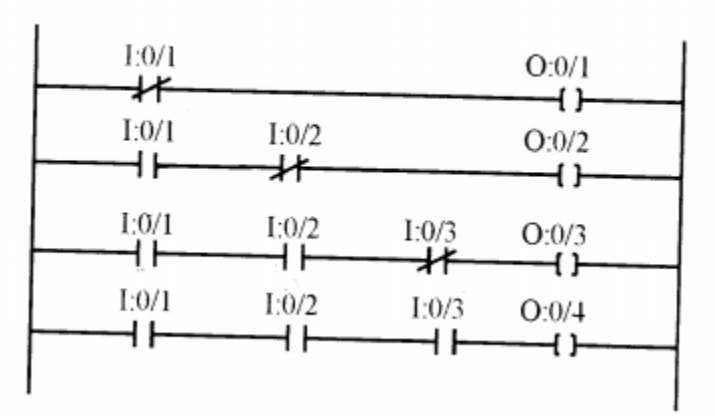
			**4M**
	b)	**A Railway station has 3 platforms A,B and C. One train is coming into station. The entry to this train is to be given to platform A if platform A is empty, if both platforms A and B are occupied, then it has to given entry to platform C, if all platform are full, then train has to wait. Design necessary ladder diagram with proper assumption and truth-table.**	**8M**
	Ans:	**The input signals with address are as follows,** Ta- Train present at A => I:0/1 Tb - Train present at B => I:0/2 Tc - Train present at C => I:0/3 **The outputs with address are as ,** Pa – Go to platform A => O:0/1	**02 M** Proper I/O Assumptions (addressing)

Pb- Go to platform B => O:0/2
Pc - Go to platform C => O:0/3
W –wait => O:0/4

Input Ta	Input Tb	Input Tc	Output Pa	Output Pb	Output Pc	Output W
0	1	1	1	0	0	0
1	0	1	0	1	0	0
1	1	0	0	0	1	0
1	1	1	0	0	0	1

02 marks for truth table

Ladder diagram:



04 marks for ladder diagram

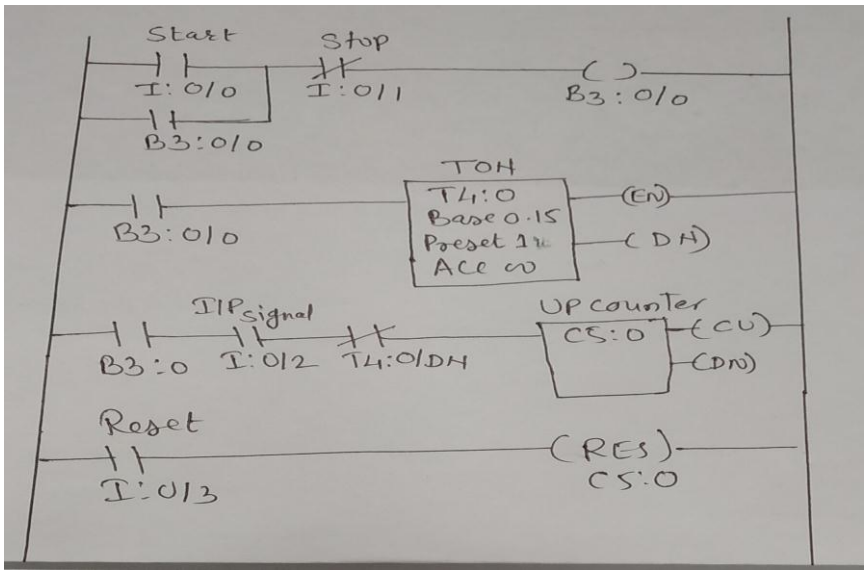
OR

Any other relevant ladder diagram shall be considered

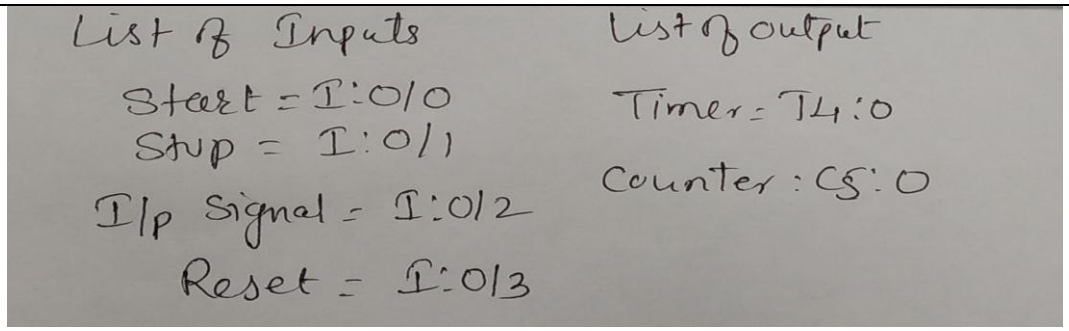
c) **(i) Write PLC ladder program to measure frequency of events using timer and counter and explain it.**
(ii) Draw the ladder diagram for 4:1 multiplexer. **8M**

Ans:

Diagram:-



2M



1M

Explanation:-

When start button is pressed timer T4:0 strat for 1 sec delay, When start button is pressed computer start counting pulses at I:0/2 input terminal 1 sec.

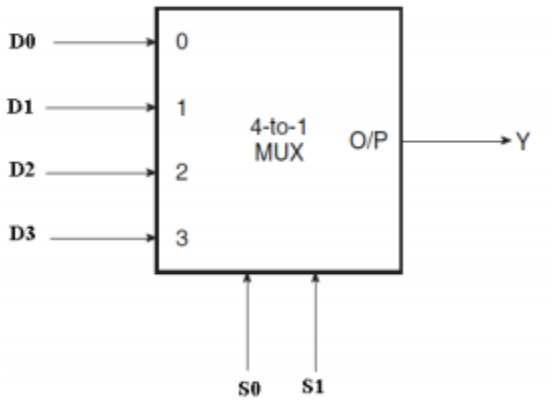
So after 1 second counter stop counting the pulses and it shows number of pulses within 1 second of input signal i.e. the frequency of input signal which is to be measured.

1M

OR

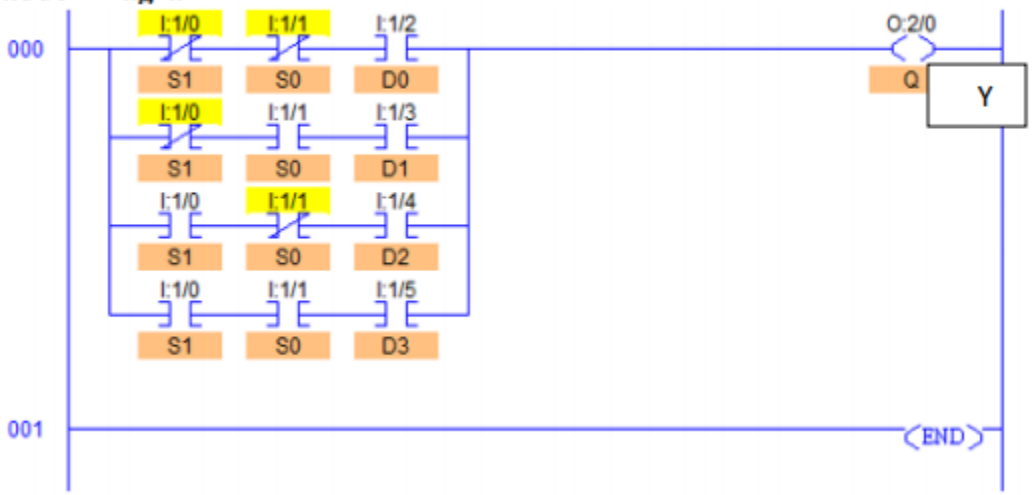
Any other relevant ladder diagram shall be considered

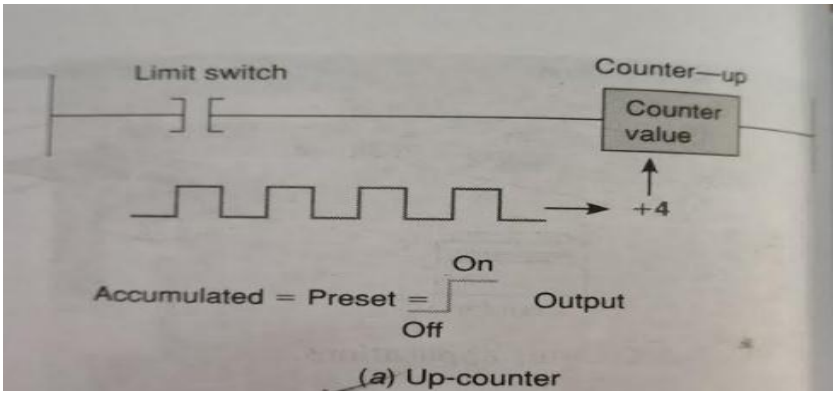
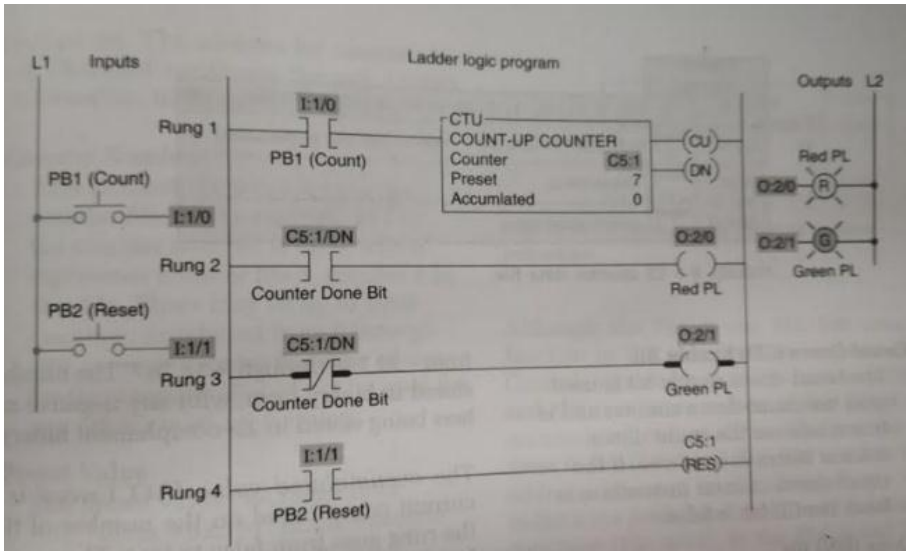
(i) Draw the ladder diagram for 4:1 multiplexer.

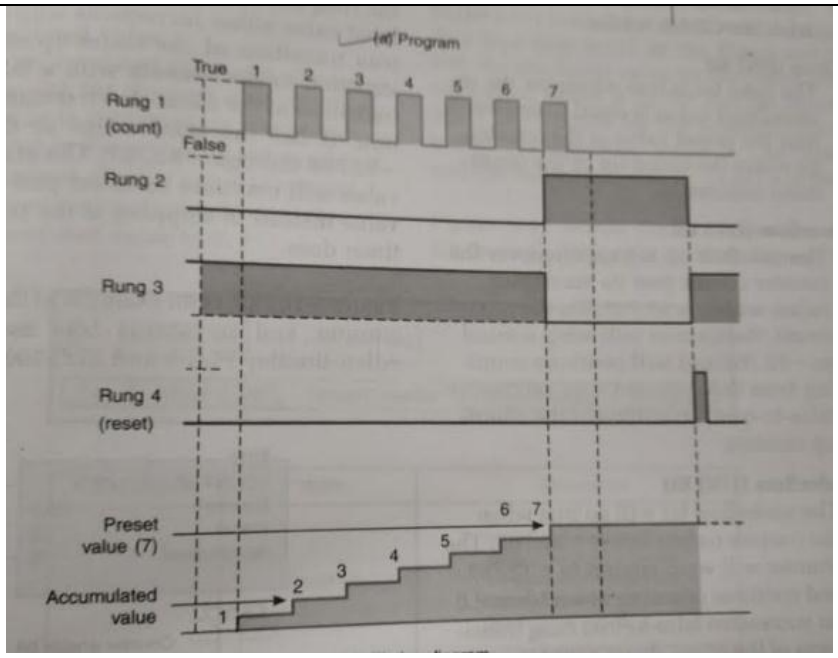


2M

Select Data Inputs		Output
S_1	S_0	Y
0	0	D_0
0	1	D_1
1	0	D_2
1	1	D_3

		Expression: $Y = \overline{S1S0}\,D0 + \overline{S1}S0D1 + S1\overline{S0}D2 + S1S0D3$ **Ladder Diagram**  **Explanation:** For every combination of select lines that particular input is selected at output For eg. If S1=,S0=0; D0 will be selected at output ,Y=D0	**1M** **1M**
Q.6		**Attempt any Two of the following ::**	**16- Total Marks**
	a)	**Give the types of specialty I/O module and explain any two.**	**4M**
	Ans:	**Different types of speciality I/O modules:** 1) Communication module 2) RTD input module 3) High speed encoder 4) Stepper motor control 5) Thermocouple input module 6) Remote I/O sub scanner **1) Communication module: -** The communication modules are used to communicate with programming devices, displays, plant computers, other PLC's. The four common communication modules are ASCII modules, local I/O adapter modules, the serial data modules, network interface modules. **2) RTD input module: -** This module interfaces RTD's to a PLC and other types of resistance input devices such as potentiometers. It consists of bridge circuit filter, amplifier, and isolator circuits. **3) High speed encoder:-**When input pulses come in faster than a discrete input module can handle them, a high speed input module is used. High speed counters are also used to interface encoder to a PLC. **4) Stepper motor control:-**A stepper motor module is a intelligent module that resides in a PLC chassis and provides a digital output pulse train for microstepping stepper motor	**1M for type** **1 ½M Each (Any two)**

		applications. **5) Thermocouple input module**:- The thermocouple input module converts input from various thermocouple or millivolt devoces into values that can be input and stored into PLC data tables. **6) Remote I/O subscanner:-**A subscanner scans the remote I/O chassis and the respective I/O chassis points. After the subscanner has scanned all remote I/O points, their I/O status is stored in a build in buffer(storage area).	
	b)	**Write the formats of Up counter and explain with waveforms.**	**4M**
	Ans:	**Diagram:**  **OR**  	**2M**



Explanation:

The count-up counter is an output instruction whose function is to increment its accumulated value on false-to-true transitions of its instruction. It thus can be used to count false-to-true transitions of an input instruction and then trigger an event after a required number of counts or transitions. The up-counter output instruction will increment by 1 each time the counted event occurs.

The program and timing diagram for a simple up-counter is shown in the figure. This control application is designed to turn the red pilot light on and the green pilot light off after an accumulated count of 7.

Operating pushbutton PB1 provides the off-to-on transitions pulses that are counted by the counter.

The preset value of the counter is set for 7.

Each false-to-true transition of rung 1 increases the counter's accumulated value by 1.

After 7 pulses, or counts, when the preset counter value equals the accumulated counter value, output DN is energized.

As a result, rung to becomes true and energizes output O:2/0 to switch the red pilot light on.

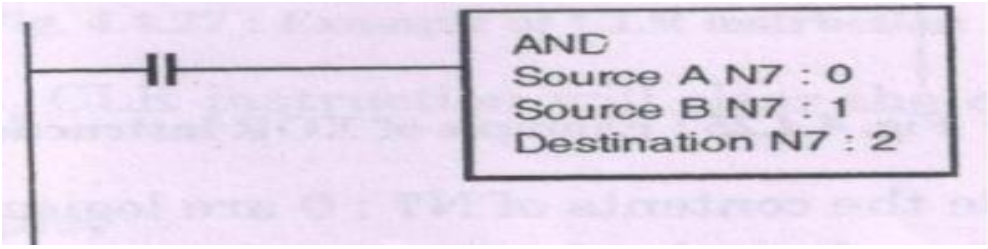
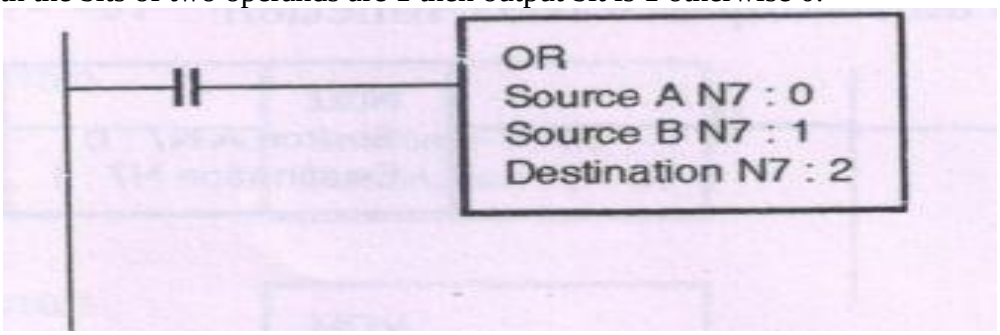
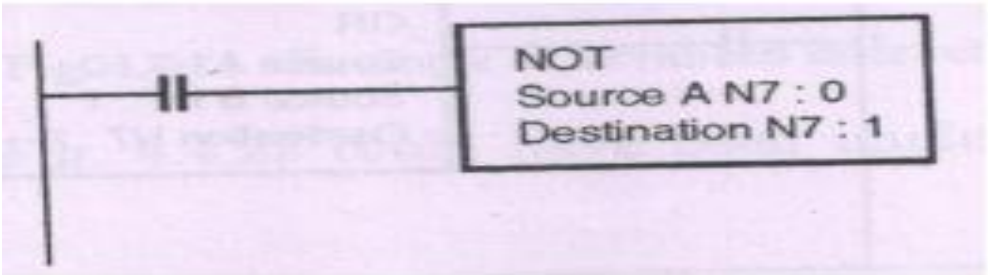
At the same time, rung 3 becomes false and de-energizes output O:2/1 to switch the green pilot light off.

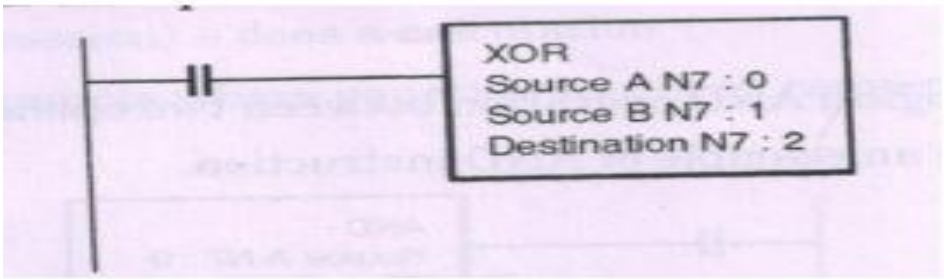
The counter is reset by closing pushbutton PB2, which makes rung 4 true and reset the accumulated count to zero.

Counting can resume when rung 4 goes false again.

2M

c)	**State the necessity of grounding for PLC during installation.**	**4M**
Ans:	**Grounding is necessary for PLC during installation:** • Proper grounding is an important in safety measure of all electrical installations. • For safety of personnel working on the system • To avoid melting of conductor in case of flow of high current through conductor. • For safety of PLC and enclosure. • To avoid static discharges from human being affecting to PLC memory cards. **OR**	**1M each point any4**

		Any other relevant answer should be considered	
	d)	**List four logical instructions and also draw their formats.**	**4M**
	Ans:	**List of logical instructions:** 1. AND instruction 2. OR instruction 3. NOT instruction 4. X-OR instruction 5. N-AND instruction 6. N-OR instruction 7. X-NOR instruction **1. AND instruction**: It performs the logical AND operation between two operands.  **2. OR instruction:** It performs the logical OR operation between two operands. If one of the bit or both the bits of two operands are 1 then output bit is 1 otherwise 0.  **3. NOT instruction:** It has single source and perform logical NOT operation and store result in destination memory. Output is complement of input. NOT instruction reverses all of the bits in the source word.  **4. XOR instruction:** It performs the logical EX-OR operation between two operands. If odd number of inputs are 1 then output of EX-OR is 1 otherwise 0.	**1M each (any four)**

			
	e)	**Explain the procedure of troubleshooting of ladder program in PLC.**	**4M**
	Ans:	• A hardware fault in the memory IC that holds the ladder logic program could alter the program, but this is a PLC hardware failure. If all other possible source of trouble have been eliminated, the ladder logic program should be reloaded into the PLC from the master copy of the program. • Start program troubleshooting by identifying which outputs operate properly and which outputs do not. Then, using the programming software and search function, trace back from the output on the nonfunctioning rung and examine the logic to determine what may be preventing the output from energizing. Common logic errors include: ▪ Programming an examine-for-on instructions instead of an examine-for-off (or vice versa). ▪ Using an incorrect address in the program. • The process may be in a state that was unaccounted for in the original program and thus is not controlled properly. In this case, the program needs to be modified to include this new state. A careful examination of the description of the control system and the ladder logic program can help identify this type of fault. • The suspend (SUS) instruction is used to trap and identify specific conditions for program debugging and system troubleshooting. When the rung is true, this instruction places the controller in the suspend idle mode .operation is suspended and the suspend ID number is placed in word7 (S:7) of the status file so that you can track ladder program. As a result, multiple rung conditions can control the same output coil, making troubleshooting more difficult. In the case of duplicate outputs the monitored rung may be true; but if a rung farther down in the ladder diagram is false, the PLC will keep the output off. Some software allows foe checking multiple coil use. • Some PLC manufactures allow the same output coil to be used more than once in the suspend (SUS) instruction is used to trap and identify specific conditions for program debugging and system troubleshooting. Troubleshooting instructions operation	**4M**